BREAD, CHEESE, AND EXPERTISE:
DUTCH SCIENCE SHOPS AND DEMOCRATIC INSTITUTIONS

By

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[1] The European Commission is the main policy-making body of the European Union.

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They say that in graduate school you learn as much or more from your fellow graduate students than from your professors. You certainly spend more time with the graduate students.

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ABSTRACT

**Bread, Cheese, and Expertise:
Dutch Science Shops and the Design of Democratic Science Institutions**

This dissertation presents a detailed description of Dutch science shops and contextualizes how they emerged and exist within Dutch society. I develop an analytical framework of three models of democratic expertise and analyze the extent to which Dutch science shops' experiences correspond to the models. Of primary concernn is to glean lessons for the portability of science shops around the world. The empirical research is based on thirteen months of qualitative field research performed in Holland between 1998-1999. The study addresses a significant concern to STS scholarship: that technoscientific expertise be more directly engaged with social problems and that new institutional configurations capable of accomplishing this be explored and evaluated. This study answers the following research questions:

1. Are science shops successful at getting scientists to take on projects of importance to the community, and what factors shape scientists' willingness to do so? (representative model)
2. Do science shops provide a good model for increasing participation of scientists and citizens in matters of science and technology policy? (engagement model)
3. Do science shops provide evidence of, and suggestions for how to develop increased public participation in the content of science, including agenda setting and research process? (partnership model)
4. Finally, how rooted is the science shop in Dutch culture, and how portable is it to other cultures, such as the U.S.? (design of democratic science institutions)

CHAPTER 1: Introduction

The purpose of my dissertation is to analyze the Dutch science shops for their contribution to “democratic expertise.” Designing more democratic scientific institutions is a growing concern for reasons that include taxpayer funding of science, the empowerment of citizens to participate in the activities that shape their lives and society, and the far-reaching consequences of science and technology (Barber 1984; Morone and Woodhouse 1989; Winner 1992; Sclove 1995a). In the field of Science and Technology Studies (STS),[2] scholars have been evaluating alternative methodologies and organizational structures for scientific institutions (Rip, Misa et al. 1995; Guston 1999; Vig and Paschen 2000). Some important questions about these institutions include: Do they alter power relations between citizens and scientists (Epstein 1996)? Do they produce ‘usable knowledge’ for communities (Lindblom and Cohen 1979)? Do they empower communities to participate in knowledge creation (Freire 1980; Brown 1997)? Do they overcome institutional obstacles that inhibit scientific institutions from better serving those in their communities (Collingridge and Reeve 1986)? To this end, many have cited the Dutch science shop system as a model for orienting traditionally elitist academe towards societal needs (Dickson 1984; Irwin 1995a; Irwin 1995b; Sclove 1995b; Sarewitz 1996; Hess 1997). Scholars associated with the field of STS argue that scientific and technological developments do not proceed according to their own internal logic, but rather, are mediated by the politics and values of the worlds that make them possible (Bijker, Hughes et al. 1987; MacKenzie and Wajcman 1999). If we want to live in a

[2] An interdisciplinary field that uses social science research methods to study science and technology in society. Includes literature from sociology of science, sociology of knowledge, anthropology of science and technology, political science, history and philosophy of science (see Jasanoff, Markle et al. 1995; Hess 1997).

democratic society, then we should also have democratic control over the systems that have monumental consequences for the ways we live. The control and governance of existing and future technologies should be as deliberately planned as political systems themselves.

In this study, I develop three analytical categories for exploring efforts to democratize expertise. Democratic expertise promotes enhanced representation of citizens within scientific research (the "representative model"), increased engagement of scientists and citizens in policy-making (the "engagement model"), and increased citizen-scientist partnerships in basic and applied research (the "partnership model"). An underlying feature of democratic expertise is that it works towards community revitalization by improving environmental sustainability, social equity, and economic development.

The three models comprise a framework that is intended to help evaluate different approaches to democratizing expertise and tease out tensions and conflicts that prevent scientific and political systems from distributing expertise more equitably. This framework is intended to spotlight the multifaceted nature of democratic expertise and the different and sometimes competing normative concerns embodied by the different models. In doing so, the framework calls attention to obstacles that activists and scholars face when trying to reconfigure expertise. Based on empirical data from Dutch science shops, I developed the three models of democratic expertise to explain what is going on at science shops, to help understand these efforts and evaluate new ways to resolve these tensions in light of different political, economic, social, and cultural circumstances. These models combine concepts from science policy, Sociology of Scientific Knowledge (SSK), and the Social Construction of Technology (SCOT) to flesh out characteristics of democratic science institutions.

Activists and scholars who want to pursue more democratic orientations for scientific institutions need to explore alternative methodologies and organizational forms. Dutch science shops are an attempt to configure such new institutional structures. Extensive and concrete data about experiences with new alternatives will foster a better understanding about what works and what does not. Case studies that explore such methodologies and organizational forms in their unique historical, political and cultural contexts will reveal important information about their successes and limitations. Data presented in this way informs other attempts to democratize expertise and extends STS theories about democratic scientific organizations. My research represents a significant contribution to what is known about how science shops work because I present case studies of particular projects, from a range of science shop types, within their historical, cultural and socio-economic context.

My research provides qualitative data on alternative ways to organize and distribute expertise based on field research done in the Netherlands. This study presents the most complete picture of Dutch science shops to-date, with detailed case studies that explicate their procedures, organizational dynamics, and significance to clients, students, university community members, and their own employees. I describe a model that not only presents the determinants of a "successful" science shop but also elaborates on the aspects of science shops that might be used to model a general approach to expertise in society. I emphasize the criteria Dutch science shops use to choose their clients and the research questions, and importantly, how those criteria have been implemented over time.

Definition of Science Shops

Dutch science shops (*wetenschapswinkels*) are university-based organizations that do pro-bono or low cost research for community groups. They solicit research questions from community groups and then find university researchers to conduct research in the natural, technical, and social sciences. “Wetenschapswinkel” translated literally means “science shop” or “science store.” The name “science shop” derives from a premise that universities are responsible for providing easy access to knowledge. The Dutch word for science, “wetenschap,” does not distinguish between natural and social science. It has no exact English equivalent and is translated alternately as “learning,” “science,” “scholarship,” and “knowledge” (Hannay 1996). An entry for *wetenschapswinkel* in the van Dale dictionary lists its English equivalent as “research exchange” or “information center” (1996). I use the term “science shop” in this study because it is in wide use (e.g. by the International Science Shop Network). In place of the term “science” I use the more approximate English equivalents “research” and “expertise.”

Science shops facilitate research projects in the interest of certain social interests by matching undergraduate students, usually in their third or fourth year, to a problem posed by a “client.” “Living Knowledge,” the International Science Shop Network established in 1998 and comprised of partners from nine countries, defines a science shop broadly: “A science shop provides independent, participatory research support in response to concerns experienced by civil society” (Gnaiger and Martin 2001: 6). Science shops:

- provide civil society with knowledge and skills through research and education;
- provide their services on an affordable basis;
- promote and support public access to and influence on science and technology;
- create equitable and supportive partnerships with civil society organizations;
- enhance understanding among policymakers and education and research institutions of the research and educational needs of civil society;
- enhance the transferable skills and knowledge of students, community representatives, and researchers. (Gnaiger and Martin 2001: 9)

The title of this study refers to the early idea that science shops provide a fundamental service to daily life by making expert knowledge accessible. In this way, science is a basic necessity, like bread and cheese. Many science shops have played on the theme of a grocery store in their public relations material, with depictions of shopping carts or people ordering “a pound of science” at the market. For the remainder of this work, “science shops” refers to the Dutch science shops, except where otherwise noted.

Clients, for the most part, are non-profit organizations that aim to carry out the goals of the social movements that began in the 1960s and 1970s, such as environmental protection, women’s and racial equality, and labor rights. They are usually non-governmental, community-based organizations such as environmental advocacy groups, tenant or neighborhood associations, handicapped and elderly advocacy organizations, childcare centers, transit authorities, parent-teacher associations, and patient-care organizations but may be municipalities, or in some cases, commercial entities such as start-up companies or farmers. Clients commission science shops to do research either free of charge or for a nominal fee that covers some of the costs of producing a final report. They may be asked to meet up to three criteria: 1) they are non-profit, 2) they cannot afford to pay for research themselves, and 3) they are capable of implementing policy changes based on the research outcome.

Through a process they call “intermediation,” science shop workers collaborate with clients to “diagnose” possible areas where research would be helpful to an organization’s pursuit of its goals, find students to conduct this research (often for their final thesis project), and professors to mentor them. Usually, the result is a report that clients can take to local governments and the media. Throughout this process, science shop employees mediate between the interests of the client and scientist so the final product serves the goals of all parties.

For thirty years, science shops have worked within universities to focus traditionally elitist academe outward towards societal needs, as articulated by their client groups. Similar organizations around the world acknowledge the Dutch science shops as their inspiration, and an international audience, including STS scholars and community-based research advocates, is abuzz with hope that the Dutch example will serve as a science policy model for improving the public understanding of science, increasing citizen access to science, and creating opportunities for citizen participation in science. Beyond the hype however, the empirical research on science shops is extremely limited. My study addresses this gap in the literature. It explores the goals of the science shops, their methodology for achieving those goals, how successful they are, and the influence of the Dutch context on their development and practice. Fundamental to this research is a desire to extend understandings of methodologies and organizational forms that might be engaged to design more democratic scientific institutions.

Existing Literature on Dutch Science Shops

In 1997, I conducted a pilot study that indicated science shops do make a difference in their communities, at a low cost, by making efficient use of university resources. I also found that the empirical literature on Dutch science shops, either in Dutch or English, is scant. The most substantial study of Dutch science shops was conducted between 1984 and 1986. Loet Leydesdorff, a professor of Science Dynamics at the University of Amsterdam performed a series of quantitative studies on the University of Amsterdam Science Shop with a colleague, Peter van den Besselaar, and a student, Rolf Zaal. The studies evaluated the impact of science shops from a science policy perspective. For instance, on whether science shops have a lasting effect on university curricula, one study found "…investigations taken on behalf of clients...have given rise to follow-up research, publications, and many enduring effects on academic practice" (Zaal and Leydesdorff 1987: 314). Among the "cognitive effects" of the science shop were "…the development of research methods, access to relevant data, continuation of existing research lines, and generation of material for educational purposes"

(Zaal 1986: 99). They concluded that studies of science shops "can deliver better insights into the steering mechanisms of science and technology" and from the point of view of the public interest they are "desirable to broaden [the] possibilities of scientific and technological developments" (Leydesdorff and van den Besselaar 1987: 156).

In 1986, Rolf Zaal published his doctoral dissertation on science shops. The primary goal of this research was to gauge the impact of science shops on the university. The focus of the research was to give quantitative measures of the impact of one science shop on university research. He showed that science shop research was more likely to lead to follow-up research if the researcher had a "personal concern…for the social aims of the client" (Zaal 1986: 99). Also, the chance of follow-up research is more likely if the researcher reformulated the client question, a process "involv(ing) a transformation of the problem from descriptive, inventorising, and specific towards interpretive, declarative, and generalizable (*sic*)" (100). Apart from the need to alter the client question so it has more of an analytical (rather than applied) dimension, there are still many obstacles to follow-up research, including "lack of substantial connections with current research programs, a very applied character of the research required to respond to the demand, and a simple lack of time" (Zaal 1986: 100). In order to promote more follow-up research at the university, Zaal recommended that science shops spend more time on reformulating client questions and universities provide more support to students who want to do practical research (Zaal 1986: 85). From a science policy perspective, the quantitative studies were able to pinpoint some of the effects of science shops on university research and to make recommendations for stimulating follow-up research based on science shop questions.

Another cluster of work on Dutch science shops are two anthologies of essays written by science shop coordinators and science policy-makers (Pennings and Weerdenburg 1987;

Weerdenburg and Pennings 1987). The first, written after the ten-year anniversary of the first Dutch science shops, focuses on their changing position with respect to university policy and societal attitudes. The second examines possibilities for future collaboration that would secure the science shops' position at the university. The authors of both anthologies are almost all former science shop coordinators. The works cover many aspects of science shops related to their organizational placement at the university, such as their relation to student affairs, faculties, public relations, and "transferpoints" (*transferpunts*—a science-shop type of organization that works to help companies find research partners at universities). The essays are not, however, accessible to an international public because they are written in Dutch. While many of the themes are relevant to a broader audience that may be thinking about how to create and stabilize a niche for science shops at universities, the books are targeted to a Dutch audience who is generally familiar with the details of science shop practice.

The Maastricht University Science Shop, on the occasion of their ten-year anniversary, published an anthology on science shops (Hendriks-Lemmen, van Mierlo et al. 1996). Written by current and former science shop employees, clients, students, and faculty advisors, the essays relate the importance of the science shop from a variety of perspectives. The authors were asked to answer three questions in two to three page essays: 1) looking back on the science shop, what jumps out at you? 2) what social effects did the research have? and 3) what is your vision of the future of science shops? Not all of the authors answered all of the questions, but in compiling information in this way, the anthology presents data on the science shop from a more confessional and personal perspective. The authors articulate the importance of the science shop to client work and to the democratization of science and technology. Nevertheless, the essays are neither accessible to a broad audience because they are in Dutch, nor are they designed for an outsider to learn about the strategies that science shops use to satisfy multiple stakeholders.

In addition to the anthologies on Dutch science shops, several Dutch journals have published articles about the science shops—most notably, *Wetenschap en Samenleving* (*Science and Society*), and *Revoluon* (*sic*), an anarchist journal no longer in publication. Early on, articles were published regularly (Oudshoorn and Galesloot 1977; Boers and Rip 1979; Govers 1979; Spaniks 1981). The May 1982 issue of *Wetenschap en Samenleving* is devoted entirely to science shops and the Institutes for Socially Oriented Research[3] (Bökkerink and Berber 1982; de Kool 1982a; de Kool 1982b; de Ruiter 1982; Hooghiemstra and van der Luit 1982; Milieuwinkel Wageningen 1982; Rijk 1982; Ulenbelt 1982; van Wijk and Blok 1982). Over the years, articles became more sporadic and retrospective (Bodewitz 1988; Lürsen, Mulder et al. 1999). Additionally, Dutch science shops have published internal policy studies to better understand their own work and develop inter-science shop collaboration. These works have been invaluable for me in learning about the history and practice of Dutch science shops. They are all in Dutch however, and while based on personal experience, they do not present empirical research designed to explore science shop research projects in depth.

In 2001, Living Knowledge, the International Network of Science Shops, published eight reports that are the most recent addition to the body of science shop literature. Reports one through three document organizational configurations (Gnaiger and Martin 2001), successes and failures in starting science shops (Mulder, Auf der Heyde et al. 2001), and training programs for staff and students (de Bok 2001b). Reports four and five explore ways the network can support science shop activities through a magazine (Steinhaus 2001) and an on-line database of science shop research projects (Chopyak 2001). The sixth report explores the

[3] See Chapter 2.

impact of science shops on university research (Hende and Jorgensen 2001), the seventh report documents the significance of an international network (Lürsen and Sclove 2001), and the eighth is the conference proceedings of the first SCI-PAS conference (SCIPAS 2001).[4] The reports provide background on science shops in the European Union and community-based research groups in the U.S based on questionnaires, phone interviews, and personal experience (all are written by directors of science shops or by people with extensive experience in the field of community-based research). The reports suggest metrics for success and ways to prevent failure and are an invaluable resource.

The next round of studies on science shops, currently underway, is another European Union-funded study, "Improving Interaction Between NGOs, Science Shops, and Universities: Experiences and Expectations" (INTERACTS). The project is the first comparative work on science shops: it aims is to compare the relations between science shops and their NGO partners (clients) in five European countries (Austria, Denmark, Germany, Spain, and the United Kingdom) (Jorgensen, Gnaiger et al. 2001). A final report is scheduled for the end of 2003.

Research that explains the impact of the science shop on the client, student, and science shop personnel complements the earlier and emerging studies. My research adds to existing research by giving a detailed picture of how science shops operate that especially seeks to explain what is meant by the term "intermediation," what methods science shops use to generate student interest, and the extent to which science shops are involved with the client organizations once the research project is finished. Such a picture is critical for gaining insight on how science shops translate questions from social groups into university research questions, the reasons students and scientists work for science shops, how clients use the

[4] All reports and the database may be accessed at www.livingknowledge.org

research results, and the extent to which science shops help clients with implementation of research results and media coverage. My project complements earlier quantitative studies with qualitative data on Dutch science shops gleaned from ethnographic research. It presents information about how science shops work and what they mean to the students, clients, employees, and university administrators associated with them. Using case study examples, I depict science shop practices and what people and organizations have learned from their experiences providing scientific knowledge to interest groups. The empirical work provides an insider's picture of the process of intermediation—how it works, how different science shops define it, what goes wrong, and what makes it successful. Also, the analytical framework of three models of democratic expertise may be used to compare and contrast science shop work in different countries in new ways. It will be of interest to, among others, community activists, university scholars, and civil servants, not to mention members of the emerging international network of science shops (SCI-PAS) and to the Loka Institute's Community-based Research Network (CRN). As noted by the authors of an evaluation of a failed science shop (the WiseNet Science Shop in Australia), case studies of science shops are critical: "Without such gradually accumulating data, valid generalizations about the best structures and functions and indeed the potential of science shops will not be available for further testing" (Bammer, Emery et al. 1992). Those who are skeptical that a model developed in a small, homogenous European country could be successfully used in the United States can look to growing networks of people eager to exchange ideas about science shops. My preliminary research suggests the Dutch science shops' experience may advance understanding and theorizing about the design of democratic science institutions.

Research Questions

This study uses three models of democratic expertise (described in Chapter 2) to better understand the success of science shops. My primary research questions are:

1. Are science shops successful at getting scientists to take on projects of importance to the community, and what factors shape scientists' willingness to do so? (representative model)
2. Do science shops provide a good model for increasing participation of scientists and citizens in matters of science and technology policy? (engagement model)
3. Do science shops provide evidence of, and suggestions for how to develop increased public participation in the content of science, including agenda setting and research process? (partnership model)
4. Finally, how rooted is the science shop in Dutch culture, and how portable is it to other cultures, such as the U.S.? (design of democratic science institutions)

These questions are intended to help understand the comparative benefits of alternate practices, tensions among them, and obstacles encountered in the day-to-day efforts of science shops.

Research Methods

The primary method of the study is on-site observation and interviews at two primary and three secondary sites. I used participant-as-observer interactions and interviews to gather data about science shop practice, archival documents from the science shops to inquire about changes in science shop policies and determinants of success, and a questionnaire at the beginning of the research to inform later stages of data collection.

The research design is an outcome of an earlier pilot study of Dutch science shops I conducted in September 1997 consisting of eight semi-structured interviews at five universities and meetings with representatives from all twelve universities with science shops at one of the bi-monthly meetings of the Dutch Science Shop Forum (*Landelijk Overleg Wetenschapswinkels* or LOW). This pilot study revealed the science shops are having an impact on their universities and local communities, but that the specific determinants of their success are not well-documented.

In 1998, I gathered baseline data from all thirty-three science shops by completing a questionnaire using annual reports (from 1997 or earlier if 1997 was unavailable) and follow-up interviews (in person and by phone) (Converse and Presser 1989). Also in 1998, I began taking private Dutch lessons from a professor at SUNY-Albany and continued in the Netherlands at the Institute for Dutch as a Second Language (*Institut voor Nederlands als Tweede Taal*). I conducted most of the interviews for this project in Dutch and relied almost exclusively on Dutch-language sources at science shops. I used participant-observation interactions at primary and secondary sites and documented my experiences in ethnographic fieldnotes (Lofland 1971; Emerson, Fretz et al. 1995). I conducted forty-five semi-structured interviews with current and former science shop employees, clients, students, and university professors (chosen by snowball sample and through ethnographic field methods). I collected primary historical data from archival materials such as meeting minutes, project reports, notes taken by science shop workers, and news items, as well as secondary data such as internal evaluations of the science shops (Frankfort-Nachmias and Nachmias 1992). The individual science shops and the LOW provided me the resources necessary to complete this project—office space, photocopying, help making appointments with interviewees, and hours of translation and explanation. A literature review of initiatives to democratize scientific institutions provides context for making preliminary recommendations for future comparative work. The diverse data help construct a comprehensive picture of the determinants of science shop success (Barzun and Graff 1977; Creswell 1994). The research design made it possible to observe a full range of science shop activities and triangulate data collected from the primary sites with shorter visits to the remaining science shops. All thirty-three Dutch science shops are represented in the sample (see Appendix A).

Qualitative research methods access the data required for this study in a way quantitative research methods cannot. Face-to-face interactions, semi-structured interviews, field notes, and cultural immersion are used to gather data that explores the experiences of science shops and recognizes their cultural, political, and socioeconomic context. Ethnography, guided by the metaphor of cultures as texts, helps uncover a layered picture of social relations within in their socioeconomic, political, and cultural contexts (Geertz in Marcus and Fischer 1986); ethnography is “a sensitive register of change at the level of local experience” (1986: 82). Ethnographies capture cultural diversity, stimulate cultural critique of the researcher’s own culture, and avoid simplistic answers to research questions by documenting the “messier side of social action” (Marcus and Fischer 1986: 26). “Critical ethnography” postures ethnography as a tool for social change, the purpose being to “connect the ‘meanings of the meanings’ to broader structures of social power and control” (Pfohl and Gordon in Thomas 1995: 6). Using these methods, I was able to gain access to data in ways that operationalize my strengths in communicating with people, building social networks, and using informal social settings in the ongoing process of answering questions and generating new ones.

Summary of Chapters 2-7

Chapter 2 is a literature review of thinking about democratic expertise. I present the literature according to three typologies of ideology and practice in the pursuit of more equitable distribution of scientific and technical knowledge.

Chapter 3 is a historical narrative of science shops that emphasizes the evolution of thinking about the production and distribution of scientific expertise. It begins by giving some historical context about the Dutch student democracy movements of the late 1960s and 1970s. I discuss their struggles with consensus decision-making and the major debates among science shops about their organization and practice. This chapter also covers some of the national events that had a formative impact on science shops—such as government policy for universities and university research, the Institutes for Socially Oriented Research, and transferpoints—during a period of science shop expansion and professionalization in the 1970s and 1980s, followed by a period of downsizing in the 1990s. The chapter concludes with an overview of some of the international developments regarding science shops.

Chapters 4 and 5 focus on the process of intermediation at centralized and decentralized science shops respectively. Empirical data helps answer the first three research questions:

1. Are science shops successful at getting scientists to take on projects of importance to the community, and what factors shape scientists' willingness to do so? (representative model)
2. Do science shops provide a good model for increasing participation of scientists and citizens in matters of science and technology policy? (engagement model)
3. Do science shops provide evidence of, and suggestions for how to develop increased public participation in the content of science, including agenda setting and research process? (partnership model)

There are seven centralized science shops in the Netherlands, and Chapter 4 presents case studies of projects done at three different ones: Nijmegen, Twente, and Maastricht. Each case study follows one science shop project and highlights the elements of each of the three models. Early analysts of science shops thought centralized and decentralized science shops would tend to operationalize science shop goals completely differently. This chapter shows that many of the early assumptions about centralized science shops have not born out in practice.

Chapter 5, on decentralized science shops, aims at further explaining the differences and similarities between centralized and decentralized science shops. Three universities in the

Netherlands have decentralized science shops distributed throughout different academic faculties (Groningen, Utrecht, Eindhoven) and one university has just a single decentralized science shop (University of Amsterdam). This chapter is different from Chapter 4 because it focuses on the interaction of these science shops within universities and on the organizational aspects of these science shops, rather than on individual projects. The main point of the chapter is to illustrate the implications of such factors as the location of decentralized science shops within university faculties and the presence of staff scientists.

Chapter 6, on portability of science shops, begins with a section on why science shops are important given current and historical university-community partnerships as well as contemporary trends in global systems. Next, based on the empirical material from earlier chapters, this chapter discusses what science shops have accomplished with respect to each of the first three research questions. This chapter also answers my fourth research question:

4. How rooted is the science shop in Dutch culture, and how portable is it for other cultures, such as the U.S.?

This is done by examining elements of Dutch society—the rise of the social movements, the university system, and political culture—that have influenced the science shops and shaped the society in which they emerged. It concludes with recommendations for science shops.

Chapter 7 presents an analytical framework of three models of democratic expertise. The framework assists with describing, interpreting, evaluating, and prescribing strategies to democratize expertise. I conclude with suggestions for future research.

CHAPTER 2: Literature Review

This chapter begins with a description of the complex relationship between expertise and public policy. Next, it introduces three models of democratic expertise with respect to the STS literature. Elements from feminist theory, social movement theory, anarchist theory and globalization studies inform the models and help develop a critique about the possibilities and limitations of each.

Policy-making, Expertise, and Democratic Expertise

Public policy is a “projected program of goals, values, and policies” (Lasswell and Kaplan), or in other words, “whatever governments choose to do or not to do” (Dye 1995). As an outcome of interactions between governmental structures, it is subject to the influence of ideological, cultural and economic factors (Theodoulou 1995; Cochran, Mayer et al. 1999; Heidenheimer 1990). Scholars of policy identify stages in the policy-making process and try to identify mechanisms by which citizens, corporations, or other nation states may have influence on these phases (Berry 1995; Cahn 1995). Literature on the subject of science policy, however, was slow to emerge out of the general field of policy studies; few policy scholars argued for separate discussions on matters of *policy for science* and *science for policy* (Brooks 1964; Gilpin and Wright 1964; Cozzens and Woodhouse 1990).

Science, technology, and policy scholars identified a need for unique concepts to analyze technoscience policy (Hamlett 1992). For instance, Dickson divides science policy into issues of research, access and allocation (Dickson 1984). Noll and Cohen divide technoscience policy into two categories, activities that involve either choosing projects or managing them

(R&D) (Noll and Cohen in Kraft and Vig 1988). Martin breaks science policy down into more specific topical areas: setting of research priorities; establishment and maintenance of institutions for carrying out research; salaries, conditions and career structures for scientific workers; and decision-making about issues with significant technical dimensions (Martin 1994: 140). As scholars moved toward greater specificity in describing science policy, they also moved toward explaining the importance of democratizing all stages of the policy process and to suggesting particular mechanisms for doing so.

Upon closer study of technoscientific policy matters, STS researchers argued that more scientific information does not automatically trigger improved policy decisions, especially when the consequences for action with that knowledge are great (see discussion of certainty in Collingridge and Reeve 1986). Closer attention to the role of expertise in policy decisions reveals that certain tidbits of knowledge (or "facts") come to be aligned with certain types of people or the attributes those people have, such as race and class (Merton 1973; Fleck 1979; Jasanoff 1990). In the policy realm, scientists maneuver to maintain their credibility—what Gieryn calls "boundary work" (1990). "By drawing seemingly sharp boundaries between science and policy, scientists in effect post 'keep out' signs to prevent nonscientists from challenging or reinterpreting claims labeled as 'science'" (Jasanoff 1990: 236).

STS critiques explore the ecology of how experts use knowledge claims to appropriate power. Expertise tends to reinforce and reproduce current power relations.

> Because research itself reflects the assumptions and worldviews of those who participate in its creation, the worldviews of officials, industry, and a segment of the public are carried into scientific knowledge and then carried along with it into many areas of practice. What begins as someone's choice ends up perceived as fact by someone else. (Cozzens and Woodhouse 1990: 539)

Expertise also becomes politicized (Fischer 1990). In technical controversies, "the way in which clients…direct and use the work of experts embodies their subjective construction of reality—their judgments, for example, about public priorities or the level of acceptable risk or discomfort" (Nelkin 1977: 54). In her work on genetic engineering policy, Wright explains that previous accounts of genetic engineering controversies do not adequately capture the complex influences on policymaking. Such explanations

> …exclude the possibility that policies, as well as the assessment of hazard that provided their justifications, were affected by socioeconomic contexts and by interests in securing policy outcomes. (Wright 1994: 444-5)

Wright suggests that we re-examine cases in which controversies seem to be resolved on technical grounds and look for larger patterns of interests, "expressed as policies and discursive practices" (Wright 1994: 445).

The media is particularly important to the reproduction of power relations with respect to expertise and consequently must be recognized as a mechanism for both negotiating and stablilizing its power. Oudshoorn uses the case of male contraceptive technologies to illustrate the need to consider the media's role in the negotiation, and in this case, rejection, of scientific claims (Oudshoorn 1999). This realization shows the urgency of work such as Pierce's on community-based media production that combines insights from media studies, design studies, and STS to show communities being empowered by producing their own media (Pierce, forthcoming).

For institutions to allow expertise to be channeled towards helping people cope better with uncertainties, Lindblom and Woodhouse argue that laypersons,[5] policymakers, and technical experts would need to practice more "intelligent trial and error" with regard to decisions (1993). For example, a cohort of STS-policy authors are concerned certain technologies support unbalanced power configurations. Some systems (those that are both

[5] The term laypersons, however, is inadequate because it seems to imply that laypersons are not skilled. A better term would acknowledge that people have all different types of skills, and that so-called experts are laypersons at times, and so-called laypersons are experts in certain areas.

‘tightly coupled’ and have ‘high complexity’) place conflicting demands on managerial structures (Perrow 1984). In cases where accidents could have catastrophic consequences, we are wise not to pursue such technologies. Large-scale, rapidly-changing technologies are inherently difficult to steer (Morone and Woodhouse 1989). Technological inertia, momentum and (low) malleability can be shown to block the “error-correcting ways of democratic institutions” (Morone and Woodhouse 1989: 129):

> The results for nuclear power have been sufficiently unappealing that they raise serious questions about the ability of democracy in application to manage the complex societal issues created by large-scale technology (Morone and Woodhouse 1989: 132)

Incremental action and ‘sophisticated trial and error’ are strategies that favor decisions where the risk of error is low, flexibility is high, and learning is fast (Collingridge and Reeve 1986; Morone and Woodhouse 1989; Lindblom 1990; Lindblom and Woodhouse 1993). Sophisticated trial and error could guard against mistakes that lead to great inequity (Hamlett 1992; Lindblom and Woodhouse 1993).

As researchers focus attention toward understanding how expertise is operationalized in public controversy—e.g. to set legislative agendas and to influence public opinion—they began to articulate the importance of “democratic expertise”: ways to make expertise more responsive to the needs of local communities (Winner 1977; Winner 1986; Fischer 1990; Wajcman 1991; Woodhouse and Nieusma, forthcoming). One useful way to frame a discussion on expertise and policy-making is to identify qualities about expertise that help people make better policy decisions. In this vein, Woodhouse and Nieusma ask, “How should experts and users of expertise orient their efforts so as to structure problems and evolve sensible policies?” (Woodhouse and Nieusma, forthcoming). And subsequently, when the input of expertise does so happen to lead to policies that have more sensible or equitable outcomes—Woodhouse and Nieusma give the example of the case of finding alternatives to chlorofluorocarbons (CFCs)—what goes right? Woodhouse and Nieusma argue what goes right is “democratic expertise” (forthcoming). Democratic expertise refers to practices that:

1. (Counteract) bias by moving from phoney neutrality to thoughtful partisanship, working disproportionately to assist have-nots in understanding and making their case; and
2. (Assist) all partisans in coping with uncertainties. (Woodhouse and Nieusma, forthcoming)

By recognizing problems with the way expertise is deployed in relation to political structures we may be better equipped to develop new institutions that help people use expertise to improve decision-making.

Three Models of Democratic Expertise

I have created an analytical framework for the theory and practice regarding democracy, equity, communities, and science that is informed by my empirical study of the Dutch science shops. Each model is distinguished by its assumptions about the roles of citizens, policymakers, and scientists in the pursuit of more equitable technoscience institutions. The models may be more useful if they are understood to be zones of practice identifiable within current systems, or desirable for future ones, rather than as bounded systems.

In the representative model, scientists represent citizen interests in scientific arenas. This model espouses the view that scientists can represent the public either through their regular work, or by taking on scientific projects that directly address citizen concerns. In the engagement model, scientists take on political tasks beyond normal science practices, for instance by speaking to the press on behalf of an interest group, testifying in court, or attending meetings with elected officials. In the partnership model, which both blends and extends the two previous models, scientists and citizens collaborate directly in scientific processes. The three models and examples of them in practice can tell us something about how to design organizations that distribute expertise more equitably. Practical examples reveal ranges within each model, overlaps between them, and tensions among them.

Using Woodhouse and Nieusma's idea of democratic expertise and mapping it onto the three models for thinking about democracy and science, democratic technoscientific institutions should:

1. direct scientists and other experts toward social needs and community involvement (representative model);
2. encourage scientist and citizen participation in the policy process as it relates to science and technology (engagement model); and
3. promote increased public participation in the content of science, including agenda setting and research process (partnership model).

Assuming that equity in political systems is closely bound to equity with respect to the environment (Chiras 1992; Hawken 1993; Irwin 1995a; Tokar 1997) a fourth component may be added, that democratic science institutions:

4. promote sustainable and equitable economic development.

I use case studies of science shop projects to illustrate the first three characteristics of democratic science institutions. The topical areas of these case studies illustrate the fourth point regarding sustainable and equitable economic development.

Representative Model

The representative model works to serve citizen interests by inducing experts to take up citizen concerns in their research projects. This model of democratic expertise is closest to what might be considered 'science as usual'. Science is something done by specific people (scientists) in specific ways (the scientific method), in specific locations (such as the laboratory). Mediators are centrally important to the representative model because they match scientists with citizen interests and induce scientists to take up such themes in their work.

Numerous institutional examples follow the representative model. Cooperative extension services help scientists work on research that can be applied in agriculture and farming. "Public interest science" implored scientists to take up the concerns of citizens in their work (Primack and Von Hippel 1974). The former U.S. Office of Technology Assessment, a congressionally-funded body whose aim was to analyze the social and economic consequences of new technologies through rational, scientific methodologies has features of the representative model because its organizing principle was that experts would analyze research and development from a social perspective as well as the engagement model because scientists were expected to weigh in on policy matters (Morgall 1993; Bimber 1996; Vig and Paschen 2000).

Theories of representative democracy inform the representative model. Madison viewed representation as a way to achieve a stalemate until the people's wisdom prevails (Pitkin 1967). In Pitkin's view, Burkean and Liberal theories suggest we think of representing as:

> …acting in the interest of the represented, in a manner responsive to them. The representative must act independently; his action must involve discretion and judgment; he must be the one who acts. The represented must also be (conceived as) capable of independent action and judgment, not merely being taken care of. (Pitkin 1967: 209)

Representatives should work in a way to reduce, or at least explain, conflict in political situations. Ideally, they should not go against the wishes of the represented, but when this does occur, they should be able to explain why. Representative democracy is also referred to as "indirect democracy" because it is "government in which the people rule through elected representatives" (Greenberg and Page 2000: 8). The representative model of democracy and science applies representative criteria to scientists, pushing them to make scientific work explicitly representative of citizen interests. Just as critics of representative democracies have argued for better forms representation (see for example Lindblom and Woodhouse 1993 on improving representation, such as linking the vote to accountability), the representative model seeks to improve the way citizen interests are represented through scientific work. Tasks of representative model organizations may include developing “cognitive compatibility” between science and citizen interests—adjusting citizen questions so they are more compelling to scientists (Leydesdorff and van den Besselaar 1987)—and creating accountability within current science practices.

Critics of the representative model may point out that scientists are not democratically chosen to be representatives, and therefore they are not sanctioned in the same way as political actors (Martin, 2000). The representative model expects scientists to represent citizen interests (“acting for”), but does not provide for other important facets of political representation, such as “authorization” and “accountability” (Pitkin 1967: 11). Because people do not vote to elect scientist representatives, scientists do not necessarily have authorization from the people, and aside from legal restrictions, scientists are not directly accountable to citizens. Regardless of the lack of formal structures by which scientists become representatives of the public interest, however, the representative model expects scientists to act for the people—or in Burkean terms, as “trustee” rather than “delegate” (Pitkin 1967).

Further, critics of representative democracies have pointed out that they often fail to represent societal groups equally. For example, business interests have privileged positions within political spheres (both because of government’s role in supporting the economy and because of business’ disproportionate influence based on wealth) (Dahl 1989; Hamlett 1992; Lindblom and Woodhouse 1993). Representative systems often lead to the professionalization of representatives. In the environmental movement, for example, this has led to an expanding network of Washington insiders unable to respond adequately or efficiently to problems and needs at the grassroots level (Tokar 1997).

An STS perspective also identifies some problems with the representative model. Though pragmatic, the representative model is also technocratic if it does not challenge science practices (such as methodologies) (Jasanoff 1990). It is also inefficient, relying on the ability of some groups (such as public advocates or mediators) to get scientists interested in solving problems relevant to citizens. In the late 1970s and 1980s the critique of science and the social construction of science hypothesis helped scholars question the ability of representative institutions to reduce inequities in technoscientific matters (Cozzens and Woodhouse 1990). However, few concrete proposals exist for shifting reward structures within science in a way that provides scientists incentives to work on problems related to community problems rather than, for example, problems of concern for the military-industrial complex or to multinational firms (Martin 1979).

Also from an STS perspective, the representative model can be criticized because it does not explicitly challenge the "deficit model" of the public understanding of science (Irwin and Wynne 1996). Citizens are represented by scientists within scientific processes but are not necessarily given broader decision-making responsibilities. This has ramifications for how the representative model would inform the organization of scientific and civic institutions. For example, one problem inherent in the deficit model is it assumes the reason citizens need to understand science better is so they will support government science initiatives. Consequently, a popular approach has been to try to communicate science *to* the public. This often results in sexy, "gee-wiz" (Winner 1977) presentations of science and technology (e.g. National Air and Space Museum) that do not provide a meaningful framework with which to assess or criticize technoscientific developments (e.g. the controversy around and subsequent cancellation of the original exhibit of the Enola Gay, the plane that dropped the atom bomb on Hiroshima).[6] The emphasis is on unilateral flow of information rather than on reconfiguring institutions so citizens have enhanced roles in setting policy or research agendas regarding science and technology.

Feminist critique also informs the representative model. Unless representatives have been marginalized themselves, the critique posits, they do not fully empathize with the needs of marginalized groups. This perspective might argue that in order for science institutions to be truly representative, they must have a diverse body of practitioners. One possible remedy would be to seek greater numbers of women and minorities in scientific fields (Wertheim 1995).[7] For example, Hess argues the participation of diverse groups within scientific institutions has a diversifying effect on science: “when the social body is diversified, the content of science and technology changes as well as its communication and social structure” (Hess 1995: 253). A diverse body practicing science is likely to formulate both problems and solutions differently, in ways that are likely to inform and enhance current practice. Feminist critiques point out that scientific practices are patriarchal and hegemonic and therefore to the need for deeper remedies to power imbalances. This may involve scrutinizing how objectivity is constructed and legitimizing different “ways of knowing” (Schiebinger 1989; Tuana 1989).

Advocates of the representative model may counter some of these critiques by asserting that these strategies *do* change the practice and content of science. The process of having scientists recognize and respond to these concerns is a significant departure from “science as usual.” Without seriously disrupting current science and political institutions, representative

[6] When popular approaches manage to do anything besides glamorize, they seem to fall into a line of reasoning that although a new scientific or technological development (cloning, bioengineered food, etc.) may be dangerous and have unintended consequences, it would be worse (and even anti-democratic, communistic) to impede progress.

[7] This seems to be gaining ground on the agenda of national science organizations and technical institutions, though it is definitely not clear this is part of a greater project to enhance democracy.

model strategies can redirect current practices. Mediators between scientists and public interest groups may help give scientists greater latitude to pursue their own interests while they still produce research that is useful to community groups.

Engagement Model

Engagement model practices have scientists taking on responsibilities outside of their usual scientific ones and interacting with laypersons in political arenas. The result is that scientists influence policy issues related to science and technology by directly participating in public policy or NGOs. Engagement model practices—scientists working for consumer advocacy groups, counter-expertise, participatory technology assessment, and demarchy—promote not only enhanced scientist but also citizen participation in science and technology policymaking (Dickson 1984; Petersen 1984; Dahl 1989; Sarewitz 1996). Engagement model practices encourage layperson and scientist collaboration in political arenas and therefore put issues of science and technology more squarely in the political arena.

Many public interest groups operate as engagement model organizations. Consumer advocacy groups and environmental groups who have staff scientists (such as Center for Science in the Public Interest and the National Resources Defense Council) work to put experts in political arenas to defend social goals. At the same time, interest groups acquire scientific knowledge to advance their goals, and then pass information on to their members. The Union of Concerned Scientists, which started out as a membership organization that supported scientists who sought to incorporate social concerns into their work (representative model), evolved throughout the 1990s into a think tank of its own which produces studies on policy issues related to science and technology and advocates particular policy positions (engagement model). The National Science Foundation's Science for the People program paid for scientists to work in applied research and public education projects in non-profits, citizen groups, and state and local governments (Hollander 1984).

Instances when experts work for communities as "counter-experts" during a crisis or regarding a specific problem—a physicist testifying in court about noise pollution, an environmental engineer interpreting an environmental impact statement, or an urban planner advising a neighborhood about how to critique a road-widening plan—fit with the engagement model. Counter-experts assist interest groups in gaining access to science or improving their ability to mobilize science for their goals (most often in the legislative and judicial branches of government). For example, counter-experts from peace research institutes provided an essential 'weapon' to the German peace movement:

> Without the alternative strategies proposed by researchers—nuclear-free-zones, no first use of nuclear weapons, nonoffensive defense, social defense, conversion of defense industries—the movement would have remained simply a negation. It would not have been able to present genuine, workable alternatives to real, existing NATO doctrine. The alliance between movement and peace researchers was indispensable, and one of the movement's greatest strengths. (Breyman 1998: 69)

Counter-experts are especially important during controversies that proceed quickly, or during procedures that exclude public participants by withholding relevant information.

Participatory Technology Assessment is an emerging area of Technology Assessment that includes "consensus conferences" (Durant and Joss 1995; Vig and Paschen 2000). Originally developed in Denmark, consensus conferences organize lay citizens and selected experts to discuss policy regarding a single technoscientific issue. Over several days, citizens meet with policy and technical experts, ideally reach a consensus about policy decisions, and then deliver position papers. A central goal is to promote early and judicious discussion among experts and laypersons about the use of technologies in society, before they are in wide use. Although individual consensus conferences have so far not had success connecting the conferences to an actual policy impact (Durant and Joss 1995; Guston 1999; Danish Board of Technology 2000) they are valuable for their experimentation with ways of configuring expert-lay interactions.

Demarchy is an alternative practice that has so far been theorized, but not implemented (Martin 2000). Demarchy proposes an alternative way of organizing governance in which individuals, randomly selected from the larger population, are selected to

> serve in decision-making groups which deal with particular functions or services, such as roads or education. In a full-fledged demarchy, …[the state and bureaucracies are] replaced by a network of groups whose members are randomly selected, each of which deals with a particular function in a particular area. (Martin 1995-6)

As in the case of other engagement model methodologies, social movements are thought to be a major vehicle for implementing demarchic organizations (Martin 1995-6). Demarchy would combine experts and laypersons in civic organizing bodies, and is thus an engagement model concept that puts particular emphasis on direct participation of laypersons in the political sphere.

Some of the early discussions about the role of the scientist in public life occurred in the aftermath of WWII, as scientists protested the atom bomb and scholars on science and government took notice of the singular role of the scientist as advisor to government decision-makers (Brooks 1969). Of great concern was the extent to which scientists would have autonomy in decision-making about science policy (as Vannevar Bush argued) (Bush 1945) or whether a single governmental agency would make decisions about policy based on a range of social interests (as Kilgore proposed) (see Kleinman 1995). The discussion focused on ways the government could better utilize scientists in advisory capacities (Gilpin and Wright 1964; Brooks 1969).

The engagement model stresses both scientist and civic participation in politics. A goal is to create a public sphere in which people work together in problem-solving (Mills in Pitkin 1967). Democratic theory informs the engagement model by theorizing civic participation and providing criteria and benchmarks with which to evaluate participation. “Democratic process criteria” can be used to evaluate institutional mechanisms for citizen input (such as public hearing, ballot initiative, public survey, and negotiated rule making) (Fiorino 1990: 229). In “strong democracy” participation may be gauged by how well democracy is institutionalized at three tiers: strong democratic talk, decision-making, and action at the local and national level (Barber 1984:266). Dickson suggests democratizing three levels of science policy: research, access, and allocation. Similarly, Sclove proposes change at multiple levels, starting with broadening “social awareness for the need to democratize technology” and moving on to “establishing core activities and institutions of democratic technological politics” and “supporting macroconditions” (Sclove 1995a: 197).[8]

STS perspectives help identify some shortcomings in the engagement model with respect to the public understanding of science. The engagement model, like the representative model, tends toward a deficit model view of the public understanding of science. This relates, in part, to a question of intent. After WWII, scientists were enlisted engage in political life as a way to produce a more scientifically informed public—one that understood enough about science to support it. An improved public understanding of science would also lead to improved ability of the general public to make decisions, such as calculating risk with regard to public policy or personal health (Rydell in Petersen 1984), enhanced economic development, increased support for taxpayer-subsidized science, and, because an understanding of science

[8] This may involve, for example, extending this to economic processes because most of our time is actually spent in the workplace and because economic processes are as important as political processes (especially to scientific and technological innovation) (Dahl 1989; Schor 1992).

is part of a broader cultural fabric, a more culturally educated citizenry (Gilpin and Wright 1964, Royal Society of London report in Irwin and Wynne 1996). Scholars of technoscience point out this issue is much more complex. Public understanding of technoscience is nuanced—embedded in cultural values and trust in institutions (Douglas and Wildavasky 1982; Irwin and Wynne 1996) not just an outcome of a lack of knowledge. Plus, the public understanding of science should not bar citizens from setting policy about science—especially when public participation has the potential to improve decision-making (Martin 1980; Barber 1984; Brown 1997). As scientists take on enhanced roles in political arenas in the engagement model, they should also enhance public participation in science and technology policy.

The engagement model, relying on scientific information to inform public policy, tends to reify technocratic methods as a way to resolve conflict. Some early scholars of science policy addressed the limitations of expert advice in making policy decisions (Laski in Brooks 1969), but the prevailing assumption was that more scientific information leads to better policy decisions (Bush 1945). STS scholars argued that scientific information is ill-suited to resolving policy disputes (Collingridge and Reeve 1986; Jasanoff 1990; Lindblom and Cohen 1979; and Lindblom and Woodhouse 1993). Professional impairment can hinder the kind of decision-making that makes for good policy (Lindblom 1990). Moreover, expertise itself becomes politicized in technical controversies (Nelkin 1977; Frankena 1992). Because technocratic models of decision making tend to leave normal relations of power intact, they support the interests of policy, economic, and scientific elites (Perrow 1984; Collingridge and Reeve 1986; Morone and Woodhouse 1989; Hamlett 1992; Lindblom and Woodhouse 1993). Power relations manifest themselves in funding patterns (Cozzens and Woodhouse 1990) or in who has access to the legitimate tools (equipment or methods) by which data is collected

(Nowotny and Rose 1979; see also Fisher's discussion of Risk Assessment in Fischer and Black 1995). At a material level, scientists' professional responsibilities conflict with demands for their participation in public arenas. Whether experts take pro-bono work depends on their willingness to forego other activities that might earn them more money or prestige (publishing in journals, for example).

Social movement theory is also relevant to the engagement model. Scholars of new social movements, recognizing the importance of movements in articulating concerns about new technologies, have studied why movements form, how they reproduce, and how they facilitate citizen participation in technoscientific debates (Laraña, Johnston et al. 1994; Breyman 1998). When social movements amplify citizen concerns in technoscientific policy, they carry out "participatory technology assessment" (Morgall 1993). Whether through women's movements advocating for improved birth control or farmers lobbying for restrictions on genetically modified organisms, movements have become one of the most effective outlets for citizens to voice their concerns regarding science and technology policy. Through movements, citizens become educated on scientific issues and strengthen their ability (or at least confidence) to participate in policy debates. Social movements are thought of as the implementers of variations on participatory democracy that attempt to resolve the inadequacies of representative science institutions, such as strong democracy (Barber 1994) and "participatory expertise" in which social movements direct citizen participation in policy arenas and align expertise with democratic values (Fischer 1990).

STS theory helps identify shortcomings with participation. It is argued participation is often conditional, and all too often *post hoc*: rather than widespread or vigorous debate about technologies early on, technologies are often in widespread use before thoughtful discussion about them takes place. By then, it is frequently too late to alter them. Debates often marginalize critics of technology, especially by conflating criticism with misunderstanding; those who question merits or values in science and technology are labeled "Luddites."[9] Also, participatory policy mechanisms are vulnerable to problems because of their dependency on the vested interests of policy-makers, experts, or bureaucrats. Participants can be co-opted by expert opinion, resulting in the advance of special interests or the legitimation of previous policy decisions (Rydell 1984). Existing inequalities, such as those related to race and gender, also may exacerbate problems with participation (Brown 1995). Skeptics of consensus conferences, for example, wonder whether the consensus is achieved through the process of holding a conference where participants are pampered for several days, rather than through substantive discussion (Hagendijk 1999). Participatory systems also have difficulties coping with large numbers of people in decision-making capacities "without succumbing to the same problems as representative systems" (Martin 1995-6).

Nevertheless, the engagement model indicates a shift toward a more complex relationship between the sphere of science and the sphere of politics. Scientists who take on political responsibilities often do so through political interest groups and citizens who become involved in political controversies interact with scientific facts and scientists. Because scientists are expected to take up the needs of marginalized groups in political arenas, this model acknowledges the need for more democratically controlled science policy rather than science policy as decided by scientists themselves—Kilgore as opposed to Bush (see Kleinman 1995). Engagement model strategies promote enhanced citizen and scientist interactions that may be precursors for further expert-lay collaboration, for example within scientific processes (partnership model).

[9] This rhetorical move is historically inaccurate: "Most instances of Luddism were not motivated by a fear and hatred of new machinery; their grievances were those of people suffering from low wages and unemployment caused by a generally depressed economy" (Volti 1995: 21).

Partnership Model

The most salient feature of the partnership model is it represents a fundamental shift in science by calling for increased citizen participation in the process of scientific research (Sclove 1995a; Martin 1997a). Whereas both the representative and engagement models focus on the political arena for allocating expertise more equitably, the partnership model sets its sights on changing the practice of science—choosing research questions and collecting, analyzing, and using data. In the partnership model, communities are more than just sites for data collection, they are active participants in knowledge-generating processes.[10] This model is a blending and extension of elements from the representative and engagement models. Examples of partnership model institutions include action research, participatory design, and community-based research (including popular epidemiology and community based participatory research).

Action research (AR) refers to a diverse set of strategies, used predominantly in social science research. It is defined more by intent, rather than by methodology. AR is

> …a cogenerative process through which professional researchers and interested members of a local organization, community, or a specifically created organization collaborate to research, understand, and resolve problems of mutual interest. AR is a social process in which professional knowledge, local knowledge, process skills, and democratic values are the basis for cocreated knowledge and social change. (Greenwood and Levin 1998: 93)

Rooted in the "industrial democracy tradition" (largely about democratizing decision-making in industrial workplaces) some have argued AR was co-opted in workplace arenas for Tayloristic ends. Elsewhere, however, it thrives in diverse forms such as southern participatory AR (Fals-Borda and Rahman 1991), feminist research (Maguire 1987), education-based approaches (Freire and Horton 1990), action science and organizational

[10] Research, when broadly defined, can range from the production of a documentary video, to the design of low-income housing, to statistical analysis of asthma rates.

learning (Agryis and Schön 1996), and community-based participatory research (Israel, Schultz et al. 1998). By developing new relationships between researchers and communities, AR is said not only to "convey a view of science as a form of action involving complexity, ambiguity, creativity, group dynamics, and many pragmatic concessions to the limitations imposed by time and resources available" (Greenwood and Levin 1998: 63) but also, through a program of creating arenas for dialogue, cogenerative research, and use of multiple methods, to be "more capable of producing scientific results (in a positive sense) than conventional social science" (56).[11] Greenwood and Levin contend that AR has been marginalized in academe, not because it has failed to produce 'good results,' but because of "the general lack of commitment to democratic social change in our societies" (89).

Participatory design refers to processes whereby meaningful participation of users is incorporated in the design stages of technology. The idea is that better integration of information about users (including the user environment and user expertise) will result in "more workable prototypes and products" (Greenbaum in Schuler and Namioka 1993: 35) and in the restructuring of technology "along more democratic lines" (Bravo in Schuler and Namioka 1993). Participatory design also emphasizes collaboration between designers and users and the users' valuable insight into daily practice (Ehn 1989; Schuler and Namioka 1993); users' experiences are important to a designer's ability to improve technology designs (making them more user-friendly, less-breakable, and more effective at servicing consumer needs) (Greenbaum and Kyng 1991; Welch 1995). Participatory design is related to the idea of user-centered design, which, using concepts from social psychology such as 'learned helplessness' and 'affordances,' identified the importance of user interface for thinking more deeply about the user when doing design (Norman 1990). Although user-centered design

[11] The authors acknowledge that this argument rejects the strong relativist position that all forms of knowledge

called for designers to think more about the user and the user environment, it did not suggest specific methodologies for implementing these considerations, nor did it address “the thorny questions of control and decision-making” (Greenbaum in Schuler and Namioka 1993: 31). Rather, ‘user-centered design’ internalizes paternalistic assumptions characteristic of the representative model. Participatory design addresses matters of collecting data about user-environments and methods for user-designer collaboration. It is especially thoughtful about the contribution of ethnographic approaches to participatory design—how to mobilize ethnographic research methods to access information about everyday practice (Blomberg, Giacomi et al. in Schuler and Namioka 1993). Participatory design, however, is a somewhat shallow example of the partnership model—its primary focus is on producing better design, rather than empowerment for the user or a fundamental shift in power relations (Greenbaum in Schuler and Namioka 1993) although this seems to be changing as STS and design studies merge (e.g. work presented at the annual Participatory Design Conference).

“Community-based research” (CBR) attempts to facilitate expert and lay interaction and change the basic practice of science. In CBR:

> Communities often *identify* the issue or problem and participate in *defining* the research question, *conducting* the research and, finally, *using the results* toward an action-oriented outcome….research conducted by, with, or for communities (emphasis in original). (Sclove, Scammell et al. 1998: 1)

This broad definition fashioned by the Loka Institute accommodates a diverse set of interests, people, and practices to network and exchange ideas (see www.loka.org). Community advocates in the Loka Institute’s Community Research Network remain divided over the extent to which scientists should be expected to collaborate with citizens (Sclove, Scammell et al. 1998). Some are chiefly concerned with power issues related to science and would have communities involved with all aspects of the scientific project as “obligatory passage points”

are equally flawed (Greenwood and Levin 1998: 66).

(Latour 1987; Epstein 1996). Such a practice, they argue, leads to a more collaborative relationship between scientist and citizen, where even the boundaries between scientists and citizen are blurred (Loka Conference 2000).[12]

Community-based research also describes enterprises such as ‘popular epidemiology,’ a practice in which local communities cooperate with scientists in data gathering and analysis to promote community empowerment and change (Brown 1997). In a widely cited case of community activism against toxic pollution, the residents of Woburn, MA, worked with scientists to collect data in their community after becoming aware of alarmingly high rates of childhood leukemia (Brown and Mikkelsen 1997). The case is so compelling to those interested in CBR and environmental issues because it shows a community becoming politically aware through participation in an activity normally the uncontested province of scientists:

> Popular epidemiology is by nature activist, because it involves the lay public in work that should be done by corporations, scientists, and officials. Popular epidemiologists attack the corporate and governmental status quo. (Brown and Mikkelsen 1997: 156)

This approach makes the point that citizen participation in science can lead not only to empowered, invigorated communities, who are better prepared to participate in democratic institutions, but also to better science (Brown and Mikkelsen 1997; Schumacher 1998).

The aims of partnership model institutions are consistent in many ways with what Gibbons et al. call Mode II knowledge production (Gibbons, Limoges et al. 1994). In Mode II, knowledge differs from Mode I primarily in that it is conscious of the application context. Mode II is also characterized by flexibility, transdisciplinarity, and social accountability/reflexivity, and it acknowledges that knowledge is produced in heterogeneous

[12] This thinking is also reflected in new media forms. David Isay and Stacey Abramson create radio documentaries from interviews that are taped by community members, and makes what they call “sound

places—inside and outside of universities and research laboratories. The utility of the Mode II knowledge concept materializes when these authors discuss the ramifications for institutional practice. In transdisciplinary contexts, effective institutions will be able to "manage disciplinary identities" and adapt to the new constraints posed by transdisciplinary work.

Post-normal science—an insight, not a theory—also informs the partnership model. It proposes that something be added to the practices of applied science and professional consultancy that "bridges the gap between scientific expertise and a concerned public" (Funtowicz and Ravetz 1992). It stresses that democratizing science is important not just for the sake of increasing social equity, but for improving science by giving a framework for uncertainty in science. "Extended peer communities" can help sustain a broader dialogue about uncertainty in science as it relates to policy-making, especially by rethinking the idea that quality in science is inversely proportional to uncertainty. The argument for extended peer communities helps substantiate the place of 'outsiders' within scientific and political decision-making, while the emphasis on uncertainty as indigenous to science practice puts post-normal science in the company of other risk-related discussions—such as risk society (Beck 1992), precautionary principle (Colborn, Dumanoski et al. 1997), intelligent trial and error (Lindblom 1990), trust in experts and institutions (Irwin and Wynne 1996) and the public understanding of science (Wynne 1995).[13] Post-normal science does not specify methods for changing current institutions but it does make the important point that a better framework for uncertainty and science can be a boon for both science and equity. Citizen interest groups play a vital and well-recognized role in airing public concerns regarding

portraits" out of these interviews, by consulting with the interviewers and sometimes directly collaborating with them in the studio (See www.soundportraits.org).

[13] See Healy (1999) for a discussion that locates post-normal science in the literature on social theories of risk.

science, particularly when uncertainty is high (e.g., biotechnology or nuclear energy) (Krimsky 1985; Breyman 2001).

The partnership model reflects substantive thinking on the subject of power. Lukes' definition of power, "A exercises power over B when A affects B in a manner contrary to B's interests" stimulates discussion about how political and scientific systems construct "interests" and operationalize power (1974: 34). By Giddens' definition of power, science functions as a resource capable of determining outcomes (1995). Foucault's "microanalysis of power"—power is manifested and resisted in many ways, including through scientific methodologies and technological artifacts (1979: 26)—prompts STS scholars to look at multiple sources for the 'cultural and political authority of science.' Aronowitz (1988) argues science is a discursive power; its truth claims are tied to methodological claims (which are used to show science as immune from influences of social and historical situations), and its claims to authority rest on the possession of legitimate knowledge, defined by science itself. If we are to create alternative science institutions, according to Aronowitz we need to make explicit the logic of (what we currently call) science, and replace its "logic of domination" (1988: 27) with an alternative logic. Similar worries crop up in the work of Donna Haraway, who wonders about narratives of purity woven into dominant (Enlightenment) discourses of science, and surface even in environmental debates—she gives the example of the Pure Food movement against genetically modified organisms (1997). Haraway does not oppose the goals of this movement, but she does favor a more comprehensive and permanent destabilization of boundaries between the technical and political. Should neither kind of explanation be completely embraced, a diffracted picture of "situated knowledges" emerges; situated knowledges place "much stronger demands on the reproductive apparatuses of technoscience"

(1997:112) and ultimately lead to “more adequate…self-critical” (1997: 33) understandings of scientific facts and objectivity.

A central idea in STS is that social values and power shape what comes to be accepted as scientific knowledge or expertise (Fleck 1979; Gieryn 1990; Jasanoff 1990). In light of this negotiation, the argument for greater participation of laypersons in scientific processes becomes more persuasive. Instead of rejecting citizen participation because it might lead to value-laden or biased science, it is embraced in a framework that highlights values in policy models as a way to avoid technocratic decision-making (Dickson 1984; Fischer 1990; Jasanoff 1990). Some say this is a more accurate account of the way policy works; “Scientists are drawn into questions of policy…because the making of political decisions requires more than the digestion of delivered facts, it calls for a dialogue between expert and decision maker” (Collingridge 1980). Because the conditions needed for producing agreement in science fundamentally conflict with the needs of policy, Reeve and Collingridge (1986) argue we should be more realistic about what science can and cannot do. This means pursuing solutions that do not require scientific consensus and whose potential errors have low risks. Institutions in which technical and political issues can be discussed together would require less adversarial modes of conduct (Hamlett 1992; Jasanoff 1995). Government regulators could be given more flexibility to consult with experts (mandatory vs. discretionary advice) (Jasanoff 1990). When experts are consulted to enhance decision-making, they should be more generally qualified in a range of expertises (as opposed to narrowly specialized). Sarewitz (1996) calls for a more *honest* relationship between scientists and policymakers—policymakers need to learn how to demand what is possible, while scientists must promise only as much.

In the partnership model, the public understanding of science must be more than a unidirectional flow of knowledge from experts to laypersons, partly because of the recognition that communities and individuals possess “local” or “indigenous” knowledge. Thus it is not only an issue of the public understanding of science, but also of the “scientific understanding of the public” (Irwin 1995a). Citizens are not simply illiterate when it comes to science—when so motivated, they show an ability to “reconstruct” science for their immediate purposes (Hess 1999). Hence the partnership model values *reflexive* and *self-critical* institutions (Fischer in Fischer and Black 1995)—institutions that take into account the knowledge of laypersons which traditional science tends to gloss over, devalue, or ignore and promote collaborative relationships between scientifically trained experts and other knowledgeable groups (Irwin and Wynne 1996; Fortun 1998; Hess 1998). For example, the Institute for Interdisciplinary Studies (ISIS), works at this junction “not only to provide citizens with knowledge they lack, but to create multiple feedback loops that continually modify the practice of science, while redistributing crucial access to scientific authority” (Fortun and Cherkasky 1998: 148). Fortun and Cherkasky suggest we examine the “politics of collaboration” to better direct as well as to change expertise.

> Collaboration recognizes that counter-experts are indeed experts, which means that they cannot straightforwardly identify with the demoralized, depoliticized, and disorganized people with whom they work. Collaboration stresses the *labor* of working across difference, the *un-easiness* of the counter-experts’ responsibilities (emphasis in original). (Fortun and Cherkasky 1998: 146)

Scholars in the sociology of scientific knowledge and the social construction of technology argue that citizen participation in activities previously thought to be the divine province of experts leads not only to citizen empowerment, but also to the practice of “better” science (Martin 1984; Martin 1993; Epstein 1995; Brown and Mikkelsen 1997).

Social movement theory can help in understanding how citizens can challenge traditional science models and build coalitions with scientists (Epstein 1996) that can lead to new scientific research agendas (Hess 1999). Because new social movements challenge power relations, they are integral to the creation of partnership model institutions: "new movements publicize grievances and anxieties about everyday life, and uncover hidden power relationships that come together in its shared customs and routines" (Breyman 1998: 23). Social movements are recognized as a resource for improving public interaction with science and for challenging conventional scientific models. Epstein looks at outsider influence on science in two aspects of AIDS, causation and treatment. "By emphasizing the role of laypeople in the production of biomedical knowledge [his] study challenges approaches to the social study of science that tend to assume knowledge-making is the province of a narrow circle of credentialed experts" (Epstein 1996: 4). Social movement theories such as framing or resource mobilization (Laraña, Johnston et al. 1994) can help identify ways that citizen groups use "[credibility] tactics… to disrupt the smooth transfer of knowledge from hypothesis to fact to common sense…" (Epstein 1996:142). Social movements are expected to play a pivotal role in creating reflexive organizations—ones that value participation over technocratic modes of decision-making (Fischer in Fischer and Black 1995: 169)—the lack of which impedes public engagement with science and scientists.

Partnership model collaboration challenges accepted boundaries between politics and science. From an anarchist perspective, partnership model institutions encourage a more substantive exploration and valuation of different types of knowledges and self-governance. They have the potential to support different kinds of political ideologies (Martin 1994; Restivo 1994b). If anarchist principles can be described "as involving opposition to all forms of hierarchy and domination—especially the state but also monopoly capitalism and patriarchy, among others—and support for self-management namely people collectively running their own lives" (Martin 1994: 136-37) then this opposition also recognizes the role of science in perpetuating hierarchy and domination (Restivo 1988; see also Jacob 1988 for a discussion about hegemony with regard to the scientific revolution). Anarchist thinking provides a backdrop for understanding "modern science as a social institution" (Restivo 1993; Restivo 1994). Anarchist thinking may play a key role in deconstructing objectivity as it is operationalized by current institutions and promoting reflection about the social and political nature of current scientific institutions and future "social rearrangements" (Restivo 1993):

> As anarchist thinkers interested in science, we would ask some new questions all at once as a package: what do scientists produce, how do they produce it, and whom do they produce it for; what resources do they use and use up; what material by-products and wastes do they produce; what good is what they produce, and for whom; in what social context is what they produce valued, who values it, and why do they value it; what costs, risks, and benefits does scientific work lead to for individuals, communities, classes, societies, men and women (especially in terms of sex and gender) and the ecological foundations of social life? What are the relationships between scientists and various publics, clients, audiences, patrons; how do scientists relate to each other, their friends, and acquaintances, their colleagues in and out of science, and especially the children in their lives? What is their relationship as workers to the owners of the means of scientific production; what are their everyday lives like? What are their self-images, and how do they fit into the communities they live in; what are their goals, visions, and motives? (Restivo 1993: 22-3)

Anarchists may reject programs that aim to democratize science in favor of ones that foster critical thinking and "focus on creating a better society, educating human beings who care for one another and for their communities and environments in local and global senses" (Restivo 1993: 28-9). An alternative, for example, is "culture jamming," – taking actions such product boycotts, turning off the television, and producing commercials that "uncool" certain products and the lifestyles they promote, all in an effort to "chang(e) the way information flows; the way institutions wield power; the way television stations are run; and the way the food, fashion, automobile, sports, music, and culture industries set agendas" (Lasn 1999).

Nevertheless, anarchist theory has informed proposals for institutional reform. An anarchist science policy would seek to make scientific research a more participatory activity, something in which virtually any person could be involved.” (Martin 1994: 143). Further proposals for undercutting decision-making by elites through institutional arrangements and deliberate actions by scientists include: promotion of greater participation and sharing of work in scientific workplaces, enabling non-scientists to join in scientific work, reducing hierarchy in the scientific community through more equal salaries, part-time work, and tax incentives for individuals and small groups to undertake research linked to community concerns (Martin 1994).

Feminist critiques also inform the partnership model. They call attention to the way that subjectivity and objectivity are defined, especially with regard to gender roles, race, and class (Hubbard 1989; Keller 1995; also Restivo 1994a). For example, feminism has also informed anthropological studies of science that promote a deeper understanding of the role of culture in the construction of scientific facts and in practices that determine who gets to do science—and who does not (Traweek 1988; Martin 1994). Feminist analyses have argued that gender and technology mutually shape each other (Wajcman 1991; Cockburn and Ormrod 1993). Feminist analyses call for increased recognition of the material basis of science (Star 1995) that helps substantiate the partnership model call for a deeper role of laypersons in scientific practices.

Literature on globalization informs the partnership model by recognizing the importance of community within global systems, but at the same time cautioning not to over-react by idealizing the concept of community. For example, while it is certainly worthwhile to think about cultural differences that might be preserved in spite of globalizing forces (Barber 1996), some have noted technological advances fueling and fuelled by globalization have the potential to create community where it has not previously existed (Turkle 1995). "The community" embodies so many hopes and meanings some suggest being more critical and reflexive to better understand what we want from it:

> …. 'the community' is the name given to that hoped-for thing in the system of knowledge/belief which will salve the wounds of science. It is a fetish object, an object of desire, the saving power for a fallen material world, the place in the thought-system where millennial hopes are located. Or maybe 'community is the place hol(e)der that marks the absent space within the system, the thing we do not have but think, for whatever multiple obscure reasons, we want or need. (Fortun 1998: 190)

Theories that are skeptical of globalization but guard against presumptions that it signals an end to community, hopeful about community but caution exaggerated idealism about it, provoke deeper thinking about how the partnership model might be applied to change policy and science.

As new partnership model approaches emerge, so do rewarding, frustrating and challenging experiences. Experts wanting and willing to engage communities as active participants in the research process will face "double-binds," as Fortun did during her fieldwork on the Bhopal disaster.

> Though in Bhopal to conduct Ph.D. research, I spent all my time in political activism, hoping that, in the end, it would 'count' as participant observation. The conundrums produced in process were multiple, provoking continual reflection on how ethnography and direct advocacy collide, yet remain distinct, equally important responsibilities…advocacy became a way to translate between different obligations, possibilities and perspectives (Fortun 1998: 193)

Double-binds can be used to further question and analyze science and activism.

Partnership model institutions are concerned with recognizing different types of expertise and the inherent political nature of science, by providing a more congenial space for scientists and citizens to collaborate. Partnership model institutions question who gets to produce science in much the same way that groups such as The Alliance for New Community Media question who gets to produce media (Pierce, forthcoming). This model confronts the power relations embedded in the distribution of scientific knowledge, and so is deeply critical of the traditional science model (Aronowitz 1988; Haraway 1997). Those in mediating roles will gain valuable insights into establishing a community presence in science. Partnership model institutions may help both communities and experts to reflect on the role of science in society and citizens in science.

Conclusion

Each model of democratic expertise embodies a range of practices, assumptions, values, and concerns. The models are analytical categories that help map the different possibilities for redistributing expertise along more equitable lines. The purpose of the models in this study is to provide a structure within which to view the Dutch science shop experience and evaluate the benefits and tradeoffs of different practices. Chapter 3 highlights points in the history of science shops in which individual choices correspond to the concerns empbodied by the different models. Chapters 4 and 5 are sensitive to the commonalities among and tensions between the three models and illustrate the work that science shops do in order to move between different modes of practice based on the dynamic processes of science and politics.

CHAPTER 3: History of Dutch Science Shops

This chapter reviews the historical development of the Dutch science shops, paying special attention to changes in thinking about the production and distribution of scientific and technical knowledge. I look at personal motivations, internal debates, and organizational incentive structures of science shops, historically and ethnographically. The chapter begins by giving a basic snapshot of Dutch life, including some information about demographics, the political system, and universities. Next, it describes the emergence of science shops as well as similar initiatives aimed at changing university practices. It then describes how science shops operationalized government policy to institutionalize science shops and the subsequent period of professionalization. I address the closing of several science shops and strategies used by others to remain open. The chapter concludes with a discussion of international developments regarding science shops.

Snapshot of Dutch Life

The Netherlands is a highly organized, highly educated, homogenous society. In 2002, its population passed the 16 million mark, of which nearly 1.5 million are first generation immigrants from a non-western background. The leading countries of origin for those born abroad are Morocco, the Netherlands Antilles, Suriname, and Turkey (Centraal Bureau voor de Statistiek 2001). The Netherlands Antilles and Aruba are still Dutch territories. The political system is a constitutional monarchy. The constitution was adopted in 1814, the Netherlands formed in 1830, and the constitutional was last amended in 1983. Due to a large amount of decentralization, the 12 provincial governments and the 504 municipal governments form a strong component of the political system.

Formerly, Dutch society was organized by sectors based on religious beliefs, the so-called "pillar society: "A vertical division of society into blocs with their own ideology and organizations, and communicating only at the top" (Lijphart 1968). Each pillar had its own social organizations, media outlets, political parties, and educational system, with relatively little contact between people in the different groups. In this fragmented society, people placed a high value on authority and the presumption that the political realm was reserved for the elites in each pillar (de Voogd 1996). This system dissolved and although vestiges of the pillars remain, today Dutch society is no longer as religious or as compartmentalized.

The welfare state is a hybrid of corporatist (low incentives to work, protection of acquired standard of living) and social democratic models (accessibility of services) (Social and Cultural Planning Office 2002). There is a vast social services network: offices for legal aid, specializing in different areas of the law such as children's affairs or the environment, dispense low-cost or free counsel; community centers are a hub for distributing information about local infrastructure and provide not only programs for sports and hobbies, but also social services—for immigrants to adjust to life in the Netherlands, parents raising children, and people with depression. Information about available services is widely distributed through brochures placed in public spaces such as libraries, post offices, and municipal governments. The poverty line is 95% of Dutch national assistance norm (Social and Cultural Planning Office 2002). The literacy rate is 99%, defined as persons over the age of fifteen who can read. Nearly 55% of men and women the age of 19 are involved in full-time education (MOCW, 2001). This is at least in part due to its compulsory nature; people between the ages of 5-16 are obligated to pursue full-time education, and from 17-18 must at least be involved in part-time education.

Dutch people self-identify with their country and with groups, and tend to look down on individualistic societies, like the United States. To a foreigner, Dutch life can seem regimented. People keep very regular schedules. It is very possible to that today for lunch, any given Dutch person had either a croquette (a fried vegetable or meat patty) or a simple cheese sandwich. The Dutch drink copious amounts of coffee and tea all day and eat dinner at 6:30. When they finish they watch the news or go to classes for some kind of sport or hobby. Unlike Americans, Dutch people ask what outsiders think of their country—mostly because they love to talk about themselves. The biggest national holiday, Queens Day, is a group event; it is essentially a country-wide yard sale. As always in the Netherlands, space is a premium: people mob the streets and mark out small patches of territory with chalk in front of their houses for a table to sell what they have accumulated since last Queen's Day.

There are thirteen universities in the Netherlands—at least one in every province but two. All are under the auspices of the Ministry of Education, Culture and Research (*Ministerie van Onderwijs, Cultuur, en Wetenschap* or MOCW) except for the Agricultural University in Wageningen, which is a part of the Ministry of Agriculture. Universities are funded by what is known as the "three funding flows": the first comes from the MOCW, the second from the National Organization for Scientific Research (*Nederlands Organisatie van Wetenschappelijke Onderzoek* or NOWO), and the third from international and national government agencies, the private sector, and the not-for profit sector. Since 1992, universities have greater latitude to set their own policies and priorities—rather than the Ministries approving university budgets, universities receive lump-sum funding based on productivity benchmarks (van der Veen and Bakker 1999). The Board of Directors (*College van Bestuur* or CvB) receives government money and distributes it to university departments.

The Dutch government subsidizes university education generously, although not as much today as it did a few decades ago, when students could take up to seven years to finish their studies without penalty. Students earn a Drs degree (*doctorandus*) accepted internationally as a MA or MSc, in four and five year programs (168-210 credits, 42 per year).[14] Over the past several decades, university matriculation has declined significantly in the fields of chemistry, physics, and biology. There is a general feeling in the Netherlands that students are much more concerned than ever before with finding a secure, well-paying job when they leave university.

In 1998, the Ministry of Education spent NLG 4.1 billion out of a total of NLG 15.3 billion spent on R&D. Of the NLG 8.4 billion that companies spent on R&D during this period, most of the money came from the five Dutch multinational firms: Shell, Phillips, Unilever, DSM, and Akso-Nobel (MOCW 2001). In the last two decades, a decline in government funding of research has been tempered by an increase of funding from the private sector—which increased from 15% to 29% of R&D spending from 1980 to 1998 (MOCW 2001). Doctoral candidates perform research as ‘trainee research assistants’ (*Assistent in Opleiding* or AIO) financed by the first funding flow or ‘researchers in training’

[14] “On average 50% of the money students receive from the Dutch government is in the form of a loan, the other 50% is a gift (the maximum gift is about USD 350 per month). The total government support that students receive is below the social security bottom line, so they depend also on parental support or on the earnings from a part-time job. Students must use these various sources of support not only to pay their living expenses, but also their university tuition and fees. The government loan must be paid back after completing or discontinuing university study; the loan repayment schedule is capped at 10% of the recipient’s annual income, and the interest rate is fixed at ½ percent beneath the normal bank loan rate. If a student fails to pass a certain minimum number of exams each year, the government gift for that year converts irreversibly into a loan. Students are eligible to receive this combination of government gift-plus-loan for a maximum of four years, and not after they are 27 years old” (Mulder in Sclove, Scammell et al. 1998).

(*Onderzoeker in Opleiding* or OIO) funded by the second funding flow. OIO's do not have teaching responsibilities and are therefore able to spend more time on research.

University-based Initiatives for Democratizing Expertise

In the late 1960s when science shops started, university students were extremely concerned about issues including labor, the environment, sexual liberation, nuclear disarmament, housing, and peace. It was common for thousands of people to turn out to university protests. All this in the context of world events such as the Vietnam War and national developments like dismantling of the pillar society. Developments such as television and the birth control pill, and changing professional relationships, such as increased contact among science professionals, have been sited as evidence of a new level of idea exchange and lifestyle options that helped de-emphasize the differences between the pillars (Blom and Lamberts 1994; van der Horst 2001). Increasingly, people saw political choices as being more a matter of creating workable social policies, rather than, as they had been under pillarization, a matter of religious or ethical principles. With the breakdown of the pillar system a variety of new political parties entered into Dutch Parliament, with names such as Democrats 1966 (D'66), Radical Political Party (PPR), and the Pacifist Socialist Party (PSP) (de Voogd 1996).

As the escalating pace of industrial growth and the scientization of production processes put a premium on scientific and technical skills, industry looked to universities to supply them with graduates who had these skills (Bökkerink, Gerritsen et al. 1981; for an analysis of this in the U.S. see Noble 1977). The national government responded to this demand by drastically increasing its budget for university research and students. The percentage of the government budget going towards R&D went from 10% in 1955 to 23% by 1963 (Bökkerink, Gerritsen et al. 1981). The number of university students increased from 12,000 in 1936 to

122,000 in 1975 (Schermer and Stuart 1993). Between 1950 and 1970 alone, the student population tripled (de Voogd 1996). As the number of students increased, so did the percentage of them coming from middle or working class backgrounds. This influx of students, bringing with them a variety of material and social concerns, helped erode the longstanding tradition of elitism at the universities. Many students objected to the escalating consumer society that accompanied a period of unprecedented economic prosperity. (This trend was not unique to the Netherlands; for an analysis of this same trend in the U.S. see Mayfield 2000).

In 1963, students established the first Dutch student labor union (*Studenten Vak Beweging* or SVB). The SVB spoke out on issues such as student subsidies and the democratization of university decision-making. Students criticized universities as ivory towers working in the service of "Kapital" and unconcerned with the broad distribution of their primary product, knowledge (Nelkin and Rip 1979), although many realized the limitations to working through broader social problems within the context of their studies (Bökkerink, Gerritsen et al. 1981). On a massive scale, students formed leftist movements with names such as "The Kritical University" (*sic*) (Boekraad and van Nieuwstadt 1968) and "Anti-Imperialism," and joined social movements for labor, environment, women, disarmament, and housing (Bökkerink, Gerritsen et al. 1981: 19). Students organized en masse to democratize the administrative arms of universities. In Utrecht, for example, 10,000 out of 20,000 students belonged to the student union (not to be confused with the student labor union) (Weerdenburg 1999). Those who joined these movements expressed intense feelings about the urgency of social concerns that they applied to the democratization of everything about society, including social and cultural norms such as language.[15]

The range and intensity of political opinions is evident in the differences in the way these movements organized their critique of expertise. For instance, the Kritical University movement argued that it was only through a complete overhaul of the university's governing structure that science could be redirected to serve oppressed social groups (a representative model goal) (Bökkerink, Gerritsen et al. 1981). Others, directing their energies toward groups outside the university, reasoned that if science was controlled by Kapital, then scientists could do better than hawk science to fix social problems—they could work inside activist groups (attend protests and help present political demands) (engagement model) and, as some participatory-action researchers argued, collaborate with citizens in collecting and analyzing data (partnership model). Many searched for ways to incorporate their social critique into the scientific process:

> It should be clear…that we are not trying to transfer science to society without being critical of the way science is developed and organized and science policy determined.
>
> One way we do this is to criticize the monodisciplinary character of the way science deals with problems and its reductionist way of thinking. The other is to try to initiate research projects that are brought under one department but in which people in various disciplines work together. (Hofman and Bökkerink 1986: 58)

Those with this perspective worked with movements outside of the university, particularly with local activist groups organized around environmental and civic protection. In general, students and scientists were questioning both the use of scientific knowledge *and* its utility in alleviating social problems (as compared to other kinds of knowledge and action) (Ades 1979; Nelkin and Rip 1979; Dickson 1984).

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[15] As was also the fashion in radical political movements elsewhere in Europe and in North America, they eliminated silent letters and replaced "c's" with "k's", and "s's."

An emerging STS discourse helped fuel critiques of expertise (Boers and Rip 1979; Slaa 1979). Activists established lecture series and courses on "Science and Society" (*Wetenschap en Samenleving*) in natural science faculties around the country to debate issues such as the merits of "socialist science," "action research," and "project education." The lecture series and discussions spurred the formation of research groups such as "Chemistry and Society" (*Chemie en Samenleving*),[16] "Physics and Society" (*Natuurkunde en Samenleving*), and "Biology and Society" (*Biologie en Samenleving*). Goals of the STS 'movement' included:

- Democratizing the university; having students and teachers included in setting policy for the university
- Empowering those groups society has left behind; helping those groups in their political and social struggles
- Giving scientists an active role in social problems (Schaareman and Felix 1995: 11)

For instance, between 1965 and 1968, a lecture series on Chemistry and Society within the research group for chemistry at the University of Utrecht examined topics such as improving the image of chemists in society by working on socially responsive themes (such as environmental clean-up). Other groups organized experts to give presentations on themes such as chemistry and ethics and chemistry and air pollution, the goal being to open up the uses of chemistry in science policy to greater public scrutiny (Govers 1979). Bas de Boer, who was the head of the University of Amsterdam Science Shop for nearly fifteen years (the longest tenure of any science shop director to-date), discussed how the courses were meant to facilitate a discussion about the democratization of science policy:

[16] Rip and Boecker discuss the historical lineage of the social responsibility of scientist movement within the field of chemistry from 1918–1970: "The Dutch Chemical Society had, from its beginning in 1903, always taken a lively interest in the economic and social position of the chemist. The weekly journal of the society, Chemische Weekblad, devoted considerable space to the application of science and whether to socialize the chemical industry" (Rip and Boecker 1975: 459-460). In 1946, scientists created The Association of Scientific Research Workers (*Verbond van Wetenschappelijke Onderzoekers* or VWO) for the pursuit of goals such as "a deepening sense among scientific researchers of social responsibility with regard to the soundness of their work, to the choice of research and to the consequences of their activities for society" (i.e., representative model goals) (Rip and Boecker 1975: 463).

> One of the major issues at the time was biotechnology. What were the promises of biotechnology? What could it not deliver? Some people expected it would solve the world's food problems, but that is really a political issue about resources, not a scientific problem. The overriding question regarding new technologies was: should you leave decisions to the researchers who think everything will go well, or are these issues that society should decide? (de Boer 1998)

Although some wanted to change the way scientific knowledge is produced, mostly people who started science shops wanted to change the direction of scientific research and the availability of expertise to weaker groups in society.

The excitement, optimism, and frustration that the student movements generated across the Netherlands can explain both the variety of initiatives with respect to science and social responsibility, and the confusion regarding the origin of the first science shop—accounts differ, for example, as to whether the first science shop was the Chemistry Science Shop at the University of Utrecht or at the University of Amsterdam. Literally "science shops," their stated goal was to "mediate between academic researchers and [socially underprivileged groups] that would not normally have access to scientific research" (Zaal and Leydesdorff 1987: 310). Socially underprivileged groups were chiefly those who sought change through social movements—mainly labor unions, women's and environmental groups, but also groups struggling for affordable housing and against racial discrimination. According to Jan Weerdenburg, co-editor of two anthologies on Dutch science shops, science shops started out as modest student initiatives:

> You have to keep in mind, that the University of Amsterdam's first science shop was a *box*. A *cardboard box*. It was filled with a bunch of cards, and written on each was the name of an activist group and what sort of questions they had—these were our files. We took the box around with us when we went to ask scientists if they were interested in working with us. And when we wanted to work we would pick up the box and take it to an empty room. That was the science shop. (Weerdenburg 1999)

Similarly low-budget and appropriately Dutch, The Groningen Chemistry Science Shop's first facility was in a bicycle shed. As word traveled about initiatives at one university, people were inspired to join them or start programs of their own. Weerdenburg explained what led him to leave the University of Utrecht:

> In 1970 I started my studies in biology, but I was also taking courses in STS. When I heard about group of STS students in Amsterdam who were trying to start a science shop, I went there to see about working with them. I liked STS, and still wanted to be involved with it, but I thought it was too theoretical. I wanted to change society. Science shops seemed to be a way to work on applying the ideas of STS. (Weerdenburg 1999)

In 1970, students and faculty in the University of Utrecht Chemistry department were pushing their faculty to delve structurally into issues of chemistry and social responsibility. In March, five students and two staff members proposed an initiative called “Project Education” (*Werk Projekt Onderwijs*) to integrate socially responsible goals into the chemistry curriculum (Govers 1978). Three years later, even as the movement for democratization of the university itself began to wane, they won university approval for the “Working Group for Project Education” (*Werkgroep Projectonderwijs* or WPO). They begun publishing their own newspaper and attempting to organize a new research group for Chemistry and Society in which they debated issues such as Vietnam or the consequences of giving scientific information to the Suharto regime in Indonesia. The project eventually grew into the Utrecht Chemistry Science Shop (Govers 1978). Many early decentralized science shops started this way, as the culmination of different efforts to restructure academic departments around more socially responsible goals.

For the most part, the people who became involved with science shops were not anti-science. They sought broader distribution of scientific knowledge, rather than to dismantle state/science power.

> Most in us in the science shop movement had nothing against science. Science shoppers had a positivistic idea about science: science as an instrument for empowerment. It was about having a say in determining research questions [*onderzoeksvraagstellingen*]. (Weerdenburg 2002)

The mass democratization of university policy-making bodies, which gave students a strong voice in all aspects of university business, helped steer money and resources towards science shops. Additionally, the fact that the first science shops were in the natural sciences, helped science shops gain government and university recognition. Dominated by male scientists in the “hard sciences,” they had some leverage to argue for a change in science. Later, a number of factors— such as the expansion of science shops into the social sciences, increasing numbers of women, and demands from professionalization—made the issue of scientific credibility into a more of a concern for science shops. Debates within the science shop community, which were inherent from the beginning, reflected the uneasiness with which science shops tried to make this transition. For example, some argued that participatory action research was not real science (Hak 1981), while others argued that science shops “reinforce the power of expertise and science over client groups” because “a counter-expert is still an expert” (Hooghiemstra and van der Luit 1982). The Wageningen Science Shop, for example, became a science shop so they effectively criticize the science shops for being technocratic (Milieuwinkel Wageningen 1982; Dohmen 1999).

Government Support for Democratizing Science

Efforts to democratize expertise were often met with resistance from university administrations, but were for the most part tolerated—if only as a lightning rod to diffuse students’ anger (Rip and Boecker 1975: 471). Activists rode a wave of favorable governmental policy that was an outcome of the debates during the 1950s on economic policy. These policies, fashioned by a coalition of social democrats and liberal conservatives, recognized the economic and social advantages of having a highly skilled workforce in natural, technical, and social sciences (Hagendijk 2002). The 1960 Scientific Education Act

(*Wet Wetenschappelijk Onderwijs*) supported the vision of a socially responsible university: "Apart from teaching and performing research, [universities] have social responsibilities" (*maatschappelijke dienstverlening*) (Article 2.2).[17] In 1973, F.H.Trip, the first Minister of Science, issued a policy paper outlining his vision for conducting research according to social priorities (Trip 1974; Pennings and Weerdenburg 1987). In 1979, after the Ministry of Science became the Ministry for Education and Science, Minister A. Pais officiated at the "opening" of the University of Amsterdam Science Shop—activities had begun as early as 1970. In the same year, Minister Pais mailed the board of directors at all Dutch universities to voice his support for science shops. Universities, he argued, are obligated to take steps to democratize expertise:

> Undeniably, universities have an essential social function….the science shops serve social interest groups that, under normal circumstances, are limited in their ability to gain access to the knowledge potential of the university. I urge you to take steps to ensure that attention for these groups does not fall by the wayside. (Pais 1979)

Such government support lent credibility to the science shops and abetted the creation of others (de Ruiter 1982).

Two Varieties of Science Shops – Centralized and Decentralized

As science shops evolved into university offices, they organized in two different ways: *decentralized* science shops in single disciplines co-located with academic faculties and *centralized* science shops in multiple disciplines institutionalized as part of the university administration. Decentralized science shops first emerged in the natural sciences and later spread to social sciences and technical sciences. The centralized science shops tended to be more oriented to social science research. The different organizational configurations were thought to result in two different types of science shop methodologies.

[17] Translated in Rip and Boecker 469.

Based on the idea that members of decentralized science shops performed research—which they largely did in early years—many characterized decentralized science shops as adhering to a “participatory action research model (also called simply “participatory” or “action”) (Groenewegen and Swuste 1983). This would supposedly lead to more comprehensive collaboration between scientists and citizens, particularly within political arenas (engagement model) but also in scientific research (partnership model) (Hooghiemstra and van der Luit 1982). Advocates of decentralized science shops argued that scientists should take direct action in the political activities of clients by taking part in demonstrations, writing letters, and accompanying groups to meetings with local government functionaries (van Wijk and Blok 1982). Some argued that decentralized science shops, “stand closer to the client” (Hooghiemstra and van der Luit 1982: 5), the assumption being that because research would be done in-house, the science shop would be available for deeper collaboration with citizens. In general, adherents to the decentralized organizing strategy were interested in changing their disciplines from within and changing the experience of scientists.

Fig. 1. Illustration of a Decentralized Science Shop Advocate.
This illustration of a scientist/protester from the Utrecht Physics Science Shop (*Vrij Experiment Group Utrecht* or VEG) shows him holding up a report called ‘Measurements’ in front of a sign that says “VEG: The Action Model.” His pin says “Action” written in the alternative spelling that was popular during the student movements, with an “x” in place of “ct” (van Wijk and Blok 1982:18).

Centralized science shops were said to follow an "intermediary approach—they essentially matched clients to researchers (van Wijk and Blok 1982: 18). Advocates of centralized science shops argued that using their familiarity with the university to creatively translate social problems into multidisciplinary research questions, centralized science shops were better equipped to help interest groups move beyond traditional or entrenched ways of thinking about their problems. Advocates of centralized science shops wanted to make the university more accessible to the needs of social interest groups through one centralized channel (representative model). Former director of the University of Amsterdam centralized science shop, Bas de Boer, an outspoken critic of decentrally organized science shops, argued that all contact between the university and outside groups should be channeled through one centralized science shop:

> People tend to have a pre-set idea about what university discipline they need. Also, scientific experts do not necessarily question whether research in their discipline will really be the best way to solve a client's problem. At centralized science shops, employees are more experienced in a range of scientific disciplines and are knowledgeable about selecting a discipline—or disciplines—to best meet a client's needs. (de Boer 1998)

Proponents of centralized science shops also argued decentralized science shops would tend toward unidisciplinary or one-dimensional formulations of research questions, and thus would neglect multidisciplinary perspectives they argued better characterize most social problems (Hooghiemstra and van der Luit 1982: 5-6; also de Boer 1998). Also important to advocates of centrally organized science shops was that science shops infuse all university activities with an awareness of contemporary social issues and perform an "early warning function" or "antenna function"—they alert the university to social problems (de Boer 1998; Schlüter 2001)

While there were significant differences in opinions about the university position of science shops in the 1970s and early 1980s, they dwindled in the late 1980s and 1990s. As science shops sought to keep up with university changes, in-fighting among science shops dissipated in the face of a need to unite against budgetary cutbacks and accusations that science shops were no longer relevant (Lürsen, Mulder et al. 1999). The two kinds of science shops, decentralized and centralized, still exist, but the organizational difference has not led to automatic differences in science shops methodology (e.g. participatory vs. intermediary) (see Chapters 4 and 5).

Institutes for Socially Oriented Research

The Institutes for Socially Oriented Research (*Instituts voor Maatschappelijk Gericht Onderzoek* or IMGOs) began as a parallel endeavor to science shops. They sought researchers to work on behalf of certain social interests, but they proposed to do this outside of universities, with governmental support. This historical trajectory of the IMGOs relates to the work of two organizations, the Union of Science Workers (*Bond voor Wetenschappelijk Arbeiders* or BWA) and the Association of Science Researchers (*Vereniging van Wetenschappelijk Onderzoekers* or VWO). Students who had been a part of campus labor movements founded the BWA as a labor union for scientists. The VWO, an existing organization concerned with social issues regarding science,[18] started the STS magazine *Science and Society* (*Wetenschap en Samenleving,* later *Zeno,* and even later *Tijdschrift voor Wetenschap, Technologie en Samenleving*). Beginning in about 1974, the VWO and BWA collaborated to secure government funding for IMGOs (de Kool 1979b; Groenewegen and Swuste 1983). In 1978, a national foundation incorporated and set up four experimental IMGOs with money from the director of Science Policy at the Ministry for Science and

Education (Jacobs 1987). IMGOs were developing similar methods as the emerging university-based science shops and sometimes even worked with or through science shops to advise client groups. One difference between IMGOs and science shops was the IMGOs' stated goals for clients to “have a say in the research, not only at the level of managing it, but also at the concrete level of doing the research” (Jacobs 1987:52). “At IMGOs, the client is not so much king, as much as our partner in discussion” (de Kool 1982: 28). Partly as a way to distinguish themselves from science shops, IMGOs organized around four themes—occupational safety and health, agriculture, regional development regarding energy generation and environment, and mental health. Eventually, however, it proved too difficult to sustain two separate but similar organizational networks. The failure of the IMGOs to secure long-term government financing and their independence from universities forced them to merge with science shops or close (de Kool 1979a; Jacobs 1987).

Professionalization

When science shops were still small, non-professional organizations, they had a certain way of working. Run by volunteers, they would pick and choose research projects, often at the whim of volunteer interests or as a result of time constraints. The atmosphere of science shops was characteristic of the times, when, for example, animated debates were common and people were experimenting with all sorts of ways to challenge established norms. For example, the issues that preoccupied the Nijmegen Science Shop during the late 1970s and early 1980s are chronicled in meticulously prepared meeting minutes and annual reports—all written in the alternative spelling and only first names are used when referring to science shop workers. On her last afternoon at the science shop after fifteen years of work as a secretary for

[18] The two groups later merged and changed their name to the Association for Science Workers (*Vereniging van Wetenschappelijke Werkers* or VWW).

the Nijmegen Science Shop, Angela van Aalst described earlier efforts to create non-hierarchical, consensus-based organizations:

> No one could be in charge of the meeting because no one could have more power than the rest. Everyone was allowed a say in all the operations of the science shop. Even when we hired paid staff persons, the volunteers were supposed to have the same amount of power to steer the organization. It was a real, so-called "flat" organization, no hierarchy, no board, no chairperson or director; everyone was equal. (van Aalst 1998)

The disadvantage to running meetings like this was time:

> We had such long meetings because we discussed everything. The thematic group representatives[19] couldn't take a position without discussing everything with their groups. That took *so much time*. How awful! So much meeting time! (van Aalst 1998)

Science shop members were grappling with issues of process and product within science. Their records document what was important to them in their drive to make science practice less elitist and more community-oriented. Looking through the 1974 Nijmegen Science Shop Annual Report, van Aalst explains:

> The author describes the research, but not the results! Nothing about what the project delivered, what came out of it, and why the science shop took the project in the first place. They put so much care into explaining the research that they forgot to say anything about the impact it had on the client. (van Aalst 1998)

Volunteer organizations had a certain amount of latitude to dwell on such issues, even if it meant they were more focused on the implications science shop work had on the production of scientific knowledge, rather than on its implications for client groups.

Science shops naturally became more professional as they institutionalized at universities, a process facilitated by the work of conscientious objectors. During the 1980s, the Dutch government gave conscientious objectors the choice of working in many types of jobs (e.g., hospitals, non-profits, government agencies, municipal parks)—the main stipulation being that these jobs were not to be used for "career-building" (Mulder 2001). Conscientious

[19] The thematic groups are explained in Chapter 3.

objectors with scientific backgrounds chose to work at science shops, where they became a steady source of skilled labor. They helped science shops adapt to the changing university environment and write proposals to hire additional paid employees. With the aid of reliable, paid staff persons, science shops boosted their profile and credibility within Dutch university.

Criteria

A central debate during the development and professionalization of science shops involved what constituted *science shop questions*. Considerable effort went into answering this question. As science shops became more and more professional, it was increasingly important that the answer be clear to students, the university, and clients. If not, the worry went, science shops would be overwhelmed by questions that were ill-suited to address social inequities. These were very real concerns. For instance, scientists at science shops were often just eager to find a practical problem to which they could apply their expertise, and as long as they could help or find someone who could, they might accept a question. Loet Leydesdorff, a Science Dynamics (*Wetenschapsdynamica* and later *Wetenschaps- en Technologiedynamica*) professor at the University of Amsterdam and one of the founders of the University of Amsterdam Chemistry Science Shop, describes the atmosphere early on:

> All sorts of people knocked on my door. One man from the outskirts of Amsterdam came to tell me he was having a problem with his sundial. He wondered if someone from the university could help him fix it. I took him to a professor of astronomy, who thought this was fantastic. The three of us went to his place, and the professor fixed the sundial…
>
> …Questions, which had been just trickling in, started to increase. We had questions pending from a women's group about their indoor air quality and questions from neighborhood associations about soil pollution. It seemed like all of a sudden we had 40 questions and a debate with the university council about the kinds of questions we answer. (Leydesdorff 1998)

It became clear relatively early on that choices would have to be made about which questions served the most pressing social concerns.

Criteria helped science shops identify their target groups, communicate their mission, decide which questions to accept, and make sure their resources went to where they would make the most impact. Early versions of the criteria for clients were simple (though somewhat difficult to meet):

1. inability to pay for the research;
2. absence of commercial aims; and
3. ability to implement the results. (Leydesdorff 1985)

In addition to the three criteria for clients, some science shops developed criteria for deciding whether a research question was acceptable, or whether the researcher qualified for the project (Weerdenburg 1987)**.**

The interest in choosing a student who had a personal interest in the research reflects a concern for challenging conventional assumptions about autonomy and scientific researchers (part of the partnership model). Again, van Aalst on the conditions in Nijmegen:

> Early on, when a student came to do a research project, their background was considered as a factor for whether they would do the research. For example, for a research question from a women's organization on divorce, the science shop might prefer a student with divorced parents. I think the attitude has since changed—and sometimes even the opposite is true: an emotional involvement with the research subject might be a legitimate reason to turn someone away. (van Aalst 1998)

Specific criteria for researchers were never extensively developed or as widely uniform across science shops as were criteria mentioned above for choosing science shop projects. Personal compassion for the subject matter is but one factor that helps science shops generate student interest. Today, the problem is generally considered less one about challenging or maintaining objectivity than it is about finding a student who will be able to deliver a finished product that will help a client group pursue their own goals.

Like most everything else about the early science shops, these criteria were grist for discussion within and among science shops. For example, at one point, the Chemiewinkel at the University of Utrecht became very specific about how the results of the research would be used, stipulating that "the client must use the research results to organize people in their fight for a socialist society" (Hooghiemstra and van der Luit 1982: 5). Others objected that this placed too high of a demand on potential clients (1982). For the most part, criteria were a rhetorical tool for communicating science shops' purpose rather than a set of commandments. van Aalst described how the science shop used the criteria to weed out questions that were either not interesting to the science shop, or were not in keeping with the kind of goals they wanted to promote.

> If a question came in from a group that had a different worldview [*denkbeeld*] from the science shop, the science shop could always find a criterion that would justify rejecting the question. Sometimes, I think, this was manipulated. Today the criteria have been refined and are explained in our public relations literature. Part of professionalization was making the selection process clear. (van Aalst 1998)

The criteria served as a starting point to make sure the research question fit with the goals of the science shop and as an outreach tool to communicate with target groups. But even if the science shop accepted a question, whether or not research was performed still depended on personal interests.

Many early science shops were reluctant to take questions from well-financed (*draagkrachtige*) groups for fear of working for the interests of Capital. But by the end of 1980s, it was no longer expedient to limit questions to groups who could not pay for the research. Many organizations who were pursuing social change had money—refusing questions on the basis of ability to pay would force the science shop to ignore a whole sector of questions that were potentially very interesting to researchers and students. Furthermore, even for-profit firms supported social interests (e.g. products made from biodegradable materials or for elderly and handicapped people). de Boer describes the decision to accept some questions from for-profit entities:

> When a commercial organization came to the science shop with a question we would decline to answer it if we thought that it was purely for commercial interests. However—and this is because of our liberal view of the world—we still might have accepted a question from a group with commercial aims, provided their goal really was to solve a social problem. (de Boer 1998)

Nevertheless, he cautioned science shops not to ignore their responsibility to sound an "early warning signal" for social problems (de Boer 1999). When science shop work became more closely tied to students' thesis projects, this upped the ante on the need to create interesting research projects and led to further iterations of criteria and their implementation. Over time, the concern over exactly which student would do a particular project paled in comparison to the general problem of attracting students to science shops in the first place. The problem only worsened as the political climate became less sympathetic to activist organizations. Some science shop coordinators took this as an opportunity to develop into consultancy organizations (see Chapter 5).

The University of Twente Science Shop responded to conflicting pressures—the desire to support social responsibility in the private sector (e.g., environment, minorities, elderly, children, handicapped, etc.), the need to keep questions coming into the science shop, and the need to develop questions that interested technical students at their university—by developing criteria specifically for the private sector. Coordinator Dick Schlüter developed a new list of project selection criteria. First, he elaborated on the original science shop criteria to better communicate the science shop purpose and niche:

A. The client does not have the expertise to undertake the research
B. Clients (or groups for whom the research is directed) must be able to use the results of the research to solve an underlying problem
C. Efficient cooperation between researcher and client must be possible
D. The client must be prepared to work on the research

E. Only clients who do not have satisfactory means available to do research or to commission research qualify
F. The goal of the research must be consistent with the goals of the science shop
G. The research should be compatible with the knowledge, skills, or means that are available at the University of Twente
H. Questions must be interesting from a scientific perspective and the results should contribute to solving the general problems which prompted the question (Schlüter 1997: 5)

He also wrote criteria for questions coming from small to mid-sized commercial entities. If a question originated from a company, it could be taken based on the following criteria:

A. The product's contribution to sustainability
B. Its environmental friendliness
C. The developmental stage of the company (preference is given to companies in early phases of development)
D. Contribution to regional employment
E. Contribution to an ongoing issue in the region
F. The potential contribution to problem-based education at the University of Twente
G. The company's profit margin
H. The number of employees (Schlüter 1997: 6)

This effort to develop criteria for supporting social responsibility has not been widely adopted by science shops although today most do accept questions from the private sector.

The transition to science shop projects from private companies brought its own set of problems. Even when private companies develop a product with socially responsible ramifications, such as organic dairy products, the information is still proprietary. Historically, all science shop research has been required to stay in the public domain. Schlüter sees this as a minor problem:

> If a company requests the research stay private, we have two choices. One is to publish one report for the client, and a different one for the press. Otherwise, we do what we call an "embargo"; we wait to publish the final report for a year or two, when it is no longer necessary to keep the information from the public domain. (Schlüter 1999)

Also, the new science shop focus generated some confusion because of perceived overlap with a transferpoint—a university organization dedicated to developing contract research from private firms (discussed below).

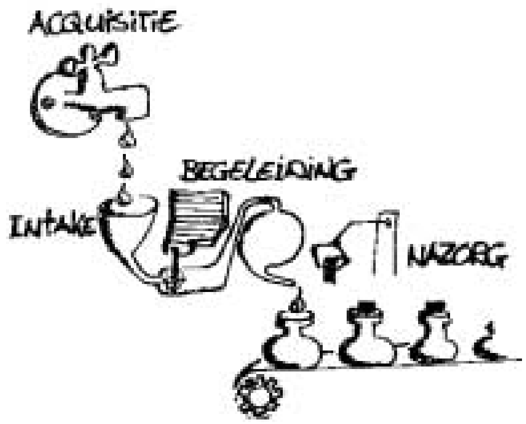

Fig. 2. Graphic Depiction of the Science Shop Process.
From left to right, “acquisition, intake, mentoring, aftercare.” From “The Way to more Technical Projects (De Weg Naar Meer Technische Opdrachten), a student report commissioned by the University of Twente Science Shop (Klooster and Paauw 1994: cover design).

Intermediation

Increasing professionalization led science shops to develop unique internal procedures. What they do became more widely known as “intermediation,” done by “intermediators.” Instead of performing research themselves, intermediators tailor research projects to the interests of students, all the while keeping an eye on what information (and what form it is presented in) would best serve the client, what can realistically be accomplished in a student project, and what can reasonably be expected in a relatively short time-frame. Through internal developments at science shops and by way of national discussions, science shops fleshed out this process, taking care to build in flexibility. It became common practice for the science shop to work by setting up a steering committee (*begeleidings commissie*) of the student, faculty advisor, and members of the client group. The advisor would be there to vouch for scientific credibility and ensure that the research trajectory was consistent with current practices in the field. Jan van Diepen, a conscientious objector at the University of Twente Science Shop, explains: “The faculty advisors helped elevate the quality of the student reports, while we became intermediaries” (van Hattem 1996). This way, science shop work became more wholly integrated to the academic curriculum (representative model) and science shop coordinators had more time to assess the bigger picture of how the science shop report would fit into their clients’ work (engagement model). As mediators, science shop staff persons were in a better position to draw the client into the research (partnership model), as opposed to students, for whom it is more difficult to make contact with groups outside the university. This also made it possible to do more science shop research projects, because students who did not necessarily have an interest in helping client groups could still do science shop research.

Another effect of professionalization on intermediation was that science shops began publishing annual reports. Most begin by giving a quantitative overview of the science shop: How many questions came in during the past year?, How many led to research questions?, and How many were referred, retracted, or refused? The reports often describe the organizational structure of the science shop and their advisory boards. Some annual reports present details about research projects, while others just list the projects as an appendix, along with the report titles and availability through the science shop. Annual reports are used internally at the university to gain support for the science shop—especially within the administration. Often, the reports are sent to science shop clients or perspective clients, and they are a good way for the science shop to publicize themselves and their research accomplishments. One difficulty most science shops have with the annual report is often the quantitative information does not adequately capture the science shop’s accomplishments, especially in a way that lends itself to analyzing science shop trends. For example, the science shop may print the number of research reports finished within a single year. Quirks in timing can make these numbers appear disproportionately weighted to a given year (see Fig. 3). Nevertheless, the annual report is one of the most important public relations materials for most science shops.

Tabel 2.

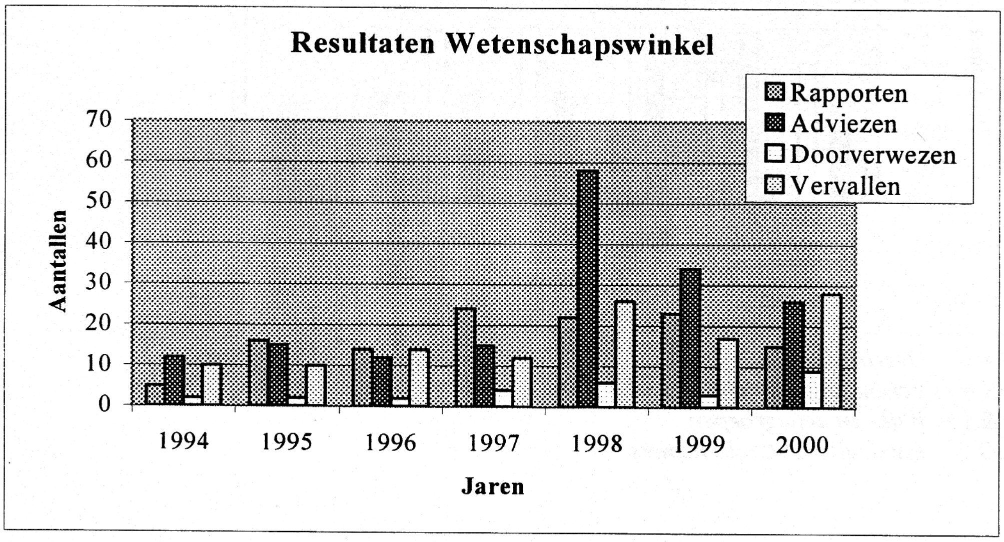

Fig. 3. Graph of Activity at the University of Twente Science Shop.
From top to bottom, the graph reads Reports, Advice, Referrals, and Lapsed (Twente Science Shop 2000 Annual Report).

Eventually, employees recognized the need to be proactive about finding research questions (Wetenschapswinkel Maastricht 1989). Previously, science shop employees had brought questions to the science shop by way of their own personal activism in social movements. Yet when staffpersons such as conscientious objectors started running the science shops, they did not necessarily have the personal ties to the community or to community groups (de Boer 1998). The job of being a science shop worker transitioned into that of intermediator, university networker, marketing director, student mentor, and client confidante. Employees conducted informational sessions for targeted community groups, contacted media organizations at the end of research projects on a regular basis, networked in national umbrella organizations, and reached out to client groups they thought might bring more interesting questions to the science shop. By the 1990s, some science shops even organized around specific government policies they suspected would be relevant to area interest groups.

To sustain a high number of incoming questions and research projects, science shops began advertising their services in new ways. Previously, science shop questions developed by word of mouth or by personal connections. Advertising questions led to problems that the science shop criteria could not always mitigate. Hajo Broersma, a professor of applied math at the University of Twente and volunteer member of the science shop's Managing Committee (*Dagelijks Bestuur*), explains why he discouraged advertising to generate more incoming questions:

> Advertising leads to irrelevant questions. If it *was* relevant, it would have already been asked. Faculty members do not have time for silly questions—they are concerned with output. They have little time for scientific problems that do not lead to publication. (Broersma 1999)

Whether or not they agree with this perspective on advertising, many share the frustration of trying to attract relevant questions, or what might be idealized as "real" science shop questions. This is a problem that has never gone away. In 2001, Jo Haesen, an intermediator at the Maastricht Science Shop, drove past a neighborhood renewal project in Maastricht, where he pointed out a shopping street whose small merchants could be put out of business if a larger shopping mall were to open nearby. His science shop is helping a neighborhood association protest the shopping mall in the context of local economic development. Explaining the science shop project, Haesen captured a perennial science shop paradox:

> This is a very typical science shop project. But only half of our projects are typical science shop projects. (Haesen 2001)

Science shops have struggled to balance the demands of maintaining a steady stream of incoming questions, producing work that is relevant to social issues, and creating research projects that are interesting to scientists and students.

Every science shop struggles with what to do when client questions do not match science shop criteria. Sometimes they are rejected or referred, other times they are accepted because they in some way increase the science shops' numbers (of clients, of reports, of students, etc.). Despite their allegiance to social goals, many science shops come under pressure to accept questions with less pressing social implications. Students are increasingly attracted to high-paying internships at multinational corporations. Some even see their internships as a more effective way of contributing to the social good. Christine Mourits, a student in Maastricht explained the attraction to corporate internships:

> At the science shop, you have to do so much yourself. You are responsible for setting up a project and for doing the research. I don't see much use for this kind of work in my future. I was paid for my work at the science shop, but I could have earned a lot more at a company. Besides, at companies, you get to work on social problems at a bigger scale. (Mourits 1999)

Mourits' view reflects a change in the definition of "social problems" from the 1960s and 1970s to the 1990s and 2000s.

With professionalization, science shops also had to be more concerned with how their scientific credibility was perceived, both at the university and among their clients. Credibility was important to attract sufficient scientist (as mentors) or student (as researchers) interest. Perceptions about their scientific credibility were also critical for helping their client groups, especially in circumstances when the science shop research would be used in a political controversy. Credibility, however, was not only based on academic performance but also on other measures of productivity, such as number of students, number of clients, and number of final reports.

In addition to mediating questions from outside clients, some science shops receive university money to conduct their own research. This gives them the flexibility to choose the themes on several research projects per year and conduct research that is often higher quality than student research. Some decentralized science shops have worked with Ph.D. researchers in the past, but this is by far the exception rather than the norm. The centralized science shop at the University of Brabant in Tilburg, regularly mediates Ph.D. research projects.[20]

In the changing political climate of the 1980s and 1990s, it was not enough for the science shop to show its contribution to what had been mandated in the university charters as social service (*maatschappelijke dienstverlening*). Universities were now asking them to demonstrate their contribution to the universities' educational mission. This was not difficult—like "service learning projects" or "problem-based research," science shops have myriad educational benefits such as real-world experience, broadening worldview, and improving students' communication skills. However, universities were also cutting back on education subsidies: students were now being asked to complete their studies in four to five years, whereas they previously could have up to seven years of government support. They now had less time to spend on extracurriculars—so if they wanted to do science shop

[20] This is the result of an administrative decision in 1984 to give the science shop money to mediate long-term research projects. The money also finances 6-month preliminary inquiries intended to lead to Ph.D. proposals. Usually, the science shop does this by providing matching funds to university departments to pay for the researchers, but in the past the science shop has also partnered with institutes and municipalities. In 2001, the science shop received 135,000 Euro for Ph.D. research projects, and had eight long-term projects and one preliminary project underway in topics ranging from theology ("The changing nature of marriage ceremonies: a study of interculturation of an ritual") to ecology ("Reduction of groundwater use in North Brabant") to law

research, they were more pressed to do it as part of their academic curriculum. Also, with the Dutch government institutionalizing many of the goals of the earlier social movements, students felt a decreased sense of urgency about political issues. Hajo Broersma explains the difficulties encountered at the Technical University of Twente:

> Science shops were suited to the '70s idealistic climate. But interest cooled off and today science shops have to carve their own niche. They have been important to a small number of students who are interested in social problems. But this is a technical school and you have people—a stereotype, perhaps—who are just interested in technology [*techniek*]. Students in applied education, management, natural and social sciences like to use the science shop projects as real cases. Yet professors are not that interested and it's difficult to spin a project in the context of the normal curriculum so that it fits the needs of the students and still helps the clients. (Broersma 1999)

These factors combined to make it more difficult to address their client needs through research projects. Even though science shops offered an avenue for students to complete their degree requirements, they were competing for a shrinking amount of students' time for and interest in political activities (Sclove, Scammell et al. 1998).

Dutch Science Shop Forum

The Dutch Science Shop Forum (*Landelijk Overleg Wetenschapswinkels* or LOW) formed in early 1980s to facilitate communication among different science shops. Because of the geographic proximity of the science shops, representatives of all science shops could meet regularly. Early on, meetings reproduced the intense debates that occurred internally at science shops. But they also enabled science intermediators to collaborate. They exchanged stories and strategies about maintaining university support, surviving university cutbacks of the 1980s and 1990s, generating student interest, and just about every other aspect of science shop work (Bökkerink and Weerdenburg 1991).

("The role of environmental organizations in the administration of European and international environmental law") (van der Avoird 2001; Wetenschapswinkel Tilburg 2001).

One significant discussion at the LOW in the late 1970s and early 1980s concerned the changing role of women, in society and at science shops. Science shops expanded at the same time that the women's movement was encouraging women to take on more diverse public roles. Many of the first women at science shops entered through the field of women's studies or as a result of their activities in the women's movement—it was only later that women became part of science shops in natural sciences and engineering. But as women became science shop coordinators and began attending LOW meetings, they encountered some of the same chauvinism they were fighting in other arenas. They were vexed by what they perceived as a tendency for men to engage in science shops only as far as setting up an infrastructure, rather than performing the practical work of sustaining an organization and research projects (Fokkinga 1999). They worried that the work of science shops was being devalued as women took over coordinator positions, just as this has tended to happen in other professional fields (telephone operators, for example). As the number of women coordinators increased, science shops became more conscious of the need to address sexism within their own organizations, and tried to use the LOW to collaborate on research projects. Marja van den Sigtenhorst, former director of the Leiden Science Shop, explains why the LOW women established their own national forum:

> The whole idea of science shops was something set up by men, the entrepreneurs. They had been involved in science shops at the policy level, both at the universities and at the national level. At a certain point, women in the LOW became frustrated with this macho culture. There was poor communication and not enough collaboration. The purpose of the women's group within the LOW was to overcome these problems within science shops, and also to collaborate on emancipation research across different science shops. (van den Sigtenhorst 1999)

In the 1980s, the balance of science shop coordinators tilted in favor of women, although the numbers balanced out in the 1990s and early 21st century. The LOW forum for women eventually stopped meeting.

The LOW continues to meet every two months for one afternoon in Utrecht. Depending on the sciences shop, it can take up to three hours by train for a coordinator to attend the meeting. Usually scheduled for the afternoon, the coordinators meet for several hours and then convene to a nearby bar for a drink and conversation (*borrel*). Henk Mulder, co-coordinator of the Groningen Chemistry Science Shop explains the significance of the LOW:

> It's standing strong together, feeling that you are not the only one in what you are doing, a chance to test new ideas and hear new things. Especially over the last few years, people seem to be bringing a lot more positive energy. Before that, it was more like “realo's” and “fundi's”—different factions and ideologies. They focused on differences rather than similarities. Still, it could be stronger. (Mulder 2002)

Although collaboration among science shops has evolved into more of a constructive, strength-in-numbers approach, the LOW still has difficulty collaborating on issues outside of the daily experience of science shops. Dutch science shop involvement in international organizing, for example, is more the work of a few individuals rather than the LOW as a whole.

Fund for Socially Relevant Research

It is interesting to note the singular circumstances at the University of Amsterdam Science Shop that led to efforts to expand client-based research from the science shop into a broader program for the university as a whole. This is, at least in part, due to the strong influence from the trade unions, and to a lesser extent, environmental and third-world developmental groups (Leydesdorff 1980a; Leydesdorff 1980b; Koopal 1988). Between 1976 and 1985, for example, questions from labor groups totaled an average of 21% of the University of Amsterdam (central) Science Shop’s questions (or 495 out of 2285) (Koopal 1988). Unions in general were well-organized and had made progress in terms of taking on a greater role in setting science shop policy—the Federation of Dutch Trade Unions (*Federatie Nederlandse*

Vakvereniging or FNV) had a representative on the science shops' advisory committee. Despite this increase in access, the trade unions were increasingly critical of the science shop. In 1981, the FNV issued a report documenting some concerns they had with the ability of science shops to fundamentally change university research and provide labor unions the desired amount of access to university research. Specifically, they complained about the long waiting period to initiate a science shop research project, the waiting time for the actual research, and that they were having better results by working directly with faculties. The document articulated a broader goal: to develop an organizational structure at the university that would improve collaboration between trade unions and faculties and increase access to scientific research (Koopal 1988).

The university reacted by setting a goal of directing 15% of the university research budget to "socially relevant research." The Fund for Socially Relevant Research (*Fonds voor Maatschappelijk Gericht Onderzoek* or FMO) was established to carry out this policy. Although the fund never reached quite as high as 15% of the university research budget (which would have meant the equivalent of 120 full-time staffpersons), it did manage to hire 16 full-time equivalents (FTE). The Advisory Committee for the Fund for Socially Oriented Research (*Commissie voor Advies Fonds voor Maatschappelijke Gericht Onderzoek* or CAFMO), which also had union representation, was charged with dispensing money to fund research by criteria very similar to science shops; research partners would be groups with limited access to scientific research, with no commercial goals, and no means to commission professional research (Koopal 1988). CAFMO funded several interdisciplinary research projects (one on welfare, labor movement and social security, another on public health) as well as many longer-term projects, such as the development of the Electronic Fund Transfers System (which was considerably publicized—in 25 reports and articles). Unfortunately, this important experiment to broaden the university's fiscal commitment to socially relevant research ended during a series of drastic budgetary reductions between 1984-5 (Hagendijk 2002).

Transferpoints

Toward the end of the 1970s, universities founded transferpoints (*transferpunts*) to stimulate regional and international economic development by increasing knowledge exchange with commercial companies. A landmark report published in 1987 noted the importance of transferpoints in technology transfer (Adviescommissie Voor het Uitbouw van het Technologie Beleid 1987). In some ways, transferpoints mimicked the science shop idea, albeit with a different base, insofar as they were though to mediate between university and actors and for-profit entities. Many science shops were asked to merge with transferpoints at their universities, or at least ask their client organizations to cover costs, like the transferpoints. For the most part however, science shops resisted. Eventually, transferpoints either closed or merged with other university offices.

Downsizing

During the 1980s and 1990s, the number of students enrolled at Dutch universities grew steadily, from around 100,000 in 1970, to 175,000 in 1980, to upwards of 250,000 in 1990, and reaching 350,000 in 2000 (Centraal Bureau voor de Statistiek 2001). Yet over the same period, changes in political climate put increasing strain on science shops. Universities cut back on student subsidies that had allowed undergraduates to take more (sometimes much more) than four years to complete their studies. As the student movements subsided, it became less common for students to view their university studies from such a politicized standpoint as they had in the past. University administrations put pressure on science shops to recoup some of their budget by charging clients or by taking questions from commercial organizations (Ree 1996).

The Zeeland Science Shop, the first science shop to close, was also the only science shop in a province (Zeeland) without a university. The Ministry of Education provided four years of start-up funds to this science shop, after which they were supposed to find funding from other sources: trade schools, the province, or the private sector (Dohmen 1999). It was originally incorporated as an Institute for Socially Oriented Research (IMGO), and although it had ties to two universities, the Agricultural University of Wageningen and the Erasmus University in Rotterdam, they were far away and besides, each was already financing a science shop of their own. Also during this time the trade schools (*hoger beroepsonderwijs* or HBOs), which were considered as a potential science shop sponsor, were in the midst of a complete reorganization; although the administrators supported the science shop idea, they had no time to develop the idea into a physical presence at the schools. Marijke Dohmen, a young graduate at the time, was hired to help start the Zeeland Science Shop in a place they thought was very accessible to the public, the public library.

> All my time was taken up with practical arrangements and lobbying. I never even got to the part about reaching out to prospective clients. We struggled so hard just to find a place to work, one that might lead to future sources of support, that we hardly had time to do the work that a science shop was supposed to do. (Dohmen 1999)

When the four years of Education Ministry funds were depleted, the science shop had no other permanent source of funding, and closed.

Unlike Zeeland, the University of Leiden shook the science shop and university community—“like a bolt from the blue” (van den Sigtenhorst 1999)—with its announcement, in March 1996, that it was rescinding the science shop’s NLG 800,000 budget. The science shop had been very popular in the university community and among its clients. But faced with a directive from the national government to cut costs, the university determined that the science shop was not a part of its "core-business:" education and research. Although this seemed outrageous to the science shop and their clients, administrators argued that the academic faculties were already conducting research with a socially responsible slant (i.e., the university had already become a good representative model organization). Marja van den Sigtenhorst, one of the coordinators of the Leiden Science Shop at the time, describes some of the events that happened just after her science shop celebrated its 15th year anniversary, in September 1995:

> It came as a complete surprise. In the end, though, I might have seen it coming—I was not networked very well in certain administrative circles where policy was decided. We organized protests to keep open—a letter-writing campaign from the faculty and our clients, newspaper articles—but the only thing to come out of them was the creation of a task force to decide how our NLG 300,000 research budget could be redirected to serve similar needs. When we heard that, we knew it was basically over. People started applying for other employment. The task of eliminating an organization is made that much easier when there are no employees left to eliminate. (van den Sigtenhorst 1999)

Years later, science shop employees familiar with the Leiden case continue to express surprise and sadness of the loss of this science shop, which by many other measures (budget, number of reports, community recognition) had enjoyed an unprecedented level of success.

In contrast to the Leiden experience, the Groningen Chemistry Science Shop (Chemiewinkel) had just enough time to organize in opposition to the University administration's announcement it was discontinuing financing. In 1990, Karin Ree, the director, was informed of university cutbacks which would eliminate the main subsidy for the Chemiewinkel, and further, that the Department of Chemistry had no real interest in continuing their support of the science shop. But the chemistry faculty *did* support the science shop and it helped convince the Chemistry Department otherwise. So did one of the Chemiewinkel's frequent client, an environmental group (Wadden Association). Together, they divvied up responsibilities for a protest: the Chemiewinkel would campaign within the university and the Wadden Association would mobilize regional support. Letters poured in—from the research group for Energy and Environmental Studies, other Groningen science shops, Chemiewinkel clients, local municipalities, county health departments, political functionaries, and university students. A professor of Energy and Environmental studies, explaining why the Chemiewinkel should remain open, wrote:

> Our faculty has an intensive working relationship with the Chemiewinkel, based on the structural and lasting presence of this shop in the Department of Chemistry. This is in part based on cooperation with respect to collaborative work on long-term research projects, and in part because of a communal interest in questions concerning actual social questions in chemistry and environmental studies. These complementary research projects are a worthwhile part of the broader chemical expertise of the Department of Chemistry. We urge you to support the enduring and structural presence of the Chemiewinkel in the Department of Chemistry. (Biesiot 1990)

Local, regional and national newspapers published news and opinion articles about the threatened science shop (Staff Reporter for Nieuwsblad van het Noorden 1990; Staff Reporter for Trouw 1990; Vermij 1990). A local radio station interviewed Ree and urged people to write postcards to the university in support of the Chemiewinkel. One postcard reads:

> The Chemiewinkel has to stay. Science is nothing without society, society is nothing without science. We as people must work to preserve the opportunity to do science that serves us. (Griep 1990)

And another:

> Just about every environmental problem has something to do with chemistry. We need to open more organizations that can provide neutral and expert opinions on the basis of chemical knowledge, not close them down. (Unknown - illegible 1990)

Ree was to have been fired on January 1, 1991, but in the end, the Department of Chemistry renewed Chemiewinkel funding for another four years. Ten years and almost a thousand projects later, Ree was still working at the Chemiewinkel.

In 2000 and 2001, the science shops at the University of Delft and University of Nijmegen became the next targets of university downsizing. Both became vulnerable after their longstanding directors left the science shop.[21] Brigit Fokkinga, former director of the Nijmegen Science Shop, reflected on the university pressure to close the science shop and recalled her science shop's history in phases:

> First there was the beginning and first ten years, which I call the "ideological phase." The shop was very strongly connected with the local social movements and had a political point of view on issues. Everything was about power differences. The science shop was even located in a building downtown.
>
> The next ten years, when I was there, was more about building an organization within the university, and trying to adapt without losing identity. We did this by taking a marginal position—by not asking for too much but being creative about generating resources. During these years we became a professional organization.
>
> Then we come to the third stage, if you want to survive and evolve it is necessary to find alliances with other organizations within the university. Our strategy was to try and work together with others. First, we tried this by becoming a part of a department called "University and Society" but that group turned out to be too loose of a federation to survive. Next we tried partnering with the department for Communications and Marketing, but there we found the opposite extreme; the mainstreaming was so strict that we would have lost all our identity.
>
> All of this has to do with a change in the political climate. The professional phase fit in a period of integral management and decentralization. Last year there was a dramatic switch when two new people came on the university board. Everything is now about centralization, control, and core-business. The fall of the science shop has nothing to do with the quality [of the work] but everything to do with the political climate. (Fokkinga 2001)

Fokkinga's story echoes the predicament of many science shops: regardless of the quality or quantity of the work they produce, their survival at the university is dependent on political variables that are often beyond their control.

[21] Brigit Fokkinga, of the University of Nijmegen, left to pursue other career options. Joop Busquet, of the Delft Science Shop, died unexpectedly in 2000 of a heart attack.

International Cooperation

The most curious development in the science shops is that at the same time that the Dutch science shops have been struggling to survive, they have found a following that now extends around the world. During the 1980s and 1990s, the Dutch science shop idea inspired activists beyond Holland—even in the absence of published training manuals, formalized policy recommendations, or organized dissemination of information. Emissaries from various countries visited the Netherlands to gather information to form their own science shops, but were hindered by a lack of contemporary empirical research, the scarcity of (English language) articles, and time constraints of the science shop coordinators. Nevertheless, as a result of the visits, similar organizations in Europe, Canada, South America, the Middle East, Asia, and Australia cite the Dutch science shop example as their inspiration (Leydesdorff and van den Besselaar 1987; Shulman 1988; Irwin 1995b; Sclove 1995b; Gaffield 1997). Every foreign visit to science shops has, to date, resulted in the establishment of a science shop in that country (Mulder 2002), although not all attempts have been successful (Franck 1983; Stewart 1988; Bammer, Emery et al. 1992).[22] Educators in Korea (Chonbuk Science Shop 2002) and Australia (Shopfront 2002) have recently opened science shops.

Another remarkable development is Dutch efforts to create science shops in other countries. The University of Utrecht Chemistry Science Shop secured funding from the university administration and the chemistry department to finance student exchanges to the Czech Republic (Fokkink and Mulder 1996). Later, under a program to fund scientific and technical development in the former East Bloc countries, the Dutch Ministry of Housing, Physical Planning, and Environment provided seed funding for a science shop in Romania

[22] For a comparison of Dutch Science Shops to organizations that practice community-based research in the United States, see Sclove, Scammell et al. 1998; for an inventory of these efforts in Europe, categorized by type see Gnaiger and Martin 2001.

and another in the Czech Republic, both matched by funds from local universities (Absil 1996; Mulder 1997). The Czech Republic attempt did not make it past initial planning stages, but in 2001 two Romanian Science Shops were open—though struggling to retain university funding.

The International Science Shop Network is another promising development. At a gathering in April 1999 in Innsbruck, Austria, that gave momentum to the international network of science shops, science shop coordinators from Germany, Austria, and the Netherlands met to discuss their own work and possibilities for future collaboration.[23] The contacts that were made at this meeting led to a European Commission project—the Study and Conference on Improving Public Access to Science through Science Shops (SCI-PAS 1999). The project, led by a consortium from science shops in the Netherlands, Denmark, Northern Ireland, Germany, Israel and South Africa, as well as The Loka Institute in the United States, published eight reports in 2001. In January 2001, SCI-PAS held a conference in Leuven, Belgium, attended by 106 people from nineteen countries in four continents. Later that year, SCIPAS issued seven reports, on operational options, successes and failures, training programs, development of an international science shop magazine, development of a public internet database of science shops, and the impact of science shops on university curricula and research.[24] The intention of the network is to become a spawning ground for new science shops and new ideas regarding them. Beyond cross-fertilization of knowledge, however, this network may be an important resource for sustaining an identity among science shop workers that will help add legitimacy to their work as a professional career. Although its submission to a subsequent funding round was not accepted (de Bok 2001a; Living

[23] I also attended this two-day meeting.
[24] All of these reports can be accessed at the International Science Shop Network's website, Living Knowledge. See www.livingknowledge.org

Knowledge Europe 2001), the international science shop network is organizing a second funding proposal. In the meantime, a consortium of five science shops from Austria, Denmark, Germany, Spain, and the United Kingdom—who met as a result of the SCIPAS study and conference—received European Commission funding for a comparative study in 2001 called Improving Interaction Between NGOs, Science Shops, and Universities (INTERACTS). The INTERACTS study proposes to interview current and potential science shop clients from different countries to improve collaboration between small to medium NGOs and science shops (Jorgensen, Gnaiger et al. 2001). The connections made as a result of the first international network of science shops' project clearly illustrate the value of this network for improving science shop work and expanding collaboration.

Conclusion

Starting in the early 1970s, science shops formed and quickly spread to universities around the Netherlands—since the beginning of science shops, every Dutch university *has had* a science shop. Activist students and scientists started science shops because they wanted to change the practice of science within universities and they wanted to give the weakest actors in society access to science. These issues were widely popular on university campuses and science shops did not have to expend much effort to engage scientists in social problems. Over time, however, the university climate changed. Science shops became professional university organizations, and rather than provide clients research on a volunteer basis, they organized around providing educational experiences to students. They developed organizational strategies (such as intermediation) to keep the work intellectually stimulating and to survive the university climate. Political pressures and the demands of professionalization changed science shops; one notable sign of this is that today, within certain science shop-imposed restrictions, many shops do projects for groups that have commercial aims. Two other organizations, the Institutes for Socially Oriented Research and transferpoints, had an impact on how people understood science shops and their ability to maintain university funding. At the University of Amsterdam, faculty and students tried to expand the idea of socially relevant research to a university-wide initiative but this did not survive budget cuts in the 1980s. The student movements’ success at democratizing university policymaking helped steer additional resources to science shops. By virtue of their ability to be flexible, many science shops weathered severe social, political, and economic pressures, while others did not, and closed. The irony in this is only magnified by the spread, in the 1990s, of the science shop idea to Australia, Africa, Europe, Asia, and the Middle East. International developments have potential to bring about a change both in both science shop practices and how their work is perceived.

CHAPTER 4: Centralized Science Shops

In this chapter I present three case studies of projects done at the centralized science shops of Nijmegen, Twente, and Maastricht. This chapter begins with an overview of centralized science shops and an explanation for why I chose the particular science shops to study. Next, in a section on intermediation, I give a general outline of the commonalities of intermediation at each science shop. For each case study, I discuss the basic characteristics of each science shop—where it is located within the university, (physically and organizationally), revenues, expenses, staffpersons, and so on. I follow the process of intermediation through one science shop research project. The case studies in this chapter are intended to illustrate what the centralized science shops mean when they refer to the practice of intermediation. A discussion about how science shop work maps onto the three models of expertise follows each case study.

Centralized science shops are housed in some part of the university administration.[25] This is different from decentralized science shops, which are housed within academic departments. Of the eight centralized science shops in the Netherlands, I chose three to illustrate a range of centralized science shop practices. The Nijmegen Shop mediates questions in the social and natural sciences and is organized by thematic groups spanning multiple university disciplines. The science shop is unique because it works with a large number of student researchers and volunteers. Their work has changed over time, yet their operations have preserved a lot of the character of early Dutch science shops. I review a research project that grapples with the

[25] Rotterdam is an exception. Severe university cutbacks in 1997 almost forced the science shop to close. The School for Humanities and Social Sciences gave an office to the centralized science shop to allow it to stay open. Their budget went from NLG 380,000 to 80,000. (Kemeling 1998).

effects of globalization, particularly the issue of immigrants in terms of a multicultural society. Nijmegen is comparable to the Delft Technical Science Shop, which is also organized by thematic groups.[26] The organizational procedures at this science shop document the brainstorming, false starts, and indecision during intermediation. The Twente Science Shop mediates questions in both the technical and social sciences. It provides a good comparison to Eindhoven, which is a technical university with decentralized science shops (discussed in Chapter 5). This shop exemplifies some of the challenges to adapt to the changing mission of Dutch universities—regional economic development and in this case, what the university calls “the Enterprising University.” I review a research project that exemplifies the role of expertise in cases where activist groups seek greater input in redesigning local communities. The Maastricht Science Shop mediates questions in the social sciences and medicine. Each of the four staffpersons is assigned to mediate projects in a different area: economics, law, social sciences, and health sciences (including medicine, pharmacy, and health policy). The case study for this science shop is important because it is an exception—it illustrates what can happen when a science shop project hits a political nerve.

As discussed in Chapter 3, in the early debates on science shops, centralized science shops, also called “mediating science shops,” were thought only to facilitate scientific research at the bequest of client groups (representative model), while decentralized science shops were seen as more willing to take on political tasks within client groups or even take on client groups as research partners (engagement and partnership model) (Hofman and Bökkerink in Mulder 1998: 55-61). Moreover, it was widely believed that centralized science shops did not do research themselves; rather, they *facilitated* research. Furthermore, it was assumed centralized science shops would gravitate toward multidisciplinary research, and

[26] The Delft Science Shop is organized by five thematic groups: environment, work and health; traffic/noise

decentralized science shops would tend to do monodisciplinary research. These distinctions, however, break down in practice. Centralized science shops *are* involved in research activities, and decentralized science shops follow similar intermediation procedures to centralized science shops. Centralized science shops often intermediate monodisciplinary research, while decentralized science shops may collaborate with each other to add multi-disciplinary perspectives to their work. In this chapter and the next I use case studies to explore how these models come together in different configurations. At both kinds of science shops there are elements of—and conflicts between—the three different models of democratic expertise.

Before 1999, the Nijmegen Science Shop was a part of the Department of University and Society. After the university reshuffling of 1999, it became a part of the Office of Communication and Marketing. The Twente Science Shop was organized as an independent body under the transferpoint known as the LiaisonGroup (*LiaisonGroep*)—an office that mediates between large companies and university researchers. In January 2000, after several years of negotiating, they became part of the Department of Student and Campus Affairs (*Dienst Studentvoorzieningen & Campus* or DiSC). The Maastricht Science Shop used to be associated with the Science Park, and before that with the Transferburo (a transferpoint), but has now been incorporated as part of the Office of Student Affairs. Centralized science shops receive most of their money directly from the university administration. They earn supplemental income from their clients, sales of their reports, and occasionally, from university faculties.

In the first case study, the Nijmegen Science Shop, an anthropologist researched the meaning of success in business by interviewing Turkish and Dutch business owners in the

pollution; sustainable cities; environment with respect to biomedicine; and chemical methods and analysis.

province of Gelderland and comparing their answers. When this project began, the client, a foundation that supports minority entrepreneurship, wanted the science shop to do the research and have very minimal involvement (representative model). After starting the project, the science shop made a pitch to the client to become more involved (partnership model). Enschede, in the province of Overijssel, is the scene of the second case study, which follows a project in civil engineering for a group organized in opposition to a particular design of a traffic tunnel. This example shows the importance of a science shop project for a group in need of counter-expertise to be taken seriously in the political decision-making process. Of particular importance in this case study is both the difficulty of estimating the research process in advance and the issue of scientist involvement in the public presentation of research results. This case displays the inherent conflicts when the client favors engagement and partnership model approaches but the scientist leans more toward the representative model. The third case study is from the Maastricht Science Shop and concerns an economics project with regional, national, and international implications—a plan to add a second runway to an airport situated on the border of Belgium, Germany, and the Netherlands. The case highlights what can happen when a science shop project is related to an issue that receives prominent media attention and illustrates what is commonly a comparative advantage of the representative and engagement models over the partnership model for the client; the client intentionally did not get involved in the scientific process due to concerns regarding perceptions of objectivity.

Intermediation

In theory, intermediation is very similar at each of the science shops (centralized and decentralized). An organization or an individual with a problem comes to the science shop.

The science shop determines whether the question is appropriate for the science shop, or whether it should be referred or refused. Most science shops will only work with individuals if they can ascertain the research might have implications for a broader audience. If the science shop accepts the question and decides to turn it into a student research project, staffpersons work to find a student researcher, preferably to do the work in fulfillment of their final thesis project.[27] The client is frequently asked to pay for expenses (such as travel costs, printing, and telephone calls), based on a sliding scale of ability to pay. The research is "free."

The science shop has to worry about attracting an advisor to the project—in some cases this is as difficult as finding a student. After an advisor agrees to mentor a project, it can still be a challenge to keep him/her involved in the work. The advisor is ultimately the gatekeeper as far as approving the scientific quality of the student's research. When science shop projects do not fit neatly into the faculty members' own research they are not properly incentivized to attend meetings regularly, read research drafts, and help the student make difficult choices. The science shop has limited recourse to hold faculty members responsible for these tasks.

For most projects, the science shop organizes a steering committee (*begeleidings commissie*) to guide the research process, consisting of a client contact person, a science shop contact person, the student, an academic advisor, and sometimes others (elected officials, doctoral students, faculty, business owners, or representatives from other non-profits). Committee members usually meet several times during the research to discuss progress, direction, outcome, and presentation of the research. The committee carves a research trajectory based on an array of experience, needs, expertise, and emotions. The science shop creates a file for all related paperwork such as intake forms, contracts (between student and

[27] Dutch university students are expected to complete an original piece of research, similar to what is required for a master's degree in North America. Professors often expect the student to choose a topic that fits with the professors' own research interests.

science shop or client and science shop), meeting minutes, drafts of student research, press releases, newspaper reports, evaluations, and other related correspondence. At the end of a project, the committee may meet to evaluate the project.

Despite the universal use of the term "intermediation" by Dutch science shops, few science shops have tried to define the term. The Maastricht Science Shop has described intermediation as:

> …the process of translating the client question into a research question. It is an iterative process in which the results must be mapped onto the interests and goals of the client, the science shop, and the researcher. (Wetenschapswinkel Maastricht 1985)

The Nijmegen Science Shop created a diagram and manual that describes intermediation and serves as a guide for new science shop intermediators (See figure 4).

QUESTION

Telephone Call GOAL: General Info from client & needs

Discussion
(Application and Assignment)…………….. Intake Form

Intake Meeting…………………………….. GOAL: Getting to know each other/ “diagnosis”

ADVICE/RESEARCH……………………. A4

Finding a Student (Maximum 5 months)

1st Discussion …………………………….. GOAL: Getting to know each other, preparation for research design

2nd Discussion……………………….….. GOAL: Putting everyone on the same page with respect to research design, budget, agreement on timeline and process

RESEARCH……………………………….. CONTINUITY
QUALITY
USABILITY
PUBLICITY

……………………………….. Agree on layout, printing

REPORT CONCEPT……………………… Things in the right order? General gatekeeping

LAYOUT………………………………….. Last chance to proof

PRINTER

DISTRIBUTION…………………………... Supporting publicity

FINISH UP AND FOLLOW UP…………... Intermediation process
Was research useful to client? What learned?
Follow-up research?

FOLLOW-UP and EVALUATION……… What did client do with the research?
After half a year Who accomplished what?

Fig. 4. Flowchart of Intermediation.
From a poster hanging at the Nijmegen Science Shop.

The Maastricht definition of intermediation highlights a problem intermediation is intended to overcome—the threat that the research will try to answer something completely different from a client's original question. This happens for many reasons—the science shop has not put enough effort into developing a research project, the student finds something more compelling than the client's question, or the student runs out of time. de Boer explains this dilemma:

> The best that can happen is that you find students who are very enthusiastic. But the worst can also happen–in trying to formulate the research project so that it interests students, the original question may get lost. It is the science shop's responsibility to make sure this does not happen. It is very difficult to keep the pressure on the original social problem, rather than on a scientific problem. (de Boer 1998)

What is compelling research in an academic field is very often different from the kind of research or report that a client needs to accomplish their goals, especially in a political/legal context.

Many science shops and clients invoke a constellation of 'free research plus cost of materials' to show the research is independent and not bought. Yet Brigit Fokkinga, the former director of the Nijmegen Science Shop, argues this is not necessary:

> …the financial aspect has nothing to do with independence – that comes through the fact that this is university research. It used to be science shops did everything for free, because clients were considered poor (a political and ideological statement). I changed that into 'a financial contribution to the extent that clients could afford it,' because things that are free tend to be valued less than things that are not free. It is also necessary for the client to keep a sense that it is their problem—not the science shop's problem (an instrumental and educational approach). (Fokkinga 2001)

In some cases it may be more desirable for the client to make a financial contribution as a way to increase their stake in the research process, outcome, and policy implementation.

Students may be paid or earn academic credits, and sometimes both. Credits normally range from 1-4: one credit equates to one week of work. Some science shops are opposed to paying students on the basis that they will learn more than they would from traditional research (Fokkinga 2001). At the University of Eindhoven science shops, decentralized science shops run by students, most students are paid a very small stipend. A coordinator from the Eindhoven Chemistry Science Shop stood up at the National Conference for Dutch Science Shops to plainly stake out his science shop's position on student stipends:

> I have heard a number of people complain it is difficult to find students to do science shop projects. But there is one simple solution. Students will always be happy to do something for the science shop—you just have to bribe them. (Houben 2001)

Although some science shops provide stipends for student researchers, this is more the exception than the norm, and depends on a variety of factors, such as the type of project and whether there are strict timelines.

Though the process of intermediation is supposed to ensure projects move along smoothly, projects may be stalled because the student is slow, but also because of client demands. A student in Twente who administered a questionnaire on behalf of an organization representing undocumented women workers on the border of Germany and the Netherlands complained the client wanted changes that would necessitate substantial recalculations using a statistical analysis program (SPSS).

> I just want to get the report done, but the client has asked for some changes. They don't realize how long these changes are going to take, and how important it is to get this questionnaire out as soon as possible. It's late enough already, and questionnaires are so important to release quickly: there is only a small window of time during which the results are relevant. (van der Valle 1999)

Increased collaboration with the client during the research process may stave off problems relating to satisfaction of the client, but can also prolong research projects, creating problems for the student.

Most science shops have an advisory board comprised of university administrators, professors, professional researchers, and sometimes students, who meet regularly to discuss the daily operations of the science shop and policy with respect to its future. Advisory boards have played a key role in keeping science shops apprised of political developments at the university that have the potential to impact science shops. Over the years, faculty members from STS departments have used their position on the science shop advisory board to stay involved with practical endeavors to democratize science and technology, even while their own research has taken them in more theoretical directions. The University of Twente has two advisory groups. Their Managerial Board (*Dagelijks Bestuur*), which meets up to eight times a year, oversees day-to-day science shop operations and policy. The Advisory Council (*Advies Raad*), comprised of a wide range of university administrators and professors, meets only once or twice year, to take stock of university and societal developments affecting the science shop.

The art of intermediation lies in framing a research project, pushing it forward, maintaining communication among various stakeholders, so in the end, a diverse set of stakeholders are satisfied. Though the basic structure of intermediation is similar at all the science shops, in practice no two science shop projects, whether within one science shop or at two different ones, are ever exactly the same.

Nijmegen Science Shop

If the Netherlands were California, Nijmegen would be Berkeley. Its nickname, “the red city,” is a reference to its strong left contingent. Same with the university—its nickname is the Critical University.[28] Stores, restaurants, and even the streets exhibit the lasting effects of the 1960’s and 70’s social movements. There is a cooperatively owned and managed organic bakery, *Knollentuin* (The Vegetable Garden). A restaurant, through an organization for empowering handicapped people through work and art, has mentally handicapped people waiting tables and working in the gift shop. There are regular vegetarian restaurants, and a vegetarian anarchist café/restaurant, "The Klinker," run by an anarchist collective out of an abandoned building (a "squat"). This anarchist collective also runs an anarchist bookstore, publishes a magazine, and holds demonstrations—during one month in 1999 they held demonstrations for Critical Mass,[29] animal rights, and peace in Kosovo. Streets have smooth sidewalks and curb cuts to improve transportation not only for elderly or handicapped people, but also people pushing baby carriages. Audible traffic signals and bumpy bricks help blind people know when and where to cross the street. The pink bicycle lanes seem even wider and better maintained than bicycle lanes in the rest of the Netherlands.

The Nijmegen Science Shop has developed in tandem with the social movements visible on the city streets—those of the elderly, handicapped, environment, labor, squatters, animal rights, women, and others. For instance, these progressive values are reflected in science shop organizational structure, practice, research methods, and attitude towards people and social change. Each year, the Nijmegen Science Shop puts out an annual report they call their "Annual Picture." For the past several years, the inside jacket shows a photograph of the staff and students who have done this work. Whether they are huddled together for a close-up shot or spread out artistically in a field of rhododendrons, the pictures capture an image of a tribe-like organization that is, above all, about people (or more specifically women, who far outnumber men). On the day of the photo shoot, the photographer summons everyone outside. In 1998, this is how there came to be sixteen people in the picture, including the seven paid staffpersons (director, five thematic group leaders, secretary), six volunteer intermediators,

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[28] In Dutch, the *Kritiese Universiteit* or KU, instead of KU for the Catholic University (*Katholieke Universiteit).*
[29] A movement that holds animated street demonstrations, sometimes impromptu, to advocate for better bicycling and pedestrian infrastructure.

three students, and a Ph.D. researcher in STS visiting from the United States to study Dutch science shops.

Rather than try to conform to established university disciplines for their research, they are organized by themes that change over time. In 2000, there were groups for Labor, Gender (formerly Women), Health & Environment (previously Energy and Environment and before that Anti-Nuclear), and Minorities (formerly Welfare & Minorities). The group Living, which served clients with housing concerns (such as tenant collectives and squatters) eventually disbanded—in part due to the success of these movements in Nijmegen. Thematic group leaders manage up to five volunteer intermediators. Volunteer intermediators are usually students finishing school or recently graduated and looking for a job, although this may vary (e.g., in 1999, one intermediator in the environmental group in her 40s came to the science shop after changing careers). They manage projects and work to insure they serve the interests of multiple stakeholders. If for some reason the intermediator leaves, which happens often, the thematic group leader appoints another intermediator or takes over the previous intermediators' tasks. In practice, both the thematic group leader and the intermediator share responsibilities for managing research projects within their group.

Each year the thematic groups have a budget to hire a professional researcher to carry out research. They each formulate a project "from their reflection on what is relevant based on the questions they get and the societal issues in their field they determine from following social and scientific literature and debates" (Fokkinga 2001). Projects must meet the general science shop criteria and receive approval from the thematic group coordinators and the science shop Advisory Board. Such projects then enter the "Science Shop Pool" (*Wewi Pool Projecten*). These projects improve the delivery of representative model services.

In 2000, the Nijmegen Science Shop had a total budget of NLG 553,900, paid for mostly by the university. Other income included NLG 19,000 from client groups, and NLG 1000 from sales of reports (Smulders 2001). Their biggest expense was NLG 265,000 for personnel costs, which included NLG 7000 for volunteers, and NLG 212,000 for Science Shop Pool research projects. The science shop received 69 new inquiries, took care of 34 by giving advice rather than research, and referred or turned away eleven others. They published nine reports. Besides eight research projects in-process, six others were awaiting student researchers. They had 46 volunteers and were mediating three Science Shop Pool projects (Wetenschapswinkel Nijmegen 2001).

The organizational configuration makes the science shop a lively place, with students and volunteers popping in and out all day. The offices are on the ground floor of a cinderblock building. The first stopping point for intermediators is usually the common room in the middle of the main corridor. The room, with two long windows interrupted by brick walls, looks out onto dense woods and a winding bike path. It has two large study/meeting tables, three computer terminals, some potted plants and a magazine rack with the current issue of left-leaning magazines and scholarly journals. Two file cabinets along the far left wall are filled with color-coded hanging files containing paperwork and documentation for research projects. The walls host a collage of newspaper articles and small posters with playful sayings such as "One pound of science please" or "Working in the Shop." Offices for each of the paid staffpersons border the common room. Farther down a dark hallway, there is a small kitchenette and a high-tech coffee machine, the likes of which propels the working day in much of the Netherlands.

Because so many students work at the Nijmegen Science Shop there is a high turnover rate. Also, many recent graduates work at the science shop to keep busy and build skills while they are applying for jobs. The science shop has responded to the turnover rate by developing detailed materials explaining how the science shop works (not a priority at science shops that do not have so many intermediators or such high staff turnover). A handbook attempts to outline science shop procedures and teach people to become successful intermediators (Wetenschapswinkel Nijmegen 1999). Also, meeting minutes document key decision points in the intermediated projects. This is vital to project continuity, especially if an intermediator or student researcher has to leave midway through.

Work at this science shop spins around the axis of meetings. There are two types of weekly meetings: meetings of the five thematic groups, and meetings with the five thematic group leaders and the director. In the thematic group meetings, the group leader first sorts through the incoming mail. Next, they discuss business from the previous week, and then finish with a discussion of any incoming questions. Following a similar agenda, the thematic group leaders convene once a week in the director’s office. In total, there are at least six regular meetings packed into the four-day science shop working week so that no matter what day of the science shop working week, Monday through Thursday, there is usually at least one meeting scheduled.

Although they moved back onto the university campus in 1989 after a few experimental years in an office downtown, intermediators today still seem free to frame research projects without strictly adhering to university disciplinary fields. Science shop workers are proud their organization aligns itself according to values derived from social movements rather than from ‘ivory tower’ ones. Brigit Fokkinga, science shop director from 1991 to 1999, explains how the thematic group organization, the Science Shop Pool projects, and other staff development initiatives help retain a staff of concerned, enthusiastic, and intellectual university graduates.

> I knew it was possible to devise a way so each staffperson, in pursuing personal goals, contributes to the organization as a whole. I helped them set challenging goals, because I think it's one of the most important ways to keep staff. People need to struggle with an issue, even to the point of becoming irritated. A certain amount of irritation is good—it's a sign people are learning. (Fokkinga 1999)

The idea is to keep science shop staff intellectually stimulated so they stay longer in what is not a traditional career. This organizational arrangement provides flexibility that is channeled toward intellectual challenges for paid staff. For instance, they are encouraged to develop activities beyond research. Salima El-Guada, the leader of the Minorities group, has pursued activities around the theme of science and religion. In the spring of 1999, she organized a public discussion the position of Islam regarding organ donation. El-Guada explained the advantage of the thematic groups:

> For me, it would be unbearable if the science shop were organized according to today's university faculties. Because we are not bound by disciplinary boundaries, we can afford to be much more analytical and reflexive about our work. But because we are so analytical, we have been accused of being arrogant and difficult. It's just that we like to hear a lot about a problem before just finding a student to answer it. We have this saying, "in Nijmegen, we like doing things the hard way." (El-Guada 1999)

At its core, the science shop runs by a peer-facilitation model that allows thematic group leaders to spend maximum time acquiring new projects and developing internal research projects. This approach is what gave Fokkinga, the former director, hope the science shop would continue to thrive after she left—she had been reluctant to leave for fear it would close. Unfortunately her fears bore out: when she left in 1999, the science shop was not allowed to permanently hire a new director. At the end of 2001, the science shop lost half their staff and the rest were fighting to preserve the science shop (Smulders 2001).

Nijmegen Case Study: Minority Entrepreneurs

In 1999, El-Guada, a second-generation Moroccan woman from the province of Limburg, had been working at the science shop for five years. Darting through the halls, her hair pulled back in a neat bun and her dress a few notches more formal than her colleagues, she exudes energy. In 1997, two years after beginning as a volunteer intermediator, she became leader of the thematic group Minorities, at a time when her fellow intermediators were all Dutch of European descent. Her position on this is evident from looking around the table at a group meeting in 1999—three of the four intermediators are first- or second-generation immigrants. She has made it a personal goal to highlight the contribution of minorities in society, because, she explains, “minority students need more positive role models and success stories” (El-Guada 1999).

One kind of success story is the minority business owner. El-Guada has been working with Maxy Piard, of foundation Osmose, dedicated to multicultural economic development in the province of Gelderland. Piard and El-Guada began working together when Piard, a native of the Caribbean, was working at a smaller organization that lacked resources to do their own research. When the organization fused with two others to form Osmose, Piard kept up her working relationship with the science shop, seeing it as an opportunity to sustain projects that have what she calls a “scientific” basis, rather than the policy research they do on their own (Piard 1999). In 1997 Piard phoned El-Guada regarding Osmose’s desire to improve support to minority business owners through regional incubator centers. Osmose was interested in research to help them better understand the obstacles faced by minority entrepreneurs in the province of Gelderland and the role of incubators in better serving minority entrepreneurs. After several phone conversations, Piard came to the science shop for an “intake meeting” (*intake gesprek*).

Besides Piard, eight people from the science shop attended the intake meeting, including Asuman Çatik, an intermediator for the Minority group and Mirjam Smulders, the leader of the thematic group for Labor (group leaders sometimes attend the meetings of other thematic groups if the content relates to both fields). The group discussed what Osmose and other interested parties wanted out of the research. Piard explained Osmose was interested in information to improve services to minority entrepreneurs. She also explained the Chamber of Commerce could use the research to improve incubator center services, and banks would have a stake in the research because they might eventually become lenders to minority-owned businesses (Wetenschapswinkel Nijmegen 1998). Piard further explained this research could eventually become the second part of a report whose first part consisted of quantitative data supplied by financial organizations (Piard 1999). They also discussed potential logistical problems a researcher might encounter when locating minority entrepreneurs through a national registry or traveling to different areas to administer questionnaires. In general, the discussion raised more questions than it answered (Wetenschapswinkel Nijmegen 1998). (By Nijmegen Science Shop standards, this means things are going very well.) Even though the process of intermediation encourages partnership model interactions between the client, the researcher, and the science shop, Osmose seemed at first to prefer very limited involvement in the research.

During or after the intake meeting, the committee develops a strategy for helping the client. This is called a "diagnosis," and its importance is described in their handbook:

> The diagnosis is the most important outcome of the first meetings. Often, the client can only vaguely describe the problem, and is looking for help from you to give it some structure. So it is critical to collect as much information about the client as you can. Listening is very important: your attention should be on the client—you'll have time to think about possible solutions later. Ask inquiring questions. Pay attention to the other person, to their ideas, body language, and any other kind of information they offer. Often, a good diagnosis can only be made after a second meeting. (Nijmegen Handbook 1999)

Fokkinga explains that

> …the diagnosis is central in the process of professionalizing this work. It is a specific process that enables the intermediators to make an adequate distinction between the action-context of the problem and the knowledge-questions they may, or may not, contain. (Fokkinga 2001)

The main point is time spent on the diagnosis results in a more targeted, professional, and pertinent science shop research project. To clarify this point, Fokkinga recites a Dutch proverb: “A good beginning is half the work” (Fokkinga 2001).

When making a diagnosis, the science shop and client make decisions that have implications for which model(s) of democratic expertise the research design and process will follow. For example, at this point in the minority entrepreneurs project, the science shop learned that Osmose wanted the science shop to deliver a final product and have relatively little involvement (representative model). Piard was not looking for the science shop to take on political responsibilities (engagement model). Osmose conceived of the science shop as a way of helping them to see their own work differently; they did not want to influence a third party’s perspective on their work (Piard 1999). So, beyond input on the research framework, Osmose wanted little responsibility after the initial setting of the research questions and design (showing signs of partnership model).

The thematic group leader and intermediator(s) work hard to solicit information about the client and the political context of the research. Checklist of questions in the handbook help solicit information about the client’s purpose and experience. Answers help the science shop and client make a diagnosis, formulate a possible research trajectory, and make decisions about research methods.

1. What is the purpose of the organization? How does it operate?
2. What is the scope of the organization?
3. What sector of the organization will benefit from this project?

4. If the question comes from an individual rather than an organization, is there some organization that might benefit from the research? Could the results from a research project have broader application?
5. Describe the client's surroundings. What kind of neighborhood, circumstances, etc. Who are the opponents, allies? Who finances them? What is the political position of these different parties?
6. Describe the client's relationship/attitude toward the organizations' stakeholders.
7. What kinds of resources are available to the group?
8. What does this individual do within the organization? How much time could they devote to the research? (Wetenschapswinkel Nijmegen 1999)

These questions assist the group in making choices about research design based on client needs, interest, and demographics, which illustrate some of the trade-offs of different models of democratic expertise.

Science shop work depends, to a great extent on their ability to interest students in performing research (a representative model concern). A second checklist in the Nijmegen Handbook helps identify a gap in the current knowledge, that, once filled, will provide 'usable knowledge' (Lindblom and Cohen 1979). This checklist can follow two trajectories, depending on whether the science shop decides to provide advice or to develop the question into a research project, and the answers help the staff set reasonable goals for a student research project:

What does the client see as the problem?
Why is this a problem?
What is the background of this problem?
What are the causes of the problem?
What other factors is the problem related to?
What are the client's goals?
What are the client's expectations about the results?
What can the client do with the results? Can the results be applied to their situation, or would another resolution be more appropriate? What resources does the client need to implement the results?

If this is a question that will probably require advice and not research, then

What sort of support does the client need? Referral, advice, literature search, support with publicity, or other?

If this is a question that may be supported with research then

> What is the “knowledge problem”? What must the client know in order to improve their work?
>
> Where can the data to answer this question be obtained?
> How can the researcher retrieve this data in the best and most reliable manner?
> How much time is needed for this research? How should data sets be limited?
> (emphasis in original) (Wetenschapswinkel Nijmegen)

The checklist helps the science shop design a research trajectory that will meet client and student needs.

The first meetings are critical to establishing a relationship between science shop and client different from a conventional relationship between a service provider and customer. Checklists help gauge the client’s position and goals. Nijmegen Science Shop staffpersons are particularly interested in developing a shared sense of responsibility for the problem and solution. José Dobbelsteen, interim-director of the science shop (at the time of my research) but formerly the thematic group leader for Health & Environment, explains:

> Because we call ourselves a shop, people sometimes get the impression they can just come here and “buy” a solution. That’s not how we work. We don’t assume the responsibility for their problems. Instead, we try to get people to give enough information, and to become comfortable enough with us, so we share the responsibility. We try to be approachable, so the client can return to us and ask for help if they still need it. (Dobbelsteen 1999)

The idea is that by generating choices early on, the science shop establishes a working relationship with the client, in which responsibility for the solution is mutually shared. Depending on the logistics of each project, the solution may entail a combination of representative, engagement, and partnership model activities.

Documentation is a heuristic for achieving such a sense of shared responsibility. Potential clients complete an intake form to record their problems and goals (as originally conceived before talking with the science shop). Detailed minutes help record discussion points for use later, when explaining the research project to a prospective student or when making revisions to the research project. The group leader writes up the result of the intake meeting into an "A4" (A4 is the paper size—it is supposed to fit on one sheet of paper). The A4 describes the client, background, what the client hopes to gain from the research, the research question, suggested research methodology, and possible disciplinary skills that would contribute to the project. Under the heading, "research question" on the A4 for Osmose, El-Guada wrote:

> What are the determinants of success and failure for new minority entrepreneurs in Gelderland?
>
> This question could be divided into the following questions:
>
> What are the determinants of success and failure for new minority entrepreneurs in Gelderland for different ethnic groups?
> Can an incubator center be considered a determinant of success or failure?
> Is there a need for an incubator center among new minority entrepreneurs?
> If so, how is this determined?
> What has happened at existing incubator centers elsewhere in Holland? Is there something that can be said about their effectiveness? (El-Guada 1997)

These questions reflected the intake meeting and conversations between El-Guada and Piard, and were meant as guidelines to help narrow the research and find students. Under the heading "researchers," El-Guada wrote:

> We're looking for two enthusiastic students with an interest in organizational questions within a social context. We are thinking of students in Management, Planning, or Social Geography.
>
> Students should have good writing skills and have some experience with carrying out questionnaires and interviews. (El-Guada 1997)

In the Osmose project, the diagnosis and minutes from early discussions shows the research leading to an evaluation of the impact of incubator centers on success and failure of minority-owned businesses. The A4 circulated internally at the science shop and to Piard for feedback.

In one best-case scenario, the science shop makes a preliminary diagnosis with the client group and then finds a student within a few weeks. The science shop advertises in the university newspaper, posters, and by word of mouth. They find a student in one of the desired disciplines who expresses interest in working on this topic to do the research as a master's thesis. Next, the science shop arranges a meeting between the client, student, and university professor to determine research direction, methodology, a time-line, as well as materials the client can offer the student. Many projects never reach this stage and are finished off with advice or a referral. The science shop does not see this as a failure: their goal is to help the client and to keep a critical perspective on what science can and cannot achieve for client groups. The negative consequence of advice-giving, however, is it does not lead to research. This can be significant because measures of science shop success include the number of students who receive academic credit for science shop research and the number of reports published. Dobbelsteen explained the need to resolve this dilemma:

> The science shop has been giving advice for as long as it has existed. To us, it's just as important as doing research, because we give the client immediate assistance for free. The problem is advice has always been undervalued here— you can't really say much of anything about advice. You might write a letter or make a phone call, but there is no report, no product. We need to make this aspect of our work visible. (Dobbelsteen 1999)

The Nijmegen Science Shop has been brainstorming ways to improve and better document instances when they provide advice instead of research (Fokkinga 1999).

No two projects are exactly alike however, and almost no project proceeds exactly according to script. In the Osmose project, soon after El-Guada wrote and circulated the A4, she had several follow-up telephone conversations with Piard to refine the project and research questions. But then months passed before an economics student expressed interest in the project, who decided, after learning more about it, that she was not interested. Eight months later, in March of the next year, Frances Steenkamp came to the science shop with an interest in researching minority entrepreneurs. In the meantime, however, Osmose retracted their question—because it had taken so long to find a student—and reallocated the money toward a different project. El-Guada had continued to search for a student because she liked the idea of working to improve support services to minority business owners (El-Guada 2001). Her plan was to proceed with the research without Osmose.

Steenkamp, a confident, blond, third-year anthropology student, was, by her own account, “blowing through” her university studies. She already had a degree in social work and had been working in the field, with minority women in community centers (*buurthuizen*) to help them find good employment. As a social worker, she helped women learn Dutch customs to better function in what she calls “an intercultural society” (Steenkamp 1999a). Based on this work experience, she decided to pursue a university degree in cultural anthropology.

At a meeting of the science shop committee—including Steenkamp (student), Çatik (intermediator), and El-Guada (thematic group leader)—Vincent Peters, a professor of research methods, suggested that research begin by interviewing business owners to understand obstacles to their success. Steenkamp worried about the practical aspect of her research: What if she did not speak Turkish? Would she have sufficient access to the interview sample? Did it matter she had no previous experience in conducting interviews? Did it have enough of an anthropological angle (it had been conceived as a project in economics, planning, or social geography) (Wetenschapswinkel Nijmegen 1998a). For the next several months, Steenkamp struggled to articulate the value of anthropological research to the project of helping minority business owners (Steenkamp 1999a).

As El-Guada prepared to start the research with Steenkamp as researcher, she soon realized the research would be much more effective if the science shop partnered with Osmose. For one thing, with Osmose, they had a much better chance of producing results that would be implemented. This illustrates a tension between the representative and partnership models—in order for scientists to effectively represent certain interests in their research, some outside help is needed. Without Osmose, there would be, for example, no final reported printed in bulk and distributed to legislators and stakeholders. El-Guada decided to try to convince Osmose to join back in the project by trying to explain to Piard that Steenkamp's research would still meet Osmose's original goals (El-Guada 2001). This put strain on Steenkamp. After beginning her research, she was in an odd position of trying to convince Osmose to cooperate on the project.

> I spoke with two people from Osmose. They were somewhat distant at first, because this was unconventional; usually the client is the one who initiates a project. The money originally reserved for this project had already been spent elsewhere. We discussed what interested them and what they wanted to do with the research. It took some time to settle those issues, but in the end, because it would cost them very little, they accepted. (Steenkamp 1999a)

The science shop, Piard, and Steenkamp, eventually agreed Osmose's involvement would consist of providing help to Steenkamp with finding informants, reading drafts of the research and making comments, and financing the cost of the final report. A project contract made it clear that anything to do with implementation was Osmose's responsibility (Wetenschapswinkel Nijmegen).

The people from Osmose might have seemed "distant at first" because they were reacting to the dramatic change in the research project between the original plan and Steenkamp's plan. Osmose wanted to conduct surveys in the minority business owners' native language, but Steenkamp did not speak Turkish. Osmose's research experience was mostly with quantitative data and analysis, but Steenkamp proposed to do qualitative research using ethnographic interviews with minority entrepreneurs to better understand the role their "social network" plays in their businesses (Steenkamp 1999a). Steenkamp described the value of anthropological methods to this research topic:

> The existing research proposal had an economic focus. They were asking questions like, what factors determine the success of minority entrepreneurs? These questions will lead to a report centered on statistics. But I see things anthropologically. I wanted

> to look at what the minority entrepreneurs are saying. How do *they* view success? My research helps to explain success in business from their point of view. (Steenkamp 1999a)

In a meeting in October 1998, Piard agreed to support Steenkamp's research, and suggested the results might become the third part of a study Osmose had begun in the meantime (Wetenschapswinkel Nijmegen 1998): The first part analyzes statistics from the Chamber of Commerce on ethnic entrepreneurs in the province of Gelderland and the second part analyzes the city of Arnhem's municipal policies regarding minority entrepreneurs (Piard 1999). Even though Osmose eventually came around to supporting the research, they could not supply some of the practical help, such as contacts with minority entrepreneurs, that Steenkamp had wanted.

Struggling to please herself and Osmose, Steenkamp muddled through several versions of her theoretical framework before settling on a research design. In the process, she consulted a Ph.D. student who works with a researcher in Amsterdam on minority entrepreneurs. She also consulted Peters (the research methods professor) and her advisor, who suggested she make use of the anthropological literature on social networks. Feeling torn between pleasing her advisor (and others in her field) on one hand, and the science shop and Osmose on the other, Steenkamp worked hard to rewrite her proposal, based on the responses to her drafts and on an inner voice which nagged her to stay faithful to her own vision of the research:

> What little contact I had with my advisor was useful. But then when I started writing my report, he would point me in a certain direction. And then when I ran this by the science shop, they would point out something else I should do. I was fighting two fires, and I had to pull back from both of them until I figured out what *I* wanted. (Steenkamp 1999a)

The presence of an interested party can put additional pressure on the process of constructing a research design, which—even under normal circumstances—is transformed through revisions.

Though Steenkamp had a certain amount of discretion to steer the research, the science shop worked to preserve Osmose's involvement (partnership model). El-Guada mailed Piard drafts of Steenkamp's research proposal and subsequent drafts. Piard made comments and mailed them back to the science shop. According to Piard, the iterative and open process enhanced her experience.

> We explained exactly how we imagined the project. The science shop wrote this up and showed it to us to see if that is indeed what we meant. They revised it based on our comments. We had wanted to know about the feasibility of an incubator center for new minority business owners, but the science shop suggested we could focus on the determinants of success and failure for these business owners, and in the course of asking those questions, we could gauge the interest in such a center. The process allows you to see alternative ways of looking at your problem. (Piard 1999)

One way the science shop is significantly different from professional consulting agencies is that the methodology or problem angle is not static, but it evolves according to the guidance of the science shop, input from the client, the student's research experience, and the advisor's requirements.

Collaboration with clients can intimidate students, especially when they seem to disrupt conventional narratives of how objectivity is supposed to work in research. Steenkamp worried contact with Osmose would influence her research results:

> It was difficult to always consider Osmose's needs. I needed to do my research, but I also had to make sure it suited their goals. This had the potential to slow things down. I worried about this influencing my results—research has shown researchers can find out what they want to find out. The advantage of working for a client group, however, is that once you have completed your report, you have something people can use. There is a lot of good university research that never gets used. It's remarkable that a student can make a difference in how people look at minority entrepreneurs. (Steenkamp 1999a)

Though cautious about her results and the effects of client influence, Steenkamp explained she did not necessarily feel pressured during this process as such, she was just keenly aware of this possibility during her research (Steenkamp 1999a). This sentiment often prevents science shop students from working more closely with the client group (more as an intern, for example). The pressure for university students to make a contribution to scientific knowledge makes them sensitive about collaboration that might jeopardize their credibility within the professional science system.

Steenkamp conducted ten interviews: five with Turkish business owners and five with their Dutch counterparts. Osmose gave her some leads to find Turkish informants, but she found them mostly in the phone book or by walking through neighborhoods she knew to have Turkish-owned shops. She conducted interviews on a number of subjects and then compared responses from Turkish and Dutch people. She found Turkish business owners much more approachable and she speculated this was because they hoped her work could depict their concerns and critique the current system on their behalf:

> I think the reason the Turkish business owners were more cooperative was probably because of the impact they thought my research could have for them. They saw my research as an opportunity to describe the difficulties a minority business owner has trying to stay ahead in Dutch society. The Dutch business owners seemed they were looking for me to use scientific methods to lever criticism on Turkish and minority business owners. (Steenkamp 1999b: 84)

Steenkamp concluded Dutch and Turkish business owners conceptualize success differently. Whereas Dutch business owners defined success based mostly on monetary gains, the Turkish business owners based their business success on a combination of economic and social factors. In particular, the Turkish business owners built their network through a combination of friends and family and other business contacts. Their Dutch counterparts had a stronger separation between their business and their social or family lives. In her conclusions, Steenkamp did not advocate any specific policy decision, as either the Dutch or Turkish business owners might have hoped.

One tension in science shop projects is that there is often a disjuncture between what the student submits as a thesis project and what is required for a final report clients can use. Even when a project goes smoothly—a diligent enthusiastic student is found early, the student produces work consistent with the client's goals, the science shop was able to keep all stakeholders together throughout the project, etc.—the report might need an overhaul before the science shop can publish it as a final report. Steenkamp's report did not require extensive changes, and after she submitted it in late April 1998, El-Guada attached only a short preface. The results, like those for many science shop reports, were published in two forms, one by the science shop and the other by the client (El-Guada 2001). The science shop report, 87 pages bound in bright yellow paper with the logo for both the science shop and the university, was titled "*Profit is the Brother of Loss: Qualitative research into the influence of contacts on the economic and social position of Turkish and Dutch business owners in Nijmegen*," Nijmegen Science Shop report no. 271. Osmose paid for 60 copies of the science shop report and then edited the academic version to fit into their series (Piard 1999). They removed the theory and jargon and used Steenkamp's narrative as one part of the three-part report (mentioned above) and then also used it for soliciting additional funding (e.g. from the Chamber of Commerce). They distributed a summary to business owners and the whole report to lending agencies, municipalities, and the Chamber of Commerce (El-Guada 2001). Piard describes how the report would be used to make policy decisions:

> We'll use it in our own work, to learn where we should be targeting our efforts to assist minority business owners. We'll distribute it to our clients, to see what ideas we can implement, and what ideas might warrant further research. We might use it as supporting documentation in applications for municipal, provincial, or national grants. We'll use when we want to make our case stronger. In Dutch society, people will believe you faster if you can show them your point in a report. (Piard 1999)

Osmose used the report to set their policy with respect to assisting incubator centers that support minority entrepreneurs (Piard 1999). The political value of a report depends to a large extent on how well the science shop resolves tensions between goals of different stakeholders. The report is a widely accepted and highly valued method of making political statements in Dutch society.

Often, the science shop will help by organizing a press conference to publicly present the report to the client or other stakeholders (engagement model). Press coverage, in politically controversial cases, may be the most important aspect of the report for the client. This can add considerable work onto the project at a time when enthusiasm is petering out. The Nijmegen Shop has done projects that generated local, regional, and national media attention, but as Angela Aalst, a former secretary at the Nijmegen science shop, explains, this necessitates a lot of work on the part of the science shop:

> In the beginning, enthusiasm runs high. Tons of work goes into developing a diagnosis, working with the client, and mentoring the student. But by the end, everyone just wants it to be over. The science shop misses out on a lot of good opportunities to make a name for itself in the press. You really need to have one person who is just dedicated to doing public relations. One project received a lot of press because I was always there to answer the phone to respond to questions about the research. (van Aalst 1998)

During the project, Piard and her colleagues at Osmose had plans for wide distribution and press coverage of the report (El-Guada 1999). But in this case, the science shop was not asked to make further arrangements and Osmose's plans for publicizing the report never materialized.

At the Nijmegen Science Shop, staffpersons try to make time to meet with the client and student to review, evaluate, and settle outstanding issues once a science shop project is completed. A final evaluation may help science shops improve support to clients and expedite the learning process (important to all three models of democratic expertise). In September 1998, Piard, Steenkamp, El-Guada, and Çatik met to evaluate the project and reconcile accounts—Steenkamp had not kept receipts for the travel and interview expenses she incurred, so Piard had to make a special arrangement with Osmose to reimburse her. The four discussed their impression of the project (Wetenschapswinkel Nijmegen 1999). Piard felt the research would be of practical use to Osmose, and she was happy Steenkamp had been self-directed during the project. Steenkamp told of some of the difficulties she encountered, such as reconciling the different points of view of her advisor, the science shop, and Osmose, but in the end, she had found many of Piard's suggestions helpful. At one point, Piard had told her she was making too many conclusions. Steenkamp reflected on this comment and then chose to scale back her conclusions. Çatik noted because this was her first time intermediating a project from start to finish, she had not been sure what to expect (she also had not taken on very many responsibilities during the project, perhaps because El-Guada was so interested in the subject matter and with working with Piard). But Çatik was impressed with Steenkamp's work and thought the project came off well (Wetenschapswinkel Nijmegen 1999). In general, the more time the science shop devotes to post-project evaluation, the more they improve their services according to the three models of democratic expertise.

Nijmegen Case Study: Discussion

The Osmose project on minority entrepreneurship illustrates a problem inherent in the representative model: it is difficult to find an interested student within a reasonable time frame to do research on a specific subject—especially if the student is not paid. Even when a student is found, the representative model is tricky because the student might not be in the discipline the client expects. This example, however, also illustrates the positive side of not finding exactly the “right” student; Steenkamp’s academic interests helped Osmose look at their work differently. The organization of the Nijmegen Science Shop also reveals something about the representative model: for science shops to be able to perform research on behalf of community groups, it is important projects be stimulating for science shop staff as well as university students. Nijmegen’s thematic groups allow the group leaders and intermediaries to improvise on projects and make use of multi- and inter-disciplinary resources. They also allow staffpersons the flexibility to explore new disciplinary territories while performing research with practical ramifications. Staffpersons support each other through regular meetings and social time together, which endows them with a sense of adventure for new subjects and what El-Guada calls “arrogance.” The idea that science shop work has to be made intellectually stimulating for employees as well as students guards against employee burnout and attrition, while at the same time propels work into new disciplinary territory.

The science shop’s contribution to resolving tensions between the representative and engagement models is highlighted in the way procedures help ensure the researcher produces a result the client can use. Throughout intermediation, El-Guada and the intermediator held regular meetings during which Steenkamp’s progress could be evaluated with respect to Osmose’s goals. Although Steenkamp’s social work experience helped her to think about the implementation from Osmose’s point of view, she was conflicted between working to complete her degree requirements in cultural anthropology and working to serve Osmose. The bridge function of the science shop made it possible for her to do both.

Besides research, many science shop projects are useful to the client because they extend activities into the political arena (engagement model). Nijmegen employees have started looking for ways to track and improve such activities, especially in cases that do not lead to student research projects. The hope is the university will continue to see the importance of community service to their overall mission (also related to Catholic affiliation of the University of Nijmegen). The case also calls attention to the difficulties with the engagement model function of science shops—aspects of implementation or press coverage are sometimes neglected. These activities can be time consuming, are often not intellectually stimulating for science shop staff, and are not as easily conveyed as a number in an annual report. Science shop engagement model work is better illustrated by the next two case studies in this chapter and the Groningen case study in Chapter 5. The next case study (Twente), for example, illustrates some differences in intermediation when employees have more advanced marketing skills.

Part of the success of the partnership model in this case comes through the general responsibilities of the science shop during intermediation—both El-Guada and Steenkamp corresponded with Piard, and Piard responded to drafts of Steenkamp's report with extensive comments. Because Steenkamp was changing her theoretical framework during the research (considered acceptable and even desirable in anthropology), Piard's involvement with the research was often a step behind Steenkamp's current work. In general, Piard's review of research drafts changed the way she understood the practical relevance of anthropological theory and data collection methods. This was also made possible through procedures such as meetings and diagnosis, and the organizational arrangement of the science shop into groups based on empirically derived themes rather than university disciplines. Osmose used the science shop report as a springboard for additional work.

Ideas about objectivity often lead to some tensions within the partnership model. Steenkamp worried about the possible deleterious effects of collaboration with the client. She thought client influence might have a subtle but significant influence on the way she thought about her research or interpreted her results. The science shop helps resolve these tensions by bridging the gap between student and client. The detailed meeting minutes catalog the discussions that transformed what had been conceived of as an economics project into a cultural anthropology project and the role of the science shop in voicing the client's perspective in the research process. Throughout the research process, the science shop filled a partnership model function by keeping the client present in the research process. The science shop solicited Piard's comments on report drafts and transmitted these comments to Steenkamp. Collaboration was facilitated partly because the research was not specifically intended for assisting the client in publicly advocating a policy decision. In some cases, this necessitates a scaled-back client role during the research process. The Maastricht case study in this chapter illustrates tensions between the engagement and partnership models when the research is wanted to help the client weigh in on a more controversial political issue.

Twente Science Shop

Among the quirky art pieces scattered about the campus of the university of Twente there is a church steeple rising out of a pond and a pyramid made of old bicycle parts. The art is remarkable, but in the Netherlands, what is unique is the campus. Most Dutch universities are in cities, and though many have some faculties on a campus, the university of Twente is the only self-contained campus (akin to many North American colleges and universities). All the basic necessities are available: a bank, gym, sports fields, supermarket, dorms, bars, and cafés.

Tucked away on the second floor of the campus Cultural Center, down a bare hallway of white painted cinderblock, a wooden sign suspended by small chains from the ceiling announces the science shop. A bulletin board just outside the main office advertises questions to potential student researchers, one question per page. “Science Shop Seeks” is printed in large red letters at the top of each page, followed by a description of the research project and a list of possible disciplines. Like Nijmegen, the Twente science shop holds public events, such as lectures and conferences. In January 1999, a poster announced an upcoming symposium jointly hosted with the Enschede Art Academy on the relationship between art and technology. This was part of an effort to stimulate science shop questions from artists in Enschede. As Dick Schlüter, director since 1996, says, in a sound-bite style that makes him effective at placing science shop projects in the regional media:

> Art has a significant function in society. And artists don’t just use paint anymore, they use computers. The idea is to see how university students can help artists solve their technical problems. (Schlüter 1999)

This symposium is part of a general effort the science shop is making to explore new ways to coordinate social issues with technical expertise.

The science shop occupies two offices, plus a conference room down the hall. Next door, there is a student club, Work and Technology in Development, where engineering students work on problems relevant to developing countries. Elsewhere in the building, there is an amphitheater, library, student union, and a cozy café where students and professors sit down for beers in .2 liter (6.8 oz.) glasses when the lights are turned way down at the end of the day.

The main science shop office, where the director and secretary have desks facing each other, is a clean, stark room. Schlüter has decorated the white walls with his own photography—colorful pictures of beaches, markets, and people in developing countries. The other two colors that figure prominently in the room are two red chairs at a desk used for small meetings and two shelves of green science shop reports. A few copies of each report are on the shelves and the rest are a big wall cabinet in their conference room (“the archives”).

The offices are small, but not cramped. There is no clutter and nothing ever seems out of place. Desks are kept empty by space saving devices such as a phone mounted on a pivoting shelf suspended 10 inches above the secretary's desk. This system makes it convenient for a science shop worker, running into the main office from the conference room down the hall or the other office next door, to snatch up the phone when the secretary is off or away from her desk.

The science shop, maximizing the use of its 2.4 full time staff lines (up from 1.7 in 1998), employs three intermediaries and one secretary (Twente 1998). Schlüter, the director (.8 FTE), is a historian and former journalist. He has written three books on regional history, co-authored one, and is working on his dissertation on the history of tolerant policies toward prostitution in the province of Twente. Jelle Smit (also .8 FTE) came to the science shop as a result of university shuffling, when his job was downsized. Every Thursday he goes to a retraining program to learn web design and video production. Egbert van Hattem (.2 FTE) is an intermediator with an STS degree, who does freelance writing on science topics. Elly Reimerink (.4 FTE) comes in three days a week (one full day and two half days) to do secretarial work.

Students from Drienerlo Student Council founded the science shop in 1981 in an office in downtown Enschede, when the university was still a trade school (the *Technische Hogeschool Twente*) (Schlüter 1996). Pepe Veugelars, a chemist, became the first paid science shop employee in 1983 when he was a conscientious objector. The science shop moved on campus in 1986**,** where they proceeded to jump around to different administrative offices. The science shop has managed to survive several episodes of university restructuring by appealing to several different university goals—student education, student extracurricular activities, project education, community service, and public relations. The science shop has worked hard to maintain an independent university office in spite of pressures for them to downsize or merge (with the transferpoint, for example).

The science shop has two advisory boards. The first is the Advisory Council, comprised of faculty and administrators, which functions as a planning body for the science shop. In 1998, the fourteen board members included faculty from several technical and social science faculties (Technical Physics, Electrical Engineering, Management, Informatics, and Communication) and administrators in departments such as the LiasionGroup (the transferpoint) and the Department of External affairs. At meetings once or twice a year, they discuss the future of the science shop and advise the staff on matters regarding ongoing changes in university administration (Twente 1998: 10). The Managerial Board (*Dagelijks Bestuur*) meets more often and is intended to be more involved in everyday business. In 1998, the three faculty and three student members met seven times (Twente 1998: 8-10). The professors who serve on this board, such as Hajo Broersma, a professor of Applied Math, are some of the science shop's strongest supporters. They have helped direct the science shop according to the changing goals of the university. For example, in 1999, the board advised the science shop to explore the possibilities of combining science shop work into an emerging major/minor program (Schlüter 1999).

The science shop's annual budget is approximately NLG 315,000, of which about NLG 286,000 comes from the university, NLG 19,000 from client groups to pay for costs associated with research, and the rest either from their reserve or sales of reports. They spend about NLG 252,000 on personnel and the rest on overhead (Twente 2000). Clients pay anywhere from NLG 200-500 for small projects to ten times that much for bigger ones. In 2000, the science shop published 16 reports, gave advice to 25 clients, and acquired 78 new questions in addition to the 40 it already had in process (science shops call this "in intermediation"). They retired 37 questions because of either a referral (client found advice elsewhere) or because no student could be found within an acceptable period of time for the client (Twente 2000). Besides some of these usual metrics of productivity, the 2000 Annual report presents data to illustrate the scope of the science shop's regional impact: 63% of their clients came from the region of Twente, 15% came from the rest of the province of Overijssel, 18% from elsewhere in the Netherlands, and 4% from nearby places in Germany (Twente 2000: 19).

The reason for the emphasis on their regional impact comes partly from internal policy decisions at the university. Reductions in government subsidies throughout the 1980s and 1990s forced universities to seek more money from public sources. In response, the University of Twente launched a campaign to characterize the university as "The Enterprising University." The name is intended to project an image of the university as a major player in regional economic development and to attract private sector funds. Twente, a province that at one time had a thriving textile industry, has lagged behind other provinces in building a strong regional economy. Hoping to cash in on its high-tech resources, a university public relations brochure defines what it means to be entrepreneurial broadly: "We characterize ourselves as an entrepreneurial university, adapting our research to the benefits of society in general" (Reinhoudt in Twente 1998: 2). There is an unmistakable connection here to the Technical University of Eindhoven, from which Phillips, the founder of the multinational firm of the same name, graduated. Schlüter spells out what many want for the university and the province: "We're hoping to graduate another Mr. Phillips" (Schlüter 1999). The science shop has worked to frame their contribution in the context of the university's mission to promote regional economic development.

If it seems odd for a science shop to be interested in industrial growth, it is. Economic development is still new territory for science shops, and Schlüter is interested to explore it. His idea is the science shop can work to grow the socially responsible niche of "small and mid-sized companies," (*Middel en Klein Bedrijven* or MKB). He is especially concerned with the idea of supporting start-up companies.

> Start-ups meet our acceptance criteria for small and mid-sized companies. We help MKB-ers if they can show they have limited financial means, which is often the case for start-ups. Our criteria also show we are concerned about stimulating regional employment. Start-ups lay the groundwork for increased employment. Start-ups, as it turns out, can also have design needs that can make for nice science shop projects. (Schlüter 2001)

Schlüter's efforts have resulted in a jump in the number of individuals and entrepreneurs among science shop clients from 50% between 1997 to 1999 to over 60% in 2000 (Twente 2000).

The science shop hopes that questions from commercial entities will help not only maintain relevance to the university mission, but also produce more technical projects. In the past, they have accepted some questions with less pressing social implications just to be mediating questions in the technical sciences.[30] Although over half of Twente's faculties are in the technical sciences, less than half of the science shop questions are in technical fields—far more questions are intermediated in management and the social sciences. To resolve this discrepancy, the science shop commissioned a policy evaluation, "The Road to More Technical Projects." The authors recommended the science shop speed delivery of its services in order to help commercial firms with more technical questions, as these require fast solutions (Klooster and Paauw 1994: 10). They also recommended the science shop increase

[30] For example, a motorcyclist was in an accident with a car, and he accused the driver of driving too fast. A researcher from applied mathematics analyzed the damage to the car and to the bike, and calculated that the driver of the car had not been traveling too fast. Because this project was deemed too dangerous in terms of liability with respect to insurance issues, the science shop asked a professional researcher to do the project, in lieu of a student. (van Hattem 1999)

publicity, develop more incentives for students, experiment with having student representatives from each faculty, give students training on how to work as a consultant, use forms to track relevant data from clients, and conduct regular evaluations after projects have been completed (10-22). Despite the well-placed articles in the campus newspaper about science shop activities and reports, the Twente Science Shop, like many science shops, is known to only a small percentage of university students. Students may read about a project in the paper or see a classified ad seeking students for particular projects (in one publicity campaign called "lunch for a buck," students could pick up a lunch coupon from the science shop).

As the Twente Science Shop looks to commercial entities for a supply of science shop questions in the technical sciences this may have implications for other areas of science shop work. Science shops might offer assistance to companies regarding political obstacles to bringing their products to market and so there is no shortage of engagement support just because a firm is a private company and not a non-profit. Additionally, the development of a product provides a unique set of conditions on which to base scientist-citizen collaboration (see the example of Eindhoven technical science shops in Chapter 5).

Twente Case Study: Safe Traffic for Our Future

Though the Twente Science Shop exploring new partnerships with private companies, they have continued to serve traditional science shop clients, such as community activists. In this case study, community activists from the town of Nijverdal came to the science shop with concerns over the design of a traffic tunnel endorsed by the municipality. Nijverdal is a small city in the eastern part of the Netherlands located on the N35, a main highway in the province that runs between the bigger towns of Almelo and Zwolle. It was originally built over a hundred years ago and then widened during the 1960s. The N35 runs straight through Nijverdal, bisecting the main shopping area, causing traffic jams and danger to people walking "from the butcher to the baker" (Rodenhuis 2002). For years, people have complained about the noise, smell, and danger from the traffic, but the protected natural areas at the outskirts of the city make it unfeasible to route a highway around the town (Staff Reporter for De Twentsche Courant Tubantia 2000; Staff Reporter for De Twentsche Courant Tubantia 2001). To address the problem, the municipality of Hellendoorn introduced a plan to route the traffic underground, through an 800-meter tunnel.

The activist group "Safe Traffic for Our Future" (*Veilig Verkeer Onze Toekomst* or VVOT), originally the "Union of Residents in the Neighborhood of the Tunnel Route" (*Belangenvereniging Bewoners Omgeving Tunneltracé* or BBOT)—they changed their name to avoid sounding like NIMBY group—formed to try to influence the specifications of the municipality's plan. They feared the tunnel, as planned, would create problems in the course of trying to solve others. For example, they worried about the noise and vibrations during and after construction, as well as damage to houses, tree removal, danger to children, and general disruption of neighborhood life (VVOT 1996). They contended that the municipality's tunnel was too narrow. Local traffic, which can use the road in its current condition, would not be able to enter the tunnel mid-way, and as such would increase the traffic load on local roads. They formed a group to try to persuade the municipality to alter its plan.

As part of their efforts to give voice to alternative traffic engineering designs, eleven members of VVOT researched alternatives and published then as a report entitled "Black Book Tunnel: A short term solution" (VVOT 1996). The report, using statistics on automobile usage, data from opinion polls, and cross-section diagrams of a tunnel foundation, presented a cost-benefit analysis of alternative solutions. Their recommendations included widening the tunnel as currently designed so as to guarantee sufficient capacity (and prevent back-ups at the tunnel which would spill into the local neighborhood) or rerouting the tunnel along railroad tracks in another part of the city (what later became known as the "combiplan"). But when the VVOT presented the report to Hellendoorn's municipal council, they were told it was biased. While reevaluating the group's strategy, group member Johan Deurlo read about a traffic-related science shop project in the regional paper, which gave him the idea to do a science shop project (Wetenschapswinkel Twente 1996). Deurlo, the group leader by way of his being one of its most active members, is a managerial advisor for the local water board on matters of drainage. He has extensive knowledge about how municipalities work and he knows many of the municipal legislators by name. On an intake form at the science shop, he requested "expertise to help weigh the pros and cons of a traffic tunnel on the N35 through Nijverdal" (Wetenschapswinkel Twente 1996). He was seeking a "cheap, independent, professional opinion about the Nijverdal tunnel" (Deurlo 1999) to help build a case for modifying the municipal plan.

The VVOT eventually ended up with two reports from the science shop. The first, by M. Pluym, analyzed two primary alternatives: a modified tunnel and a detour. During her research, however, the VVOT told her the municipality had hired a consulting firm to collect more recent data on traffic intensity and capacity on the N35. She recommended that further analysis be done when the new figures arrive. She also estimated that the tunnel would reach capacity as early as 2021 and so it would not be sufficient to meet long-term demand (Pluym 1997). One of the municipality's council members responded to the science shop report by sending a memo to members of the Public Works Committee disputing point-by-point some of its data and methods (Hansen 1997).

Deurlo went back to the science shop to ask for a follow-up project that would take up the recommendations of Pluym's report by analyzing the most recent consulting firm data. The science shop then advertised for another student. One of these advertisements caught the attention of Annemarie Rodenhuis's boyfriend. Rodenhuis, a student in Civil Engineering and Management, Traffic and Transportation, had been doing a class project in which groups of four students each analyze a section of the N35 and propose solutions based on a set of problems: "It was our job to learn how difficult it is to put a road in an alternative location" (Rodenhuis 2002). When her boyfriend showed her the science shop's classified ad in the university paper she went to hear more about the project. Though many details were still unclear after her first meeting, Rodenhuis's first impression was this would be a forty-hour research project she would finish in one week while gaining valuable practical experience outside her regular studies. She asked her academic advisor to be her faculty advisor on the project for which she would receive between one and three credits (Rodenhuis 1999). .

Rodenhuis's choice of academic advisor might have made the project more difficult for her. Her advisor, a professor in Civil Engineering and Management, works at the university only two days a week, and spends the remainder of the week at his own professional consulting firm. (The VVOT might have even hired *him* if they had more money.) Given his stature as professor and professional consultant, Rodenhuis was reluctant to increase demands on her advisor's time. She even found herself taking steps to intervene between her advisor and the interest group.

> I was always the one who mediated between my advisor and the interest group. I had this idea my advisor would be angry if he were constantly receiving calls from the interest group. So I made sure *I* was the one to contact him, and to ask him questions only when it was necessary. I didn't want to put him in a position where he was constantly asked to provide free advice. Another reason why I seldom visited him was this project was extraneous to his university responsibilities. (Rodenhuis 1999)

Rodenhuis tried to protect her advisor from what she worried would be over-exposure to the client group.

Schlüter, Rodenhuis, and Deurlo first talked about Rodenhuis basing her report on Pluym's report, but later decided Rodenhuis would analyze a report by the municipality's consulting firm that concluded overall traffic growth would be limited and not have a very significant impact on the town of Nijverdal. (Buro Goudappel en Coffeng 1997). This decision may have increased the pressure on Rodenhuis, who as a student was now expected to evaluate a professional report. In her report, Rodenhuis concluded the consultant's assessment was, in general, too optimistic (Rodenhuis 1999). She gingerly suggested the presence of a tunnel had the potential to reduce traffic flow and increase traffic jams, because drivers tend to slow down as they pass through a tunnel (Rodenhuis 1997).

Soon after Rodenhuis began her project, she went with Deurlo to an afternoon meeting with the head of transport for the municipality. Their meeting preceded an evening meeting for the public to comment on the traffic plan. In Rodenhuis's view, their afternoon meeting was more adversarial than effective:

> From the way the two were acting, I could tell they had met in the past and knew where each other stood. They each seemed to have preconceived notions about the way the other would act. It didn't seem very constructive. (Rodenhuis 2002)

Afterwards, Rodenhuis had a few hours to wait until the public comment period began. The municipal official, who had a daughter in Rodenhuis's class, sent Rodenhuis out to dinner at a nearby restaurant and arranged to pay for it. She then went back to the public comment session and joined several members of the VVOT. They had some signs protesting the tunnel plan, including a big sheet with writing on it. No one brought up the topic of her research and she did not speak publicly.

Eventually Rodenhuis decided she needed to limit contact with VVOT in order to keep the project narrow enough to produce good conclusions. Deurlo kept providing her with new leads and information about the political decision-making process.

> Johan Deurlo is very knowledgeable about how the municipality works, who does what, and what new reports are being issued. He would contact me to suggest I speak with someone or to give me articles from the newspaper. I realized, though, that I needed to set limits. I wanted to end up saying something about a few things, rather than nothing about a lot of things. (Rodenhuis 1999)

In this case, Deurlo and Rodenhuis established a direct line of communication. However, the wealth of information available to Rodenhuis through the activist groups conflicted with her desire to keep the project bounded. Schlüter empathized with Rodenhuis' predicament:

> [Rodenhuis] was not the first student to work on the project, so there were some ideas about possible research trajectories floating around. Also, clients will keep coming back with a new question. They aren't trying to be difficult. They are following the "political game" and as new developments arise, they understand how the project can be formulated to better fit their goals. This happens in about half of our projects, where the student is pressured to change the course of the research. We're there to keep the project to the original design. (Schlüter 2001)

In order to finish the project, Rodenhuis restricted her communication with the client group.

One day during exam period and near the end of her science shop project, Rodenhuis was in the library at the other end of the same building as the science shop. She decided to drop by the science shop: "I hadn't had any contact with them for a week so I just went by to show my face" (Rodenhuis 2002). Upon arrival, she learned about a meeting to hand over her report to the municipality that evening and of an opportunity to speak to a television reporter from TV Oost who was doing a story on the tunnel. Schlüter told her she had an hour to catch a train to Nijverdal.

> I had exams to study for, but besides that, I was in no mood to go. [Schlüter] went instead. I talked to him before he left, but on the news that night, he only talked about data that would prove the client's point. You can explain your data, but the media ignore data that is inconclusive. The client—in this case through the science shop coordinator—sticks to points that prove its own case. In the end, all the nuance of it

> was gone, and I was happy I stayed in the comfort of my own home. (Rodenhuis 1999)

Beyond the short notice and the fact that she is by nature a shy person—"I would rather listen than talk" (Rodenhuis 2002)—Rodenhuis decided not to risk being part of a story that might misrepresent her results. Rodenhuis was dismayed by the way her work was used/co-opted by interest groups and the press (Rodenhuis 1999).

Some science shop clients have intentionally presented distorted versions of science shop reports to the press. Schlüter agreed with Rodenhuis assessment of the situation and explained how the problem is sometimes the fault of a client group:

> Indeed, [Rodenhuis] was right not to go. The press took what I said out of context. But we have also had this problem with clients who are looking to the science shop to help substantiate their case to the press. We created a blacklist for some clients when we found out they had been going from science shop to science shop, just looking for something they can use to place their issue in the media. (Schlüter 2001)

Although political support to clients is a regular component of science shop work, science shops must carefully negotiate boundaries between science and the media to work towards loyal representation of their reports in the press. In some cases, the line between intentional distortion of a viewpoint to the press and simply using scientific information to back up political claims is messy, at best.

Schlüter's journalism background strengthens the science shop's ability to provide support in the broader political arena. The VVOT needed press attention to shift the municipality's position on the tunnel project. Deurlo and the Schlüter planned the publicity to give the municipality a way to "save face" because, as Deurlo explained, the municipality was in a position where it could not publicly back down from its own plan (Deurlo 1999). Schlüter wrote press releases and arranged for the TV Oost story on the VVOT work and Rodenhuis' report. Deurlo estimated the science shop had helped them strengthen their case against the tunnel. VVOT was planning to stay together, at least until the regional development plan was released. Deurlo knew it was a long fight and seemed prepared to keep fighting, especially given the high cost of the plan.

> The cost of the tunnel is so high there is still a good chance the municipality will not get the money for it. Besides, traffic problems in Western Holland are much more pressing than here in Eastern Holland. Who knows? At least we were able to present our views to the local and national government. (Deurlo 1999)

The science shop report, coupled with the press coverage, gave the client group important resources to voice their opinion to their political representatives.

The science shop organized a press conference to present the municipality with Rodenhuis's report and for the municipality to present the report to the Directorate-General of Public Works and Water Management (Rijkswaterstaat). This was choreographed as a way to help the municipality quietly back down from their plan.

> We could have brought "cease and desist" actions against the municipality, but we chose to present alternative solutions. They wouldn't meet with us because they (the municipal legislators) don't have their heart in their own plan. They can't abandon it now. They can 'save face' by sending our report to the Ministry of Traffic and Waterways and we are still pleased they chose to send it on. (Deurlo 1999)

Although this strategy was helpful to the VVOT, Rodenhuis was disappointed the municipality turned the report over to the Rijkswaterstaat without reading it:

> They showed the client handing an outline of my report to the legislators, who announced they would send it to the Rijkswaterstaat. Everyone was passing it on, and no one was going to read it! (Rodenhuis 1999)

Rodenhuis took the passing of the report as a sign the municipality would not engage with its content. In her experience, the intrusion of politics on science denigrated the importance of her analysis. This example illustrates how the student and client constructed different conditions for the project's success.

Over the course of the project Rodenhuis became more involved in politics than she had originally intended. She devoted the last section of her report to explaining the differences between the project as it had been conceived and the project as it was carried out (Rodenhuis 1997). In the beginning, she understood from meetings with the science shop that she was aiming for a report of about seven pages that would take her about forty hours to produce. She had been slated to base her results on an earlier science shop project, but she notes that this other project should really be considered completely separate from her work (although it was published as an appendix to her report) (Rodenhuis 1997). Rodenhuis tried to account for the 140 hours she spent to produce a thirty-five page report:

> Though it took less time to assess different research designs, this time was more than made up for in attendance at two meetings that were indirectly related to the tunnel project. This included such things as meeting with legislators and working to figure out the “deeper beliefs” underlying the current state of affairs. How do people choose a position in the ‘game’? From what standpoint do they come? How do different parties react to each other, and why? In total, about 140 hours were spent on this project. (Rodenhuis 1997: 34)

Rodenhuis attributed the discrepancy between the time estimated for the project and the time actually spent to the fact that no one factored in the time it would take her to understand the political situation.

Nevertheless, collaboration made a difference in the way Rodenhuis views both political interactions and scientific research. Since doing the science shop report, Rodenhuis sees a difference between her outlook on her course materials and those of other students. She learned to see the complexity in situations better, especially with respect to the interpersonal relationships that influence public policy.

> I was surprised at how the activists and the legislators had so much trouble listening to each other. Their communication problems prolonged the entire process. People already have in mind what they are going to do with the results, so it doesn’t always matter that you try to explain the nuances and limitations of the scientific data and methodology. I see now how political interactions are so complicated. I guess

> compared to my classmates, this makes me more 'realistic' when it comes to solving problems. (Rodenhuis 1999)

Rodenhuis learned about the role of inter-personal communication in how people process expert information and how they use scientific information to influence political decision-making. Years later, working for a company doing forecasting of infrastructure capacity, Rodenhuis remarked that she is now very interested in the way citizens become involved with issues concerning the planning of infrastructures:

> You have all these people, the Johan Deurlos of the world, who are so interested to get involved in projects and to think along with the experts who are doing the designing. These are the people who really feel the decisions that are made by experts sitting behind their desks. There is this idea that the experts get to decide. But I think that people who live in these areas are also experts. Interacting with them leads in the end to better projects. (Rodenhuis 2002)

In 2001, The Nijverdal traffic tunnel was still in planning stages, and was still one of the biggest issues facing the municipality of Hellendoorn. The VVOT was still lobbying in favor of combining the traffic tunnel with a train tunnel, but the price tag was so high Deurlo still believed the project would never be approved (Staff Reporter for De Twentsche Courant Tubantia 2001).

Twente Case Study: Discussion

The Twente Science shop illustrates an important facet of science shops—that they be flexible to fit many different organizational niches. This ability helps them secure a place as a representative model organization in a university setting. This science shop has survived several episodes of university restructuring because of its ability to align itself with different university goals, including research, education, public service, and most recently, regional economic development and entrepreneurship. Science shop advisory committees and policy studies have kept staffpersons abreast of the latest university changes and helped them articulate the relevance of the science shop to the overall university mission. It also illustrates a challenge in the representative model to combine the interests of students in technical fields with the needs of social interest groups. In the absence of organizational role models, science shop staffpersons develop expertise to combine these two interests. At the Twente Science Shop, coordinator Schlüter has sought to overcome the dearth of incoming technical questions by creating criteria that help them choose research projects for the socially responsible segment of the small business sector. (The example of the Eindhoven science shops in Chapter 5 illustrates another approach to overcoming similar obstacles).

In the VVOT project, student Rodenhuis was more comfortable with representative model arrangements than with engagement and partnership ones. Nevertheless, working by the representative model necessitates a significant change from the normal course of student research. Rodenhuis was able to produce a report the client group could use only by extending her research past what she had perceived as her original commitment. Further, tensions between the representative and engagement model arose when Rodenhuis had to conduct 'non-scientific' activities in order to produce a scientific report. This example illustrates the role of the faculty advisor and the science shop in facilitating different configurations of democratic expertise.

Rodenhuis intervened to stop the client group from taking up too much of her advisor's time. She was concerned that this work was outside of his responsibilities as university professor or that as a paid consultant, he should not have to give out his services for free. Students may do this in part because they accord a lower status to activist groups, especially when compared with other faculty activities, such as teaching, publishing articles or, doing paid consulting work. The discrepancy in value may be a reason why some students are reluctant to ask for faculty guidance during a research project. Both student and client suffer as a result: the student's educational experience is diluted (representative model) and the client is kept from discussing their concerns with the most professional expert available and from potentially learning more about scientific theories and models in the process (partnership model). Further, if the report is not as scientifically robust as possible, this may lead to problems down the line if the client tries to use the report in a political arena, where it may be subject to review by other experts (engagement model). In retrospect, Rodenhuis felt she might have done better with more advice from her advisor (Rodenhuis 2001).

Compared to the Nijmegen minority entrepreneurs project, the VVOT case study emphasizes science shop engagement model activities. Using his journalistic experience, Schlüter integrated publicity into intermediation and offered the student an opportunity to take on engagement model activities. Rodenhuis, however, declined to speak to the press because she was uncomfortable with the tendency of the press to take research out of context and gloss over inconclusive results. Engagement model activities present a unique opportunity for students to learn about the representation of scientific information. Students can learn about the transformation of scientific knowledge as it moves into a broader public sphere. The inclusion of students in the media aspect of a science shop project not only enhances their experience, but also increases the legitimacy of the client group by having a university student who can speak knowledgeably about their case. Yet these activities can be threatening to students' perception about scientific objectivity.

This case illustrates tensions in the engagement model over discrepancies in the conditions for closure and over the meaning of success for client, student, and science shop. The VVOT used the engagement model skills of the science shop to inject an alternative view into the political process. But for Rodenhuis, this had little relevance because the decision-making bodies were not engaging with her report's scientific content. The way Rodenhuis described her attendance at meetings as ‘indirectly’ related to the project suggests a difficulty students face when confronted with political situations and client groups who want to be involved in the research process. Rodenhuis realized the scientific aspect of her work depended on her understanding the political situation into which it would be delivered, although she begrudged the amount of time she had to spend on ‘non-scientific’ topics. Differences between the three models of democratic expertise became blurred in this case because it became necessary for the student to take on engagement and partnership model activities in order to complete her research. Even though engagement with news media through a science shop project can help students develop their critical thinking about the media and their professional communication skills, students may be reluctant to take on such activities out of fear the media corrupts scientific data. In addition to interacting with the media, the science shop may also become more directly involved in political decision-making. Such activities help students develop a broader understanding of how science is used in government.

Compared to the Nijmegen case study, partnership model collaboration in this case proceeded more independently from the science shop once the initial project was organized. This difference may be because the minority entrepreneurs project appealed more directly to coordinator El-Guada who fought hard to do this project whereas the VVOT project had more political urgency for Deurlo, the primary contact person. Because of his social concerns and his professional experience, Deurlo kept abreast of developments within the municipality and opinions of political leaders. Collaboration put considerable pressure on Rodenhuis, which was further aggravated by her desire to act as a third-party mediator between the client and her advisor. This example shows some of the inherent difficulties of performing research for invested client groups to use in dynamic political processes (engagement model) and how critical it is for a science shop to take a proactive role in regulating interaction among different stakeholders in a project—a student must be able to rely on experienced people for focus and guidance.

Maastricht Science Shop

Maastricht University, the Netherlands' youngest university, has seven faculties: health sciences, economics, law, cultural studies, psychology, general sciences, and medicine. Lists of science shop projects correspond to these faculties. For example, in 1999, some incoming questions included:

> From the Foundation for Attention Deficit Hyperactivity Disorder: What can be done to improve care for adults who suffer from the "kids'" disease, ADHD?
>
> From ALMA FdEWB[31]: What is the feasibility of a light rail connection among Maastricht, Aachen, and Diepenbeek?
>
> From the Organization for the Preservation of the Ravelijn: By what legal means can residents secure historical status for the former "life-skills school"?
>
> From the Foundation for Work for the Elderly in Leudal: Has the position of caretaker at the Thorner Neighborhood complex been successful, and should it be funded in the future?

Other science shop projects have included conducting a cost-benefit evaluation of an organization that supports people with handicapped and developmental disorders, developing promotional materials for a patient association, researching the social effects of women in traditionally male professions, and inquiry about how parents of children with autism confront feelings of shame when their children develop sexually (Annual Report, 1988/1989). Many of their clients are loyal customers, returning for two, three or more research projects.

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[31] ALMA is the name for the cooperation between the universities of Aachen, Liege and Maastricht. FdEWB stands for the Faculty of Economics and Business Administration (*Faculteit der Economische Wetenschappen en Bedrijfskunde*).

In 1999, shortly before the science shop moved down the street, its five offices were distributed over two floors and accessorized with six computers, one bathroom, a kitchenette, and two (practically live-in) students working on a project. The office, in quaint downtown Maastricht, was nestled among university buildings, many of which are in old cloisters. If the windows on the front side were open, one could hear the needles in the tattoo parlor across the narrow street. If the ones on the back-side were open, one could hear sounds wafting from the music conservatory and smell food from the main campus cafeteria, where the science shop staff and students eat lunch together several days per week. On their way, they might greet people by name, and pass by students pamphleteering just outside the cafeteria's entrance. On any given day, the students could be from a national student club Integrand—the name embossed on their yellow and blue windbreakers—that places student interns at companies such as Unliver, Proctor & Gamble, or Sarah Lee.

Maastricht University was founded in 1976, well after the height of the social movements that inspired the earliest science shops. But in 1984, the University Board of Directors requested the university establish a science shop. The science shop's first Annual Report defines its goal as follows: "to strengthen the overall goals of the social movements" (Wetenschapswinkel Maastricht 1985: 2). The first year, the science shop advertised to potential clients, faculty and students, and solicited questions from environmental, anti-racism, and nuclear disarmament groups. According to the annual report, more publicity was necessary to reach their desired client base, and they set the goal for the following years to "better communicate our existence and mission to our client base in the province of Limburg" (Wetenschapswinkel Maastricht 1985). In 1986, two workers in the science shop went to Berlin to visit two science shops, one centralized science shop and another specializing in healthcare. The same year, the university approved a regular operating budget of about NLG

100,000 and an internal research budget of NLG 50,000. They did not use this full amount, as their second annual report explains, because they needed more time to develop their knowledge of regional issues and regional actors (Wetenschapswinkel Maastricht 1985). At that point, the science shop was essentially a one-person operation. As the university expanded both the number of faculties and research groups, so did the science shop. By 1990, they had 2 full-time staff lines that funded four personnel, including two mediators and a secretary (Chemiewinkel Eindhoven 1990). By 1999, the science shop had 3.5 FTEs divided among five paid staffpersons. Of the NLG 400,000 operating budget, about NLG 300,000 came from the university to pay for salaries and benefits. The remainder, which paid for materials and overhead costs, came from the university (NLG 60,000) and client subsidies (NLG 40,000).

The five staffpersons of the Maastricht Science Shop form a family unit of sorts. Maurice Evers, the director, did several science shop projects as an economics student before becoming a paid employee. He specializes in economics but is also interested in alternative cancer therapies, especially the use of foods and diet to control cancer. He sees the potential of the science shop to stimulate university research in directions that, as he says, “do not cater to the pharmaceutical industry” (Evers 1999). Of the other three intermediators in 1999, Jo Haesen and Marieke Lieshout mediate questions in the social sciences, and Monique Latour specializes in law. Three days a week, Lieshout’s salary comes from her job as intermediator on questions related to women’s studies, psychology, and health, and for the fourth day, she is paid to be the general secretary for the LOW.[32] She organizes and attends bi-monthly meetings in Utrecht for the directors of all the science shops. Marja Korving, the secretary, works and lives in Maastricht three days a week, and spends the rest of the week a few hours

[32] Dutch Science Shop Forum (*Landelijk Overleg Wetenschapswinkels*).

north in Den Haag. (Korving left the science shop during 1999 and was not immediately replaced.)

The science shop has tried to organize projects around specific themes of regional importance. One way is through the “Grensmaas” (Border-Maas) Project. Grensmaas refers to an area in Holland and Belgium along the banks of the Maas River significant for economy and environment in the province of Limburg. The provincial government of Limburg mapped out a plan to study three areas: mining, creation of natural areas, and increased protection from flooding. Anticipating this provincial project would be important to Limburg interest groups, the science shop organized their own Grensmaas Project and asked their advisory council for help. The idea was for the science shop to initiate multi- and interdisciplinary research projects on topics such as responsible mining practices, ecological reconstruction of the river banks, and flood plain protection that would be used in policymaking on sustainable economic development in Limburg (Hendriks and van Mierlo 1999).

Maastricht Case Study: Maastricht Aachen Airport

Another issue of regional importance was the potential addition of an East-West runway to the Maastricht Aachen Airport. This was a sensitive regional and national issue that had been sharply divided along political lines. At issue was the potential transformation of what had been a small airstrip into a regional airport that might expand further to national and international services (van Mierlo and Haesen 1997). In the early 1990s, community and environmental groups succeeded in suppressing night flights departing from the airport’s current North-South runway. But in October, 1994 the national government started talks about the creation of a new runway. The airport was arguing that the additional runway would have immense economic advantages for the region—and specifically, that 1280 new jobs would be directly created and 5000 jobs would be indirectly created (Haesen 1999; Koolman 2000).

In December 1994, Hub Bemelmans, director of the Environmental Federation of Limburg (*Milieu Federatie Limburg* or EF), a local chapter of a national organization, asked the science shop to critically analyze the economic evidence presented by the airport. The EF was opposed to expansion for a number of reasons, including increased noise pollution, loss of animal habitat, the ecological impact of flying, and ultimately, the perpetuation of an unsustainable economy (Bemelmans 1999).[33] The airport's contention that a new runway would stimulate so much economic activity created a stir among provincial and national government leaders (Koolman 2000; Haesen 2001). The economic state of the province of Limburg had become a significant source of concern. Where once there had been a thriving industrial sector, the decline in the mining industry had put great numbers of people out of work (Bemelmans 1999; Haesen 1999; van Mierlo 1999). But Bemelmans suspected the airport's employment statistics were grossly inflated. He pointed out to the science shop that, for example, the airport did not specify that many of these jobs were temporary (Bemelmans 1999). The science shop accepted the project and asked economics professor Hans van Mierlo to sponsor it.

The EF Limburg is a member of a strong national organization and who has some access to in-house scientists. In the past, Bemelmans has worked with science shops in Utrecht, Delft, and Eindhoven because these universities have faculties such as chemistry, biology, urban planning, and landscape studies and Maastricht University does not. EF likes to have research commissioned from outside its own circles in order to use the research effectively in

[33] A number of other organizations had rallied around the airport issue, such as Mad Mothers (Boze Moeders), Association Against the Expansion of the Beek Airport (*Vereniging Geen Uitbreeding Vliegveld Beek*), and The

a political context. If it comes from outside their organization, they find it is more easily accepted as “neutral” or “unbiased” research. Bemelmans described how he uses the science shop’s independent position to legitimate the EF:

> We *could* do research ourselves and then take it to the province. But people would say it’s biased–because we did it, and it is our interests at stake. When the science shop does it, people know it is the work of an independent researcher. (Bemelmans 1999)

It is not just that the science shop provides access to knowledge in general, but access to knowledge from the university widely perceived to be independent. Politically savvy clients such as the EF have learned they can make better use of scientific expertise when it originates from the university-affiliated science shop. The science shop does more for an NGO than provide access to scientific knowledge, they provide access to research that, because it is perceived to be independent, is more usable in political contexts.

Nevertheless, the science shop worked to keep the EF involved throughout the intermediation process (partnership model). van Mierlo explains how the science shop involves the client in the research project through a series of meetings during which choices are made about the research trajectory, research methods, and possible outcomes:

> It takes time to negotiate these questions; this is the science shop’s contribution. A good science shop worker knows the university faculty and has enough academic expertise to have an overview of the disciplines. Talent in the field of diplomacy is also essential. During the intake process and throughout intermediation, science shop workers get the student, client, and advisor thinking together. (van Mierlo 1999)

The science shop intermediators are skilled at developing feasible projects that fill students’ academic requirements and produce usable results. The extent of collaboration depends on the client. Intermediator Haesen explains:

> Some of our clients are much more politically savvy than we are. [Bemelmans], for example, knows lobbyists who will tell him when something absolutely has to be

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Stewards *(Rent Meesters*), but the EF was the most closely involved in the political debate and most familiar with the economic arguments used by the airport to justify expansion.

> delivered to a member of parliament. Other clients think they are professional, but it is actually better for us if they aren't involved in the process. (Haesen 2001)

For the airport study, the science shop formed a committee of Bemelmans, economics student Xander Koolman, Haesen, and van Mierlo, who is also a member of the science shop's advisory council. The task of scheduling meetings to accommodate multiple schedules can slow intermediation. Bemelmans explains:

> Sometimes you want a quick answer, but you are dependent on the student's schedule. You might think of a good research project. If that happens during the summer vacation you have to wait until the end of September to even ask it. If you want an answer or a research project, you have to wait even longer. (Bemelmans 1999)

Science shop employees are aware of the problem and work to warn clients of potential time delays. On the way out of an intake meeting with a new client in the healthcare sector, Haesen expresses his concern the client was much too optimistic about the time frame for project completion.

> I am just sure they are being too optimistic about the timeframe. They have some money to pay students to collect the data, but I fear it will not solve all the time problems. I don't think they understood there is no way for me to guarantee a date by which the research will be completed. I tried to explain this to them, so they are not too disappointed with us. (Haesen 1999)

Because interest groups must work within tight deadlines, the length of science shop projects often impedes their ability to use the research.

The committee eventually agreed Koolman's study would critically analyze the employment statistic (creation of 1280 jobs). They did not think they would get reliable data through a written survey so they designed a phone survey in which Koolman would ask the directors of regional companies about the number of employees they have as a direct result of the airport. First, he would ask, "What factors have played a role in your decision to locate where you are today?" After a number of other questions, he asked: "If the airport closed tomorrow, what consequence would this have for your company?" If the company responded it would have no effect, Koolman would conclude these jobs were not *directly* related to the airport (Haesen 2001). A few days later, he would summarize the answers in a fax, specifying if they did not respond within a few days, he would assume his figures were accurate. Tabulating the responses, Koolman's questionnaire yielded a figure of 417 additional jobs that would be created as a direct result of a new runway, far fewer than the airport's estimate of 1280.

Tensions between wanting to produce good scholarship (a representative model concern) and wanting it to be useful for their client groups (engagement model) are underscored during the process of designing research and students' attention to the considerations that underlie their choices in research design. For example, Haesen reflects on the committee's choices:

> The phone survey really hid the really important question in order to try to get a more honest response. As a science shop, you are not really independent with regard to your choice of research question. You can choose a method that is favorable to the client. But the strength of the result was still very clear: everyone knew 1280 jobs was an inflated figure. When an independent institution says it, people can't ignore it (Haesen 2001)

Koolman describes his methodology as "back door approach" that was reflexive about the needs of the client group and how those needs influenced their opinions about the research design.

> It's understandable why they [EF and others on his committee] wanted to portray the employment data used by the province and the airport in as negative light as possible. But a researcher can't do that. What a researcher *can* do is look at the whole discussion and then focus on one questionable statistic.

When collaborating with an interest group, students rely on conventional models of science to establish a middle ground between the client's needs and what they understand to be an acceptable research design.

Although Koolman's role in this project did not involve direct political action (pace the engagement model), he previously had been an active member of the committee on regional economic development within D’66, his political party. He chose the science shop project out of an interest to combine his political interests with his economics studies. In addition to the political appeal, Koolman was motivated by the stipend and by the chance to use the research toward building a professional reputation as a researcher. The science shop reasoned that Koolman’s confidence would be vital to the phone survey. Two years after Koolman graduated, he was working at the University of Rotterdam as a paid researcher in economics. He reflected on his experience with the science shop in the bright, airy living room of his new flat:

> Economics tells you how things are supposed to work. But things hardly ever work out the way they are supposed to. Why then, do politicians keep listening to economists? I thought a good way to find out would be to do research and then to try to understand how it gets used in the decision-making process. (Koolman 2000)

Koolman hoped to learn something about the movement of scientific knowledge through the political machine from his science shop project.

Because the EF wanted to use the research results to challenge the employment statistic, Koolman and his committee anticipated the project itself would come under close scrutiny. Koolman knew he had to be not only meticulous about his data collection and analysis, but also about how he explained these methods in his report. The way Koolman understood these responsibilities and used them to choose a research question and methodology relates to the development of his own professional identity:

> We had known from the beginning our results would be controversial and possibly attacked. So I needed to articulate my research methods as clearly as possible. If you're clear about your methodology, then you shouldn't have much to worry about. (Koolman 2000)

Koolman took extra caution with his research methodology and the report’s method section because he considered the scientific credibility of his project a critical factor in how his report would be received by the public.

The desire to produce independent research (or more specifically, to produce research independently) may conflict with the constraints of political processes. At a certain point it became evident that Koolman needed the help of the committee to finish his project—this because of a newly imposed deadline. Haesen explains:

> Xander was having trouble just getting his report done. But there was a lobbyist in parliament who told Hub the report had to get out right away: otherwise, the whole effort would have been in vain. (Haesen 2001)

A consulting agency was about to publish another report on the airport that was certain to gain regional and national media attention. For Koolman's research to have any substantial impact, the science shop needed to release his report at the same time as the other report. His committee scrambled to read a draft of the report and help with the final edits. This concerned Koolman:

> At first I worried whether this would still be independent research. I considered their suggestions and I asked myself: If I take their suggestions, can I still feel my results have not been manipulated? Can I still trust my results as they are presented? (Koolman 2000)

He worried that by accepting help from his committee, which included Bemelmans from the EF, he would be allowing his research to become biased.

As soon as the report was finished, but before it was sent to the printer and bound with a science shop cover, the science shop faxed the report to the government. Haesen recalls:

> I remember that night, feeding those thirty pages into the fax machine. It was so important to get the report out to the member of parliament that we gave them priority, even over the press, the provincial government, and the airport. I knew this was going to be big. So the next morning I came into the office much earlier than usual. And sure enough, at 8:30 am, there was a man from the provincial government at the door asking to see the report. (Haesen 1999)

The success of political work (engagement model) may hinge on flexibility of staffpersons to adjust their work schedule to externally-imposed time constraints.

Working with clients can also improve students' understanding of the different implications for the presentation of scientific information (relationship between engagement and partnership models). When Koolman showed his report to his committee, they gave him extensive advice about phrasing. He was surprised by how, through careful word choices, they could convey subtle points that would, they hoped, make a difference in how the information was perceived and processed.

> When I showed my first draft to my support group [the committee], I was amazed at how they agonized over words and phrases. They made very specific suggestions about phrasing, such as what to emphasize and how. At first, I didn't see the point. Then I saw how small changes made big differences for the meaning. They had a lot of experience with presenting results effectively. And they were so helpful in helping me to finish the report. (Koolman 2000)

These interactions altered Koolman's perception of how scientific information is (and can be) presented to the public. He gained an appreciation for the relationship between language and science. The subtleties of writing mechanics can be used as a resource for depicting scientific information, something Koolman had not before appreciated.

When the story broke into the press, Koolman responded to press inquiries about his research. But he unwittingly became the subject of numerous articles and letters to the editor. In a letter to the editor of the provincial paper, the director of the airport, R.B. Lenterman, uses language such as the "the youngster" and "little report" to disparage Koolman and his research. He puts a question mark after science shop ("science shop?") to ridicule their name (Lenterman 1995). In a later article, Lenterman derided Koolman as a "mischievous youngster from a science boutique" (van Dorst 1996). Another article, entitled "More Airports are Better for the Environment" attacked Koolman's university record:

> This student is being taken way too seriously. He's been in school for seven years, and he still hasn't graduated. No one even bothered to check his work…If he were my son, I would have made him find a job a long time ago. (Bruijns 1996)

In addition to Lenterman's letters, the CEO of one of the companies in the study, a large shipping company, went on record saying Koolman had falsified data—saying that they never spoke. This CEO later admitted to Koolman that he had been under pressure from his parent company to do this. This confession had the effect of giving Koolman a sense of personal vindication (which he wanted), but it did little to change the course of events (Koolman 2000). Those affiliated with the science shop also defended the science shop in the press. van Mierlo, the faculty advisor, and Joe Wachelder, chair of the science shop's advisory board, wrote letters to the editor in defense of Koolman and the science shop. The incident illustrates how the science shop work does not end at the point of providing scientific research and how politically controversial situations may subject science shops to public criticism.

Another effort by the science shop to extend their role beyond scientific research was by organizing a conference around the airport issue. The goal was to stimulate discussion among stakeholders, and possibly generate more research projects. A brainstorming memo proposed a conference organized around a central question: "From a scientific perspective, what can be said about the health and employment consequences of an East-West runway?" (Wetenschapswinkel Maastricht 1995). They invited representatives from local non-profits, policymakers from the Ministry of Transport, Public Works and Water Management, Dutch Air Force officials, university professors, and students. Additionally, students from four (ongoing and recently completed) science shop research projects were invited to present their research:

1. An analysis of the potential health costs of airport expansion (van Elderen and Jeurissen);
2. An analysis of present and future employment effects of companies in the Technoport with respect to Airport expansion (Koolman 1995);
3. A comparison of airport expansion to alternative transportation methods such as TGV or alternate airport use (Oosterloo and Evers 1996); and
4. An examination of policy reports on employment effects of the airport expansion (Wetenschapswinkel Maastricht 1995; Harkema 1996)

By including a range of regional stakeholders, the science shop hoped to provoke additional research questions pertinent to regional and national decision-making regarding the airport. At the last minute, however, the conference was cancelled. The airport expansion had become such a politically sensitive issue that several speakers backed out. The science shop decided it would not be in the interest of their client groups to proceed (Haesen 1999).

Whereas Koolman had anticipated that the airport issue would become very sensitive, he was surprised when he became a focal point of controversy. In his view of how science is supposed to work in public debate, the researcher does not figure in to discussions of whether the research itself is credible. He was defensive about his decision to do the science shop research in spite of the extra time it would cost him to finish his final thesis:

> My report showed exactly how the airport derived their employment statistic and why this was based on faulty assumptions. I didn't want to leave any room for debate, so some other party could not come along and say we were biased because we had been hired by the EF. But I was shocked. They made me look like a terrible student. I *did* take a longer time to finish my studies because I went to Ireland. They tried to use the number of credits I got for this project against me. But I did this project out of love, not credits. I had expected they would question my results, but I never expected them to attack my dignity. (Koolman 2000)

For Koolman, these political tactics were out of place in a world where policymaking was supposed to rest on rational, scientific evidence and where scientific information is evaluated based on the robustness of research methods, not the personal background of the researcher.

The science shop and Koolman were not only attacked publicly, but also were the subject of behind-the-scenes maneuvering by the airport director, Lenterman. Lenterman wrote the governor of the province to ask him to use his personal connection with the chairman of the university board to suppress the science shop research. He contended the latest three science shop reports on the airport (by Koolman; Oosterloo and Evers; and Harkema) were the epitome of “bad science” (Lenterman 1996). He pointed to what he called “faulty methodology,” and “faulty assumptions” in Koolman’s research:

> We have determined the questionnaire was not even administered to several of the companies named in the report. Therefore, the Rijkswaterstaat has submitted incorrect information to Parliament. The conclusions were based on insufficient research, misleading questions, and carelessness. (Lenterman 1996)

Lenterman argued the science shop research jeopardized the academic reputation of the university, but that only the university could take direct action against the science shop reports:

> We’re not sure what direction to take on this. If we were to take this directly to the university, the press would misinterpret our motives. If we were to take part in a public debate with this bunch of conniving boys and girls, then our operations would be threatened. (Lenterman 1996)

By asking the provincial director to intervene on the airport’s behalf, the airport director was trying to avoid a public confrontation that could backfire and further legitimate the science shop’s work.

The governor wrote the chairman of the university board later on that day. He asked the university president to verify the credibility of the science shop research:

> This morning I received a letter from the Director of the Airport. He is concerned over the “Science Shop” report, but is anxious to prevent any public dispute over this matter…I am enclosing the letter I received from Lenterman…I await your word that the “Science Shop” reports are worthy of the university name they carry. I sincerely hope the “Science Shop” is not about to drag the name of the university through the mud. (van Voorst tot Voorst 1996)

En route to a confidential university archive, the letters were diverted to a local journalist who gave a copy to Bemelmans, who faxed it to the science shop (Haesen 1999). The science shop committee met to draft a response and both were printed in the Maastricht daily paper. Because of their close collaboration with the EF and because of their ability to take on responsibilities not normally considered within the realm of science, the science shop was able to respond quickly to accusations against them in the press.

University credibility increases science shops' effectiveness in the political sphere. Stakeholders use their association with the university to preserve or bolster their credibility. Pointing to the university logo on the cover of a science shop report, van Mierlo explains:

> As university professor, my job is to guarantee the quality of the research. This logo symbolizes this quality to the outside world. It says we are not financially beholden to the client. It tells people this research was not done by some obscure or biased consultancy bureau, but by an independent body. (van Mierlo 1999)

Despite extensive scrutiny from the public, the press, and the university administration, the science shop report withstood accusations of bias. This helped the EF to make their argument against airport expansion.

In the end, the provincial and national governments decided to postpone expansion of the airport. The science shop used the increased attention from the university to renew its relationship with university administrators, which had, up to then, been what Haesen describes as "neutral." Several months after the scandal subsided, top university administrators visited the science shop to become reacquainted with its mission and methods. The meeting turned out to have a very positive effect on the science shop and its position within the university (Haesen 1999).

At the end of the airport project, the steering committee did not meet again to officially evaluate the project. Haesen explains why he does not spend more time on post-project evaluations, and how this is related to what he sees as a general deficit of professionalism at the science shop.

> We *should* ask the client what went wrong and what went right. The problem is we *know* what went wrong. It always takes too long! But the science shop could mitigate this by taking more of a professional attitude towards all its tasks. When a client first contacts us, we should respond in writing within a certain time frame. We should be

> able to reject students who are not appropriate for the project. In general, we could be stricter with how we write contracts and fulfill agreements (Haesen 2001)

Maastricht Case Study: Discussion

The process of intermediating the Maastricht Aachen Airport project shows how critical the phase of defining a research project can be to the overall success of a project (connection between representative, engagement, and partnership models). The ability of the science shop to hire a student and finish the report by committee shows how time constraints are navigated to publish the research that caters to the media's rather than the scientist's timeline. The very public nature of this project calls attention to the educational value—replete with frustration and disillusionment—of having research emerge in a very controversial public issue. The science shop project may benefit the professional development of both the researcher and the client group but has equal potential to cause harm.

This case study highlights several important points about the intermediation process. The ability of the intermediation committee to limit the research to one statistic of dramatic importance to the debate helped keep the research to a manageable size. This case also shows the kind of involvement, from start to finish, the client may have in the research process. This interaction, though not in the scientific process per se, demonstrates the possibilities for community groups to have an expanded role in the overall production of scientific data. Time constraints were extremely critical to this case, which shows how the ability of the science shop to pay the student added a measure of accountability that helped streamline the process. Had the report appeared later, it would not have received the amount of publicity (or, for that matter, criticism) it did. The involvement of a student in a politically controversial issue illustrates how the science shop research may jeopardize a students' career. Koolman was glad to be leaving the province of Limburg, because he thought this project would negatively impact a local job search (Koolman 2000). Although this worry may have been more perceived than real, it demonstrates how a high-profile case has potentially negative consequences.

The engagement model role that vaulted Koolman into the public eye changed the way he thought about the role of science in political decision-making. The attention paid to his academic record eclipsed the arguably more substantial issue of scientific methods. He was not able to adequately defend his academic reputation because many of the events happened after he had left town. By that time Koolman (in what Haesen admits was a “huge failure” on the part of the science shop, had discarded most of his original documentation (Koolman 2000; Haesen 2001). While he did seek vindication for his character and his research by phoning the CEO who denied their earlier conversation occurred, and was relieved when the CEO retracted his original remarks, his interest in politics has waned:

> Since the incident, I'm a lot less interested in politics. It's not so much I distrust economic science. But I think if you want economic arguments in favor of your point, you can simply buy them. And I don't really believe in objectivity anymore. The strong publication bias in science means you try to manipulate your data to show your results are significant. If not, you won’t be published. I’ll never trust a result that is simply significant, now that I've seen all this and I've worked in science for a while. (Koolman 2000)

As a result of this public confrontation and his later work as an economics researcher at the University of Rotterdam, Koolman became more skeptical of the ability of scientific information to improve public policy decisions because of the malleability of economic arguments and the ease with which different parties can marshal these arguments for their goals.

This project also illustrates the dissonance between two ways of seeing the science shop’s relationship with its client. On the one hand, when it comes to questions regarding bias, there is a need for the science shop to distinguish itself from ordinary consultants, who have a reputation as “scientists for hire.” The client, then, is supposed to be just another party with a research question who manages to find a university student to answer the question. On the other hand, the science shop client is supposedly a partner in the research, and increased client involvement improves chances of client satisfaction. The science shop then finds itself in the somewhat absurd position of defending itself against any accusation of bias by trying to explain not all their clients are satisfied. In response to this predicament, science shop intermediators take a different approach to each question, favoring one of the three models depending on factors such as the client’s political goals, expertise, and interest.

> People ask us all the time whether are clients are all satisfied, as if that is the way to show our research is not biased. It is the work we do in intermediation that determines the outcome. We look for a way to phrase the research question so the client is satisfied, regardless of the exact nature of the findings. (Haesen 2001)

The Maastricht Science Shop responded to this tension by constructing boundaries between what was considered the research (taking a survey and analyzing the results) and what was not (editing the report to be released to the public).

To use the airport example to explain how the science shop works is somewhat of an unfair example, because it may give the impression that many science shop projects are subject to controversy and contested by regional actors. In fact, this is not so much the norm as the exception. It is striking so few science shop projects are as controversial as the airport project. Most cases more closely resemble what happened in the Twente case study: even when the project gets media attention, there is not necessarily controversy over the integrity of the researcher.

Conclusion

These case studies reveal different aspects of the three models of democratic expertise as they are pursued at centralized science shops, as well as overlaps and tensions between the models. The case studies illustrate how different strategies may be employed depending on the type of client, as well as client/student/employee interests. The three models often play against each other. For instance, sometimes partnership model collaboration is needed to stimulate scientists to produce research in the representative model. In addition, sometimes the partnership model is held back in order for the science shop to achieve engagement model goals—this is seen particularly in politically sensitive cases, when the distance between the scientist and the client is used as proof the science shop research is independent. When the client group must have research by a specific deadline, the engagement model may interfere with the representative model. The reverse may also be true, if the client group is unsatisfied with the research report (for example because they intend to send it to legislators or to their constituency to underscore a particular point), they may delay publication, which could interfere with the ability of a researcher to publish “timely” research.

The first case study in this chapter illustrates the importance of a client to the practice of the representative model. In theory, universities might be able to support social goals within university research without the presence of science shops. This was, for example, the argument used at the University of Amsterdam to close its science shop. The case studies in this chapter show how third party mediators bridge different interests and make projects possible. Even though El-Guada, the leader of the Minorities Group at the Nijmegen Science Shop, wanted to proceed with a research project, she found it too difficult to try to produce relevant research on minority entrepreneurs without the presence of the original client, Osmose. This case study also illustrated the student’s struggle to produce a robust theoretical framework in the context of her cultural anthropology curriculum, while at the same time tailoring it to a current social concern. The time it took to wrestle with these issues might have detracted from the utility of the research had the client needed the science shop for political purposes (tension between representative and engagement models).

The second case study highlights a central difficulty with the representative model. While some students are certainly eager to participate in the real-life aspect of science shop work, they may be troubled, as was the student in this case, by the extra effort spent on details that seem peripheral to a project's scientific "core." Generating student interest in the political context presents an obstacle to both representative and engagement model practice. In the engagement model, media savvy science shop employees help client groups promote their issue in the media. For VVOT, the press coverage was integral to their overall goal at helping deflect attention from the municipality and shift the decision-making responsibilities onto the Ministry of Traffic, Public Works and Water Management. The partnership model characteristic of involving clients in the scientific process was somewhat overwhelming to the student in this case; perhaps because of some combination of the professor's 'non-presence' and because the science shop did not take a stronger role in managing different stakeholders. Deurlo and others acquired specialized technical knowledge during the course of their activism and the partnership model might have been furthered if they could have interacted with the professor directly. Increased participation by the client might have also been instrumental in improving the clients' understanding of science—giving them an enhanced appreciation of the benefits and limitations of scientific methods and potentially improving their political caché.

The Maastricht case study illustrates how the science shop, using their university affiliation, maneuvered around accusations of bias. The client would have likely encountered similar or worse criticism had they tried to present their own research. The student's first-hand experience with the public presentation of a scientific result led him to be critical of both science and politics—though he opted for the former and out of the latter in his career choice. This is unfortunate because weaker societal groups need scientists who can understand the imbalance of power relations created from an imbalance of science 'buying power.' This angle fits with the engagement model because the science shop produced an analysis the EF could use to strengthen their position in public policy debates. Further, the science shop became involved itself in propelling media coverage of the project. The media coverage became part of the intermediation process, no less significant than the deconstruction of the employment statistic. In theory, it seems political controversy would not necessarily turn on how long a student has been in school—but on the integrity of the methods and analysis. The Maastricht case, however, shows how politically controversial problems put extra demands on the scientist; precautions must be taken—and even those do not guarantee students' protection from slander. Finally, the partnership model angle on this project shows how the intimate knowledge the EF had of the issue and the political process helped the science shop 'support group' focus narrowly on what amounted to the airport's Achilles' heel, the employment statistic.

The case studies illustrate how the earlier prediction that centralized science shops would not do research themselves has not come true. There is so much participation by the science shop staff during the course of a research project it makes no sense to conceive of centralized science shops as merely passing research topics from clients to researchers. One of the biggest assets of the science shops is that employees are closely involved in all aspects of the research projects to meet the interests of students, clients, and even science shop staff. Moreover, some science shops, such as Nijmegen and Maastricht, have internal research budgets that allow them greater latitude in choosing socially relevant research topics. These projects allow staffpersons to participate in designing research to better suit their personal interests.

Also contrary to earlier perceptions of science shops, centralized science shops do not necessarily do multidisciplinary research. They are constrained by the interests and imaginations of the university student body and faculty advisors. Because they—for the most part—do not have staffpersons who can serve as faculty advisor for science shop projects, centralized science shops may often find themselves in the uncomfortable position of having an advisor approve a student project that does not meet clients' needs. Staffpersons try to prevent this situation from happening through their close watch over the entire research project, but they may often need to rewrite student reports, or at least append them with an introduction or conclusion, so the client can use the contents to pursue additional goals. Examples in the next chapter illustrate the difference at decentralized science shops, whose employees often are the students' faculty advisor in science shop projects.

Another aspect of centralized science shops illustrated by the Nijmegen and Maastricht case studies is the need for science shop staffpersons to frame questions in a way that is interesting to them and to students. Even though centralized science shop employees do not necessarily perform research, they are more effective when intellectually stimulated by projects. Their involvement in the research formulation, process, writing, and implementation is key to all three types of democratic expertise. For instance, clients value not only scientific knowledge but also media coverage, a bound report with a professional cover and university logo, and the status gained by association with university researchers. In Nijmegen, El-Guada's interest was instrumental in developing the research project. In Maastricht, the personal interest Haesen (intermediator) and van Mierlo (the advisor) took in the research allowed the science shop to successfully help their client influence national and regional policy. In Twente, a greater personal interest from science shop employees may have helped to mitigate some of the difficulties between student, advisor, and client.

The current university environment supports science shops primarily as a representative model organization (for student education and research projects), although science shops have found ways to pursue engagement and partnership model goals. Science shops are challenged to find professors who can value all three models of democratic expertise and who understand the larger benefits to students beyond simply supplying research themes to students so they can graduate. These case studies illustrate ways in which engagement model activities have the potential to teach students to complexify their understanding of how scientific knowledge is distributed and used in the public sphere. Partnership model activities have the potential to challenge traditional views that scientific knowledge is generated only within university settings and to help demonstrate the subtleties of oral and written communication.

CHAPTER 5: Decentralized Science Shops

This chapter is organized differently from Chapter 4. Instead of presenting detailed case studies of science shop research projects, I present a brief sketch of the science shop system at four universities with decentralized science shops: Utrecht, Groningen, Eindhoven, and Amsterdam and then more detail focusing on one or two science shops at each university. I discuss the Groningen History Science Shop and the University of Amsterdam Chemistry Science Shop because their operations contrast other science shops—their clients are almost exclusively commercial organizations. The section on the Groningen Chemistry Science Shop, unlike the other sections in this chapter, presents more detailed information on one science shop project. (This is a result of my extended stay at the Groningen Chemistry Science Shop arranged so I would understand operations at both centralized and decentralized science shops.) Overall, the examples in this chapter highlight the similarities and differences between centralized and decentralized science shops. It also illustrates how the decentralized science shops' practice maps onto the different models of democratic expertise.

The primary difference between centralized and decentralized science shops, as explained in Chapter 4, has more to do with how they are supported at the university than with how they operate. Both kinds of science shops intermediate between scientists and client groups, but centralized science shops are part of the university administration. Decentralized shops are housed within academic departments. University administrations pay a higher percentage of centralized science shop budgets; decentralized science shops depend more on their academic departments for subsidies.

There are, however, some significant differences. Centralized science shops mediate projects in a range of disciplines, whereas decentralized science shops, for the most part, mediate projects in just one academic field. Centralized science shop employees are university graduates who tend to be generalists, familiar with a range of academic fields. Employees of decentralized science shops are specialists; they often hold faculty positions and can be the primary faculty advisor on student research projects. Decentralized science shop employees are more likely to co-author publications in peer-reviewed journals (e.g. Kersthold, Ree et al. 1997), although this does not appear to be a significant trend. Within each university, the decentralized science shops meet to share information about internal developments and university business.

The University of Utrecht has seven science shops in the natural sciences, social sciences, and humanities. A central office coordinates meetings among the science shops and publishes a magazine about their research. Groningen's eight science shops have much in common with each other and with the centralized science shops described in Chapter 4. Their History Science Shop is an exception because professional historians (not students) do the research. But even though it functions like a professional consulting firm, its academic philosophy remains very similar to other science shops. There are eight science shops at the Technical University of Eindhoven distributed throughout as many faculties. This example provides a good contrast to Twente, also a technical university but one with a centralized science shop. The Eindhoven case contrasts all the other science shops in Holland because its science shops are student-run. They operate similarly to a student club with a service-learning component. Each science shop is run by a board of four (third and fourth year) students. So, while most employees at decentralized science shops have professional credentials, Eindhoven is the main exception. The Amsterdam Chemistry Science Shop operates similarly to the Groningen

History Science Shop but because it is the only science shop at its university it operates in a different context than the other three universities with decentralized science shops—which rely on each other for help with university politics and funding.

This chapter also showcases how the presence of a staff scientist and the location of the science shop within an academic faculty makes a difference in the operation of decentralized science shops. For instance, decentralized science shops may have fewer problems regarding scientific credibility than their centralized counterparts. Centralized science shops are often at the mercy of faculty advisors, whose professional interests take priority over science shop projects. When decentralized science shops have in-house scientists who either mentor projects or at least are familiar with the field, they are better equipped to "police" the scientific content of student projects. Furthermore, decentralized science shop staff often have faculty assignments, which give them better access to academic faculties—this can help with attracting faculty and students to the science shops, and in general, integrating the science shop with the university community. Although not common, some decentralized science shop staff use science shop reports as a basis to publish in academic journals. This is theoretically possible at centralized science shops, but there seems to be little interest.[34]

Academic departments may protect decentralized science shops from university cutbacks. In addition to overhead support, departments are a buffer between the science shop and the university administration. This can be dangerous, however, because department cutbacks could have the potential to wipe out the science shop. Brigit Fokkinga explains why she opted to keep the Nijmegen science shop organized centrally:

[34] The Delft Science Shop is an exception. This centralized science shop at a technical university had professional staff who published articles in their fields. In 2000, however, the sudden death of their director, and the retirement of a few staff members, put the entire science shop in a position where it was unclear whether it would continue to receive university support.

> Decentralization isn't safe, at least not here. The university values the science shop because it cares about its public image, whereas the faculties aren't incentivized to care. (Fokkinga 1999)

Departmental cutbacks caused three decentralized science shops (economics, environmental studies, and medicine) at the Free University of Amsterdam Science Shops to merge into one centralized science shop in 1995, and almost closed the Groningen Chemistry Shop in 1990. (Of course being centrally located also does not make the science shop immune to pressure to close—as illustrated by the experience of the Leiden Science Shop, described in Chapter 3.)

In Utrecht, the Law Science Shop is a representative model organization with a clear engagement model angle: clients use research from the science shop to make decisions about taking legal action. The Groningen Chemistry Science Shop blends the representative, engagement and, to a lesser extent, partnership models. At the University of Eindhoven technical science shops, students conceive of their work in terms providing scientific information to their clients (representative model), and are often reluctant to levy attention on the political consequences of their work (engagement model). Yet because many of the science shops design technical equipment their clients' use, there is an increased emphasis on expert-citizen communication (partnership model). In contrast, the Groningen History Science Shop and the University of Amsterdam Chemistry Science Shop operate as professional consulting agencies (representative model).

Utrecht Science Shops

The seven Utrecht science shops have a central Coordinating Office (*Coordinatiepunt*) that gives administrative and marketing support to all the science shops. Two part-time employees work on university policy related to science shops, organize regular meetings, and run the public relations for all the science shops. Their annual budget is close to half a million guilders, most of which goes to pay for *The Store* (*Magazijn*), a glossy newsletter that profiles projects from all eight Utrecht science shops.

The Coordinating Office provides administrative support to science shops, thus freeing up their time for research projects. For example, other centralized and decentralized science shops—even if they do not have marketing skills or interests—must do publicity if they are to continue to receive university funding and client questions. The Coordinating Office hires freelance journalists to write about the science shop in order to help employees publish a professional and accessible magazine. In this way, the Coordinating Office improves the science shops' ability to do research and to place the research in a public context. The representative model is enhanced because science shops can focus on the research, and the engagement model is enhanced because articles by professional journalists are distributed in a magazine and also reprinted in newspapers.

Law Science Shop

The Law Science Shop has an office in one of the main buildings of the Law faculty in downtown Utrecht.[35] Their offices are at the top of a very steep flight of stairs, in a long office space with a pitched roof that has the cozy and detached atmosphere of an attic. The three staff persons, two intermediators and a secretary (totaling 2.2 FTE), each have desks in the main room, which is buttressed at one end by a conference room and a supply room at the other.

The Law Science Shop divides its budget into three parts: for materials (mostly overhead), income from reports, and money for commissioning professional research, so-called "non-

[35] The Law Science Shop (*Wetenschapswinkel Rechten*) is sometimes confused with the Law Shops (*Rechtenwinkels*) a network of non-profit organizations that provide legal counseling and representation.

routine research" (*niet-routine onderzoek* or NRO).[36] In accounting for the sales of their reports, they compare the total value of sold publications (NLG 4,437 in 2000) to the amount of money actually received in sales (NLG 3869 in 2000), in order to show the value of reports that were given away (NLG 1415 in 2000). The University administration allocated NLG 37,500 to the science shop for non-routine research in 2000, and the Faculty of Law contributed NLG 10,000 to the general budget. In 2000, the science shop had a materials budget of NLG 15,000, of which NLG 4970 was unused (Utrecht 2000). Financial data for personnel costs for the Law Science Shop are unavailable because they are paid for internally by the university (van Musscher 2001).

At the end of 2000 the Law Science Shop had thirty-six ongoing research questions at some stage of intermediation. In that year, four research projects were completed and led to published reports, and two others were completed that did not have accompanying publications. Of the questions the science shop intermediated during 2000, eleven were in the discipline of private law, eight in state or governmental law, five in international, social and economic public law, two in penal law, and one fell into the category of "legal theory or encyclopedia research" (Utrecht 2000).

Aside from their research projects, the Law Science Shop gives a course called "Legal Research and Advice in Practice," formerly "Science Shop Research." In 2000, as part of the course, a mailing was send of to 260 potential client groups, and of the responses, five were used as the basis for practical case studies. Students had to interview a client and then try to further define the problem and possible solutions. The course helps students develop oral and written communication skills. Through this course, law students learn how to improve their

[36] Staff acknowledged the conflation of revenue and expenses in their budget causes confusion.

communication with prospective clients, and thus become more effective representatives of citizen needs.

Like other employees at decentralized science shops, Rebecca van Musscher has a faculty position; she is a professor of constitutional law. In addition to her teaching, she stays current on new developments in legal studies by reading journals and attending a book-club type of discussion forum every two months. She points out this is only something she does personally, but it helps her overcome the difficulties of doing both the practical science shop work and keeping current on intellectual topics.

> This only happens because it is my personal interest. This aspect has not yet been integrated enough into the normal work of the science shop. When you have so many practical things to do, keeping up with academic journals is not a priority. Maybe this would change if coordinators did more research themselves. When a project comes in, I do a little bit of exploratory research in the beginning, just so I know what I am talking about, but that is different than doing a whole research project myself. (van Musscher 2001)

For coordinators at decentralized science shops, personal intellectual goals often keep them networked with scholarship in their fields, rather than specific tasks they have as part of their science shop jobs. As van Musscher suggests, such involvement may help science shops coordinators better tailor research projects to current academic topics, but is not integrated with science shop practice (van Musscher 2001).

By virtue of their subject matter, legal studies, the Law Science Shop is accustomed to working within political contexts on behalf of clients. For almost every project, they issue a press release, and as a result, there is media coverage of most of their research projects. Their clients often use the science shop research to effect a change in the law:

> Law is something that is just very close to the people. It depends on the topic, but about 1/3 of our projects concern problems between citizens and governments, either at a local or national level. (van Musscher 2001)

By staff estimates, at least one in ten students have contact with the Ministry of Justice, and at least four out of ten students work with municipal legislators. The Law Science Shop often acts as an intermediary organization for clients to explore avenues for making changes to the law (as opposed to helping them with legal representation for specific cases).

For example, one project concerned municipal policies regarding the subsidy of higher education for refugees. This project was somewhat unique because Sander Terphuis, the researcher, was not only a student, but also had been a member of the client organization, the Foundation for Refugees -- Students University Assistance Fund (*Stichting for Vluchtelingen -- Studenten UAF*). Terphuis, who became familiar with the science shop while taking van Musscher's course in constitutional law, took an inventory of how different municipalities interpreted the law with respect to education subsidies for refugees. In his report, "*Student or Sweeper*" ("*Student of Schoonmaker"*), Terphuis explored how different municipalities interpret the law with respect to higher education and welfare subsidies (Sociale Dienst Amsterdam 2000). He found that some municipalities required refugees to work, while others granted subsidies to complete a course of study. He presented his findings to the Ministry of Education and sent a copy of his report to a member of parliament who used it to begin the project of standardizing laws across municipalities (van Musscher 2001).

As at centralized science shops, the extent of client involvement in scientific research depends on the interest and background of the client. In many cases, science shop clients have extensive experience in the legal arena and have already been involved in actions to change legal statutes. One student researched a legal statute that requires female minors to have permission of their father to change their last name. A woman's organization brought the case to the science shop on behalf of an incest victim who had been trying for four years to change her last name, a change her father was trying to block. The client worked closely science shop. In this case, although the client organization had the skills to do legal research, the question was mostly of interest to one person at the organization, rather than the organization as a whole.

Law students at the science shop may determine the extent of collaboration with a client during the course of a research project. Van Musscher explained how the amount of interaction gets settled based on the interest of the client and the interest of the student:

> Most of our clients like to be in on the meetings where decisions are made. The researchers also like it. People will talk about their experiences. In some ways, it makes sense for us to try to choose researchers who have more of a personal interest in the outcome of the research, rather than just a student who needs a research topic. It seems the more a student is personally interested in the research, the more the client tends to be involved in key decisions. (van Musscher 2001)

There is a lot of flexibility in science shop projects for collaboration with client groups. This example illustrates how the personal interest of students has an influence on the extent of client involvement in the research process.

Groningen Science Shops

There are nine science shops in Groningen: chemistry, economics, biology, education, history, languages, medicine, pharmacy, and physics. In 1976, the university established a group called the Work Group Science Shops (*Werkgroep Wetenschapswinkels*), whose task was to establish university science shops. After the fifth science shop was established in 1979, this group was replaced with a groups called the Central Work Group for Science Shops (*Centrale Werkgroep Wetenschapswinkels* or CWW), whose task was to coordinate policy among the science shops and represent the science shops at the university, especially with respect to continued university support. As a result of decentralization of university tasks in the 1980s and 1990s, the function and importance of the CWW began to taper off, and was eventually broken up in 1995, although communication among science shops continued via regular meetings of their coordinators. For internal and external policy matters, each science shop has its own Advisory Council, comprised of tenured professors, professors, and sometimes students. Despite limited budgets, the science shop employees are loaded with work—mediating projects, teaching courses, and mentoring students (Bos and Sijtsma 2001). In 2001, the science shops were trying to reestablish an internal policy organization and jointly hire an employee to coordinate multi-disciplinary research projects among Groningen science shops (Mulder 2001).

Groningen Chemistry Science Shop

The office of the Groningen Chemistry Science Shop (*Chemiewinkel*) is on a dark corridor marked with a small name card—a five-minute walk through a series of seemingly endless hallways from the entrance of the chemistry building. It is equipped with three computers: one for each of the two paid staff persons, Karin Ree and Henk Mulder, and one for students. A big table in the main room functions as a conference table and communal workspace. Pictures of the Wadden Sea (*Waddenzee*), off the northern coast of Holland, hang on the walls. Delfzijl, a region north of Groningen, is home to many industrial factories, whose waste products, either by air or by water, directly or indirectly, make their way into the Wadden Sea. The Chemiewinkel's work in this region has continued a longstanding tradition of decentralized science shops in the natural sciences serving environmental interest groups.

The Chemiewinkel has no laboratory and therefore is not equipped to do tests based on actual samples. For most of their projects they analyze data gathered by other sources, such as consulting firms, factories, local governments, and national agencies. They are often asked to research how a chemical reacts in a certain situation or the known health effects, in which case the Chemiewinkel can do a literature search and distill the results into a literature review. For those occasions that they accept a project that requires laboratory analysis, they may send the sample to the analytical chemistry research group or even to the Eindhoven Chemiewinkel. Developments such as computer models to analyze chemical data, legal standards regarding acceptable levels of environmental pollution, and the ability of many professional non-profits to pay for materials testing has made it possible for the Chemiewinkel do chemistry research outside of the lab.

The two Chemiewinkel staff members are active participants in the academic culture of both the Chemistry and the Energy and Environmental Studies departments (Mulder has a Ph.D. from the latter, Ree has an M.S. in Chemistry from the Free University of Amsterdam). Mulder has been at the science shop since 1989, when he came as a conscientious objector. Ree previously worked at the Chemiewinkel at the University of Amsterdam. Each year, Ree and Mulder alternate teaching a required course for all first and second year chemistry students called "Chemistry, Technology, and Society." Through the two-week course their faces and names become familiar to all chemistry students. During lunch and coffee breaks they socialize with their academic colleagues. They attend visiting lectures organized by these departments. Their academic responsibilities and personal ties increase the visibility of the Chemiewinkel (within the university and in the region) and help give it a scientific identity. They are often faculty advisor to students working on science shop projects (many of which are 4-6 weeks long and earn the student academic course credit).

Steenwijk Residents. Many Chemiewinkel projects are done on behalf of neighborhood organizations with complaints about factory emissions. In 1999, residents from the Gagels neighborhood in the municipality of Steenwijk (*Werkgroep Gagels*) went to the

Chemiewinkel after eight years of struggling to communicate with factory representatives and local authorities about concerns they attributed to emissions from two companies (a carpet dyer and a firm that attaches the rubber underside to carpets) (van der Werf and Mulder 1999). The residents had three chief concerns: water pollution, odor, and cancer. In general, the residents felt the company and local authorities had failed to listen and respond to their concerns about toxicity, smell, and pollution of their air and water (Mulder 1999). When new leaders came in to the neighborhood group, they decided to seek scientific support for their claims.

At the first meeting between Steenwijk residents and the Chemiewinkel, the residents explained their concerns to Henk Mulder and told of studies that had been done in recent years—by the factories on the issue of odor and by the National Institute of Public Health and Environment (*Rijksinstituut Voor Volksgezondheid en Milieu* or RIVM) on the issue of cancer, and a survey by the Municipal Health Department (*Gemeenschappelijke Geneeskundige Dienst* or GGD). The residents were skeptical of these reports—of those commissioned by the factory because they might be biased, and of the one performed by RIVM because it had one methodological shortcoming (pointed out by the daughter of someone in the group who is an analytical chemist).

> The RIVM report concluded there was no evidence to indicate there were elevated cancer rates in the area. In fact, however, their conclusion should have been that science could not tell from the existing data whether there was or was not an increase in cancer rates. Still, this was not necessarily enough of a problem to justify rejecting the whole report. I waited though, to explain this at our second meeting. (Mulder 2001)

The GGD survey also concluded there was no evidence for an increased rate of cancer (Gemeenschappelijke Geneeskundige Dienst 1999; Mulder 2002). This meeting was primarily to establish a relationship among the Chemiewinkel and the Steenwijk residents and to paint a broad picture of the residents' concerns not only regarding public health and environment, but also the stalled communication among various parties.

At the next meeting, the group spoke more specifically about defining a research project. Given the availability of data and the likelihood of making some headway into these problems within the very short timeframe of a research project, Mulder explained his thoughts on strategy.

> Cancer is such a big and complex problem that if we focused on that, nothing would be done about the odor. Also, there was data available on the odor from two different reports, whereas data regarding the cancer problem could take years to come by; the residents would have to convince the municipality or RIVM to do a study and then wait for the results to be published. So we agreed to parcel the problem into three parts, cancer risk, odor, and wastewater, and for this project focus on the odor. If I had suggested this at our first meeting, the group would have probably walked out. They were so focused on solving all three problems—well, they had been working for almost a decade on these problems! The important thing was that we produce a report that this group could use to get a dialogue going. (Mulder 2002)

The fact that data was available on odor was a significant factor in helping to shape the research project. There are national standards for measuring odor that would have been difficult to meet in a student research project. The theory behind splitting the project into smaller components was that the Chemiewinkel could produce data that would stimulate communication between the multiple stakeholders, something Mulder saw as critical for the group to move in the direction of their long-term goals. When the group agreed to approach the research from this specific angle, Mulder set about designing a research project that, given a relatively short time-frame, could deliver some usable results.

In the beginning of the summer of 1999, when he had sketched out a research design to explore the problem of odor, Mulder hired Peter van der Werf, a student at the technical college in Groningen. Under Mulder's close supervision, van der Werf combined the raw data from the two reports on odor to calculate a worst-case scenario of olfactory disturbance.

Taking the highest numbers for each of the factories, van der Werf used a computer model to calculate the quantities of odor units and chemicals in the air emissions of two companies. By combining the data from two companies into one analysis, Mulder and van der Werf were exploring relatively new territory in the field of odor assessment—only after the research project did they even find out that other chemists were just starting to attempt similar kinds of calculations.

Mulder and van der Werf were using a sophisticated computer modeling program to make calculations. Normally this program is sold for NLG 11,000, but as a not-for-profit university-based entity, the science shop bought it for NLG 5,500. The program was installed on the third computer in the Chemiewinkel office. van der Werf would enter data into the program and then let the program execute—to run the program takes a full day and a half. Sometimes however, there are errors, which necessitate that the computer be reset and the program must start over. Mulder and van der Werf went through many iterations—consisting of re-entering data and running the computer program—before they were satisfied with their results.

On September 4, however, days before the report was due at the publisher, Mulder found a calculation error. van der Werf had forgotten to convert units for one of the data points resulting in "an impossible conclusion" (Mulder 1999). Because Mulder had been working closely with van der Werf on this project, he was able to catch the mistake. The next day, normally his day off, Mulder reentered the data points and reset the computer program. The report was ready in time in time to keep the original printing schedule and to present at a meeting at the Steenwijk City Hall (Mulder 2001). By correcting the scientific data, Mulder controlled the quality of the report and therefore improved the scientific content and their credibility in political negotiations. The calculations indicated that one of the companies was exceeding the legal standard for odor emissions.

Several days later, Robert Stokkers, one of the five representatives of the Steenwijk residents came to the Chemiewinkel to confer with Mulder about the report. Stokkers works in the marketing department of a company working on substitutes for PVC. He was somewhat sheepish as he confessed that in the past several weeks there was no problem with odor, but he and Mulder both speculated this was because of the summer holiday—during which most of the Netherlands becomes extremely quiet. (That summer the biggest news story in August was about a snake that was on the loose in the town of Enkhuizen, which eventually turned out to be a hoax). Mulder and Stokkers discussed the contents of the report and the upcoming meeting at City Hall to discuss the GGD report and to present the Chemiewinkel report. Mulder asked Stokkers if he could pass Stokkers' contact information onto a group in Delfzijl who is working on a similar issue with the Chemiewinkel. Stokkers at one point asked Mulder for some paper to take notes, but Mulder assured him that all the information is right in the report—even right in the introduction—and that it was not necessary to take notes. They talked about wastewater overflow (which Mulder explains was not a central focus of this report), environmental permits, and the height of the factory smokestacks. When Stokkers, using a pen, demonstrated that the height of the smokestack is the same height as the neighborhood, Mulder became nervous that he had made a calculation error. (Afterwards he adjusted the report and printed it out again.) Mulder asked Stokkers to mail him several items including the most recent GGD report and a permit for one of the factories before the meeting at City Hall in just under two weeks.

Among those attending the City Hall meeting were: a representative from the GGD (Municipal Health Department), legislators, factory representatives and their legal counsel, members of the client group, and Gertrude Hofstra, a representative from the Monitoring Network of Reporting for Health and Environment (*Meldpunten Netwerk Gezondheid en*

Milieu or MNGM) (whom the group had asked to analyze the GGD survey). The municipality was pushing the neighborhood group to accept the GGD's conclusions because of the implications it would have for their plan to build a refugee camp. The refugee camp, which would generate revenue for the municipality, could not be built if the area was subject to further environmental review. During the meeting, some of the residents grew increasingly impatient with the municipality and the GGD expert. They motioned to each other to relax and to let Mulder articulate their concerns. Mulder surprised everyone with his perspective:

> They expected me to come up with "scientific proof" for all statements previously made by the neighborhood group. Their faces showed sheer disbelief when I stated that, in our view, the toxic emissions were currently not a problem…I also told them we did not have data on past emissions (i.e. over 10 years ago) and that other research could be required to shed light on these, possibly including the monitoring of cancer rates. This conclusion caused relief to all present, including our clients. (Mulder 2001)

Because he spoke with scientific authority during a political discussion, Mulder helped the group reach some agreement about how to proceed and, in the process, deflected enough of the tension to allow the residents to relax. Being less anxious about the meeting's outcome, the residents were better poised to establish themselves as rational actors.

Mulder's presence served to re-open negotiations between stakeholders and establish communication channels.

> When residents first contacted the Chemiewinkel, the only way parties were communicating [companies, citizens, and local authorities] was through the press. This was terrible because everyone's statements were completely extricated from their original context. Nothing was being done to mitigate these problems.
>
> By breaking down the problem into three issues, and separating past from present, we managed to restore the discussion. The citizens were on more equal footing with the local authorities and the companies, now that they had access to expertise.[37] We actively participated in improving communication among the three stakeholders, by both showing respect towards all and by being firm in our analysis of the real

[37] Peter Viehen, of the Handicapped Platform (a client of the Maastricht Science Shop), expressed a similar sentiment: "What was very nice to see was the science shop research led to the initiation of a dialogue. That was the real outcome of the research. Before, the home care organizations had been a bastion. With the research in hand, we could talk to them. The research brought us in contact with each other" (Viehen 1999).

> problems. In our view, this was a better strategy than continued media battle or a legal procedure. Besides, it’s easy to be right but not as easy to be proved right in a court of law.
>
> Currently, all three parties—the local authorities (with their technical support from the province), both companies (with their consultants), and the neighborhood group (with us)—are involved in joint meetings. Together, we have selected and hired an independent company to do new analysis of selected toxic compounds and of the odor problem. (Mulder 2001)

Working outside of the scientific research process, science shops help reposition their clients in political negotiations. The presence of a staff scientist can be a strategic way to enhance client negotiating power. This enhanced power may even persist after the scientist ceases involvement because the availability of expertise may elevate the clients’ status.

After he completed the report for Steenwijk residents, Mulder took it to Jelte Bouma of the Groningen Medicine Science Shop for his review (Mulder 2001). This led not only to inter-disciplinary cooperation, but also to a critical perspective about the limitations of scientific research methods. Mulder and Bouma agreed the GGD research was acceptable, but the framework used was not helpful to residents. Bouma feared a more expensive study would only undermine residents’ goals:

> An expensive, intensive health study is not necessarily going to get people what they want. The more detailed the study, the greater the chance it will point to other causes, such as smoking in the home or chemicals freed in the course of home renovation. The point is people are having problems. That is reason enough to do something. My task is to figure out what can be done from a scientific perspective to best serve their needs. (Bouma 1999)

Intermediators are mindful that scientific uncertainty can be used as an argument for inaction. So just as the science shops conduct research on behalf of citizens, their scientific and political experience help them decide when *not* to pursue additional research. In this example, the inter-science shop collaboration led to increased reflexivity about the utility of scientific research for the interest group.

Chemiewinkel Discussion. During many science shop projects Chemiewinkel employees become translators of scientific information to their client groups. The process of translating information illustrates some tensions between representative and partnership models. Mulder finds himself discussing scientific information with laypersons, especially with regard to matters of risk and scientific proof. This type of communication brings citizens closer into the scientific process (though does not go as far some collaborative practices in which citizens produce or analyze scientific information). On the one hand, Mulder feels a responsibility to explain the limitations of scientific work. On the other hand, he is careful not to let his explanation overshadow his empathy for a citizen's problem:

> People need to know you recognize their problem. They need you to listen to them and to know you are not just another expert. But there are scientific things I feel I must explain. For example, science has its limitations. It is very difficult to prove a particular material causes a particular disease. For example, there are so many different types of cancer, and so many different cancer-causing materials, that it is extremely difficult to prove one material causes one type of cancer. I try to explain these things little by little. I might wait until our second meeting to bring up the topic, and then I say a bit more at each meeting after. If I tried to explain everything during the first meeting, I would just be another one of *those* experts. (Mulder 1999)

Similarly, Nico Haselager, of the Utrecht Chemistry Science Shop explains why emotional support is a first priority when clients first come to the science shop.

> So many times we're the first ones who listen to their problem and take them seriously. They might have already called the municipal government and received only a boilerplate response. The first thing then is to let them tell the whole story. Get everything out. When all is told and the most serious emotions are off their chests, you try to find some kind of hand-hold, some logical path to solving the problem. (Haselager 1999)

Effective collaboration between scientists and laypersons relies, in part, on the ability of scientists to recognize scientific information as only one type of information to be communicated. Science shop intermediators learn to put emotional support ahead of their scientific expertise. Such communication also facilitates reflexivity towards scientific methods and objectivity. For instance, Mulder is thoughtful about whether scientific research is always able to help solve problems. Scientists (and also science shop employees in general) have to strike a balance between giving out scientific information and showing empathy for their clients.

Decentralized science shops were previously criticized because they were presumed to favor unidisciplinary research, rather than multidisciplinary research questions (that many argue better reflects the actual complexity of social problems). Chemiewinkel employees, however, often consult with their counterparts at other science shops. Mulder explains:

> If I think a problem would be better solved by another science shop, I will go to them to discuss the case. In the past we have worked with the science shop for medicine because they are more capable of handling questions about the human health consequences of chemical pollution. (Mulder 1999)

Representatives from the decentralized science shops meet periodically to discuss developments and discuss topics with multidisciplinary implications.

Another criticism that had been levied on decentralized science shops was they would be less critical of traditional scientific practices. Science shop experiences, however, often lead science shops to be more critical of scientific conventions. For instance, through engagement model experiences, intermediators become wary of trying to solve their client’s problems with science alone—without sufficient involvement in political processes.

Decentralized science shop employees, when they are also scientists in that field, have a good vantage point from which to articulate effects of a client’s presence on scientific practices. Mulder explains how just knowing there is an audience for scientific information has changed the way he presents information. For instance, he has learned to exercise extreme caution when preparing scientific data that will be used in a political context:

> Graphs can spell big trouble. If you put a graph in a report, you have to be careful. People will just lift the graph from the report and then show it out of context. Now I make sure the label is right there next to the graph, along with any explanatory text. (Mulder 1999)

Mulder uses his experience with science in a public context to teach students to anticipate an audience for their work. The problem of producing science for use in the public sphere helps improve the quality of scientific presentation.

Like centralized science shops, decentralized science shops may be reluctant to attempt collaborative methods because of concern for the perceived objectivity of scientific data. Especially when data will be used in a political context, it becomes important to show the client was not involved in knowledge-producing activities (engagement and partnership models in conflict). At decentralized science shops, however, the availability of staff scientists sometimes makes it easier to experiment with layperson involvement. For example, at the University of Groningen Physics Science Shop (*Natuurkundewinkel*), staff physicist Frits van der Berg investigates complaints of irritation due to low-frequency noise and has consulted the Dutch government regarding guidelines for measuring such sounds. In the past, he has lent out equipment to citizens to take their own measurements. He explains the potential for this to produce better results than if taken by a physicist.

> My first priority is to try to understand what is going on. I know in the normal acoustic world, research done by citizens themselves is just not considered credible. But I have seen how the scientist can add uncertainty to the results. We have sent out researchers with citizens who complained of noise, and suddenly these people get tense. They aren't sure of themselves anymore and they have trouble saying whether they hear noise or not. So for me it is more important to find out what is going on, than to fret over who does the actual measurements. Guidelines for measuring noise levels were not developed with these problems in mind. (van der Berg 2001)

Because of these experiences, van der Berg recommended to a national organization setting standards for noise measurements that as long as non-experts were trained to use measuring equipment properly, they should be able to collect data on their own (van der Berg 2001).

Instances like these are more apt to occur when a science shop staff member has time to devote to collaboration. Because of fewer time constraints, science shop staff may be more likely than career scientists or university students to develop collaborative projects. Nevertheless, science shops are still under pressure to be productive, and collaborative projects have the potential to protract research projects, especially if a student is doing the research and must learn a whole new set of information about the client and political context.

Sometimes science shop staff use research projects to develop new scientific methodologies (not necessarily collaborative ones). In the Steenwijk case, the science shop modeled the odor pollution for two companies together, instead of individually, as it had been done before. Mulder explains how this was an innovation on odor assessment:

> This is part of the development of a usable method for calculating and assessing annoyance from odor. It is only a very small example, though, and we were not the only ones facing this issue. Also, the change of method is purely in the scientific part and thought up by a scientist; it's not something that comes out of the interface between science and citizens. (Mulder 2001)

Science shops have the potential to produce innovations in scientific methods. Decentralized science shops may be better poised to innovate because of staff experience.

Although staff scientists run decentralized science shops, it is as difficult to measure their impact on university research as it is for centralized science shops. Science shops have certainly raised new topics at their universities, but whether research on these subjects can be traced to science shops is yet unclear. Ree explains the frustration of trying to make such a correlation:

> People ask me if science shops have directed university research to particular topics. This is so difficult to measure. I remember telling a professor about the work of two science shops students who had researched organic substitutes for inorganic detergents. A few years later the professor had a Ph.D. student working on this. It's impossible to say this came our conversation, but it's the incidental contact—walking by people in the halls, talking to them about what you are doing—that makes a difference. I don't think you should underestimate this kind of contact. (Ree 1999)

Over the course of years, incidental contact between science shops and university departments may lead to changes in university research. The incidences are difficult to document and science shops receive little or no credit for them.

Science shops set a precedent for collaboration among stakeholders that may extend beyond science shop projects. The Chemiewinkel not only helped reestablish dialogue with the carpet factories and local authorities but also the mediation model was reproduced in further work between the stakeholders on this project. Using methods that fall under each model, the science shop increased the credibility of the client group enough to become a more equal partner in political negotiation and further research.

Staff scientists at the Chemiewinkel have improved their effectiveness in engagement model activities by becoming conversant in the legal aspects of environmental regulation. Often, the Chemiewinkel collaborates with other non-profits or public agencies such as the Office of Legal Assistance (*Buro Voor Rechtshulp*) and the GGD regarding environmental permits. This worked to their advantage in the Steenwijk project because they could argue that one company was not within code for odor emissions. (Mulder also pointed out that by World Health Organization protocol, odor is classified as a health issue.) The science shop works with another client, the Wadden Association, an organization involved in protecting to protect the Wadden Sea ecology. Through projects on water purification, plant emissions, and cleaner production processes, the Wadden Association uses the Chemiewinkel's research in legal proceedings regarding environmental permits for the chemical companies. Dick Stoppelburg, a staff chemist for the Wadden Association, explained that even though he is a chemist, the science shop is indispensable:

> It's difficult to imagine my work without the help of the Chemiewinkel. In our work with environmental permits, there are strict deadlines for registering objections. It is just impossible to gather so much information in so little time. What's worse is you

> are up against industries that spend a lot more time and money on this than you. (Stoppelburg 1999)

In addition to chemical expertise, the science shop has built up a cadre of knowledge about legal issues that enables them to better serve their clients.

Decentralized science shops are able to take on representative and engagement model tasks without waiting for a student researcher. As with centralized science shops, however, staff interest still plays a critical role in how the science shop chooses among different activities. Even when students do not take direct action within or on behalf of client groups, they move toward the engagement model activities as they learn about the use of science in political controversies. Science shops relay political information to chemistry students who are often uninterested in politics. But, as Ree explains, science shops do not necessarily have to take direct action on behalf of client groups in the political arena to become more involved in the work of their client groups. Because many students are averse to politics, they have a relatively naïve perception about the sophistication of client groups with respect to scientific knowledge. Ree explains her work to change chemistry students' perception of environmental organizations:

> Students coming in here think environmental groups are simply *for* something or *against* it. It's important to show them these groups and their strategies are more sophisticated in their approach to science and politics. Students go away learning something more about the way environmental groups process scientific information and use scientific arguments in their work. (Ree 1999)

Ree integrates information about political strategies into her students' chemical education and in this way is contributing to their edification about political issues even though the student does not take on particular political responsibilities.

Groningen History Science Shop

Whereas the Chemistry Science Shop has become integrated in the academic curriculum, the Groningen History Science Shop (*Geschiedeniswinkel*) has become much more removed from it. Four professional historians do all the work—itself a significant accomplishment in a profession with high unemployment and low status, according to the director, Klaas Gert Lugtenborg (Lugtenborg 1999). The majority of their work comes from private companies and foundations that commission historical research. In 1999, the science shop had an office in the liberal arts faculty, but was making plans to move off-campus to a private office. Their political posture is explained in their press booklet, a full-color four-page brochure cut to look like a file folder:

> … history is the form in which a culture accounts for its past. Each culture does this in its own unique style. Culture is synonymous with movement and change and affects all of us. [We are] interested in engaging with the past from a strong social perspective. Our organization works at the intersection of culture, science, and society. (Geschiedeniswinkel RUG)

Sitting by lamp-light in his office, surrounded by videotapes and books, Lugtenborg explains his work is subversive because

> what matters more than who asks the question is the kind of question they ask. It is the attitude you have towards your subject. You could do research for a nuclear weapons factory if you ask the right questions. The science shop has changed a lot but you see in the present attitude an emancipatory attitude. It is no longer the client who has to meet the criteria–it is the question. This is history done in a very critical manner. (Lugtenborg 1999)

They practice the representative model of democratic expertise by writing historical narratives from a perspective informed by the values of the social movements.

Companies, museums, and other institutions contract the science shop to produce historical accounts. For instance, a sugar beet factory hired the science shop to write a history of their factory to commemorate its 100th anniversary. Lugtenborg explains how he did a social and cultural analysis that looked at the company labor force, not just the management—the book's subtitle is 13,000 People In Beets and Sugar (Lugtenborg and Stenvert 1996).

> Histories of companies are inevitably about the owners. We decided to focus on the laborers. (Lugtenborg 1999)

At the History Science Shop, even a project for a large company can be spun in a way that is faithful to the topic of social equity.

The Groningen History Science Shop performs a much smaller engagement and partnership model function than other (centralized and decentralized) science shops. Historians at this science shop rarely collaborate with their clients in the research process, primarily because of a lack of client interest. Lugtenborg explains:

> Most of our clients just want us to do they research. They are not eager to be involved in the process or interested in influencing its content. I think of it as the same thing as buying a frozen pizza. Our clients want to hire an organization to do the work.
>
> There was one example. Some people wanted to publish a history of their village. They had absolutely no higher education, only one person could write. The project took five years, during which I went to the village every Wednesday evening—I had to tape the football matches! (laughs) The client participated fully, but it was a huge personal investment. (Lugtenborg 1999)

Partnership model approaches are constrained not only because of the interests of science shop staff, but also by the interests of their client groups. The History Science Shop serves clients who are more interested in the historical product, rather than the research process. This example illustrates the flip side to situations in which the client wants to be a part of the research process, but not wanting the research to appear biased. In this example, clients have no direct political goals (other than perhaps to promote the company in the region or nationally) and may therefore have reduced interest in the research process.

Although the Groningen History Science Shop has taken a much different approach than the other Groningen Science Shops, staff members participate in joint activities among the Groningen Science Shops. In 1999, the History Science Shop produced a brochure commemorating the history of the Groningen Science Shops. They keep contact with the university science shops and seem to take pride in their affiliation as a science shop. To the extent the Groningen History science shop redirects historical research in ways that challenge historical practices, it internalizes critical perspectives on expertise.

Eindhoven Science Shops

One of my informants who described some of the students at his university's science shop as "possessing a missionary zeal" might easily have been talking about the students at the Eindhoven science shops (van Diepen 1999). Each of the eight science shops is run by a board of four undergraduate students eager to apply their emerging skills to practical problems. The science shops have two-to-three room offices in the departments of architecture, biomedical engineering, chemistry, physics, mechanical engineering, electrical engineering, management, and technique and society. The university administration gives a pot of money to the university's board of science shops (*Werkgroep Wetenschapswinkels*) which distributes approximately NLG 10,000 to each shop. The academic departments subsidize the science shops' overhead. Several science shops earn supplemental income from corporate sponsors.[38] In this section, I use examples from the Electrical Engineering Science

[38] Efforts to open science shops in Eindhoven began in 1979, though like other decentralized science shops, there were informal predecessors within individual departments. For example, the Department of Planning, in an effort to apply theoretical work to practical problems, opened the Office for Planning Advice in 1975. In May of

Shop (*Electrowinkel*) supplemented with examples from the Mechanical Engineering, Chemistry, and Technical Healthcare science shops, to illustrate the decentralized science shop model as practiced in technical fields. Because the Eindhoven science shops are student run, they are particularly different with respect to the examples from the Utrecht and Groningen science shops described above.

As with most other science shops, Eindhoven requests the client pay for costs of materials. However, these costs may run slightly higher at than other science shops because projects in the technical fields often require the science shop to build a prototype and/or final product. Additionally, Eindhoven science shops do not reject questions from individuals as much as other (centralized and decentralized) science shops; many of their clients are handicapped and elderly individuals. These clients come to the science shop for help building or modifying technical devices that can assist them with general or specialized tasks. The science shop accepts these projects both because they present problems that are gratifying for engineers to solve in their spare time ("tinkering") and also because of a hope these products could eventually serve a broader market of people with similar impairments. For organizational memory, several science shops keep electronic databases of inquiries and projects so students do not duplicate past research.

1982 a formal proposal for university-wide science shops went before the university administration and was approved in 1984. In 1985 the Office for Planning Advice became the Civil Engineering Science Shop. At the same time, seven other departments opened science shops or christened similar organizations as "science shops" (Bouwkundewinkel Eindhoven 1997). From 1984 to 1995, a centralized office facilitated science shop communication and supported their activities the university level—a matter that was important especially because the shops are run by students who are often not able to take a macro view of their university administration. When funding for the centralized office was discontinued in 1995, the management science shop tried to assume some of the responsibilities of this central science shop (Bedrijfkundewinkel 1999).

Electrowinkel Eindhoven

Four student board members run the Electrical Engineering Science Shop (*Electrowinkel*): a president, treasurer, public relations director, and project mentor. In 1997, they had a budget of NLG 22,800, 10,000 of which paid salaries and 12,800 went toward overhead and equipment. Besides NLG 10,000 from the University Board of Directors (College van Bestuur), they received income and equipment totaling NLG 1400 from corporate sponsors such as Hewlett-Packard Nederland, Shell, and Phillips which gave them the capacity to etch their own circuit boards.[39] The rest of their budget comes from the Electrical Engineering faculty and material costs from client groups. Clients from for-profit entities are expected to pay more of the research and material costs (Electrowinkel Eindhoven 1997; Student staff of Chemiewinkel Eindhoven 1999).[40]

The Electrowinkel's main room has a large square meeting table as well as a lab counter with electrical equipment. There is a small room with a couch and some computers where students can congregate and check their email. The four students who make up its steering committee are 3rd or 4th year students, and each are paid for six hours of work per week. Half of those hours are supposed to be devoted to board member duties such as maintaining relations with clients, conducting on and off-campus publicity, and bookkeeping. The remaining three hours pay for the students to work on ongoing projects. It is a place to

[39] In contrast, the Management Science Shop has an above average budget: in 1998, it was NLG 68,000, which came from private sector contributions and client subsidies and paid for 6 part-time students and project stipends for 28 students at NLG 600 to 1000 each.

[40] In 2000, the Electrowinkel budget was up to 1.8 times what it was in 1997, however, they did not spend nearly as much money as their budget allowed. For example, in 2000, the Electrowinkel received additional money from corporate sponsors, clients, and the Electrical Engineering faculty, to make up a budget of NLG 20,750. Their expenditures were significantly lower however, and they only spent NLG 13,158 during this budgetary year. Part of the low cost is due to the timing of research projects—a slew of projects were finished just before and just after this budgetary period, resulting in higher expenditures for 1999 and 2001. The relative low budget for the Electrowinkel, compared to decentralized science shops at other universities, can also be explained by the difference in personnel costs: in 2000 the Electrowinkel only had a personnel budget of NLG 4500 (of which only NLG 1225 was spent), all on student labor.

socialize or do homework as well as to do science shop related work; it is normal for board members to spend a lot more than six hours a week at the science shop.

In 1999, besides the four board members, seven students worked at the Electrowinkel. Of these students, six worked for pay and received about NLG 600 each—a rate that is supposed to translate to NLG 15 per hour. To receive academic credit for science shop work, a student must have approval from a faculty member. The work requirement for such projects is very high, and in 1997 only one student chose academic credit over a stipend. Students can also do their 4th year practicum through the science shop, although few choose to do so, and some faculty have argued the projects are not demanding enough to earn academic credit. The student board has argued the opposite: science shop work is even more academically demanding than the practicum because projects demand students work independently, tackle unique problems, and communicate with laypersons (Kok and Kleinhout 1999).

In many ways, the Eindhoven science shops function like student clubs, with similar problems. For example, many organize social events such as contests, parties, and retreats. In 1997, the Electrowinkel relocated next door to "Thor," a social club for electrical engineers, to increase their visibility among students. The Chemistry Science Shop works to raise student awareness of environmental issues. They developed a course, "Human Factors, Safety, and Reliability" to teach laboratory safety and the environmental impact of university practices. They have movie nights and organize games to build group spirit.

Some of the internal disagreements at the Eindhoven science shops concern the extent to which members expect the science shop to limit their work to only the neediest cases of people who have limited access to technical expertise. Some students feel a project is important enough if it just uses their creative energies to help someone. The four students who ran the Electrowinkel in the academic year 1998-9 disagreed about which projects the science shop should accept. Rob Kok, the board president, objected to a project that Jens Kleinhout, the public relations manager, was doing. The project involved developing a motor for an outdoor sculpture that was a design academy student's final project. Kok questioned the social value of the project:

> This kind of question demands too much time from science shop board members and does not have enough of a direct benefit to society to justify it. We should be working on projects that serve elderly and handicapped people. (Kok and Kleinhout 1999)

Kleinhout shrugs this off however, and explains he likes the project because it gives him a chance to help someone.

> I've always been weird. I like technical things, but I also like to help people. Here you have the chance to bridge the distance between the common people and the university. (Kok and Kleinhout 1999)

Board members have different views about what constitutes representative model activities.

Students tend to work in these science shops for some of the same reasons they join student clubs. At the science shop they can socialize with other students and at the same time serve a social function. Kok explained the science shop suited him better than the formal atmosphere that prevails in larger companies.

> You have a deadline, but you work when you want to work. It's not necessarily that it is for the community as much as it is just fun to do. Companies demand you work two days a week, and they tell you which days. Here I am supposed to work six hours, but I could be here for up to fifteen hours a week. (Kok and Kleinhout 1999)

At a time when electrical engineering is becoming more theoretical, the science shop fills a function for electrical engineering students who like to tinker. The Electrical Engineering website describes the satisfaction students can look forward to: "You'll be dumbfounded how thankful a client may be when you present them with a finished product" (Electrowinkel Eindhoven 2001). The process validates their emerging expertise by having direct relevance to the quality of life for an individual or a group.

It is not only the relaxed atmosphere of the science shop that promotes representative model practices, but also the correlation between student interests and client needs. Even projects that require students to apply their expertise do not necessarily interest them. Ernst-Jan Bakker (EJ) and Nicole Botterhuis (NB), students who run the Technical Healthcare Science Shop in Eindhoven explained why some questions just do not appeal to mechanical engineers:

> EJ: Mechanical engineers like transportation—cars, buses, vans, bikes, wheelchairs. Disabled people in wheelchairs use a lot of mechanical things, like lifts, that engineers can relate to. They relate to buildings and construction. But they don't relate to things that have to do with personal care or eating. We had one woman who had difficulty putting on earrings because of a problem with her muscles. Well, rest assured there is no mechanical engineer who likes to do earrings! It's a problem that can be solved without much hassle. A case like this would either be done by a board member, or not at all.
>
> NB: It's not rough enough, it's not man—
>
> EJ: It's not mechanical engineering, although you solve the problem using purely this type of knowledge. (Bakker and Botterhuis 1999)

Representative model work is hindered when the students conceptualize their discipline in a way that excludes real life instances where these skills could be applied.

Many Eindhoven science shop projects combine elements of the representative and partnership models. For instance, when students modify existing or develop new technical equipment for handicapped and elderly clients, they improve representation of these clients in the built environment. Students learn that extensive communication is often required to meet a client's needs. Frank van Heesch helped a Rotterdam artist build a sound system for an interactive installation. He explains the connection between meetings and new products:

> Meetings are always essential when you are developing a product! The client has an idea of what he/she wants and explains this to the science shop. However, what the science shop thinks the client wants and what the client really wants differ at this first stage. Lots of details and the importance of these details are simply not mentioned during the first problem description. During the development of the product, the student doing the project makes lots of decisions with the client in these meetings.

> The correlation between discussion and client satisfaction is very high. (van Heesch 2001)

Even though Eindhoven students do not stake out ideological claims for collaborating with client groups, they experience the connection between time spent meeting with a client and their ability to tailor a project to meet a client's needs.

Some clients come to the science shop with ideas for products that are not commercially available. The Technical Healthcare Science Shop developed a tool for a man with impaired hand coordination to administer his own eye-drops. The science shop won a grant to make a prototype of this tool for potential commercial production (Bakker and Botterhuis 1999). Other clients seek help with modifying a product currently available on the market. For example, a visually impaired person asked the Electrowinkel to build a television remote control with larger buttons for easier use (Kok and Kleinhout 1999).

In certain cases, the science shops are asked to provide counter-expertise, which may result in the science shop operating according to the engagement model. For example, the science shop might be asked to test a current product and produce information that, in their words, would be used to "solve a conflict" (Kok and Kleinhout 1999). The board of the Electrowinkel explains they are wary of accepting any of these types of questions because of concerns over liability.

> Some clients ask us for a project that will be used to help resolve a conflict. We will talk to our faculty advisors before we take on this type of question. In general, we try not to take questions that will lead to some sort of liability for the science shop. (Kok and Kleinhout 1999)

If they are not able to figure out a way of working on the question that would not pose any legal liabilities, then they decline to work on the project. The lack of a professional intermediator seems to be one reason the Eindhoven science shops tend more toward the representative model than the engagement or partnership models. Students at Eindhoven place more importance on lab work and final product than on intervention in political situations or client collaboration.

In contrast, legal standards sometimes make it easier for some science shops to take on engagement model tasks. For instance, clients ask the Eindhoven Chemistry Science Shop (*Chemiewinkel*) to provide counter-expertise to review or explain a scientific report. To do this, they use chemical pollution standards for air, water, and soil. In 1995, a neighborhood association in a suburb in the province of Tilburg came to the Chemiewinkel with concerns over possible soil pollution. The association received a report from the county environmental officer, but without a background in chemistry, they had trouble judging whether the report was complete. They requested the Chemiewinkel to read the report and serve as an advisor during a meeting between the residents and the environmental office. Des'ree, one of the club's officers, explains the science shop can still be helpful to the client, even though they do not have professional certification the client needs for political purposes.

> Sometimes it is just helpful for us to tell a client that it is worthwhile to go to a professionally accredited firm for water or soil testing. Otherwise they might spend a lot of money on nothing. Also, even though we are not accredited, judges will often at least listen to what we have to say. We can also help by reviewing a report, translating it to the client, and giving them our assessment of it. (Des'ree, Chemiewinkel Eindhoven, 1999)

Legal standards provide the basis for an "objective" measure of determining pollution. For this reason, legal standards enable students to weigh in on politically controversial matters.

The Eindhoven science shops, being student run, are interesting for their tendencies both to innovate on established scientific norms and to rely on them. The exchange between client and student during these sessions presents an opportunity for laypersons to interact with experts in substantive ways. On the other hand, students may tend toward the deficit model of public understanding of science and technology. As one student explained,

> People will always need technical information. It's up to us to give it to them. And they are so amazed when they see what we are doing. There were some client groups who came to the "open days" of the university where the science shop had a booth. They couldn't believe we were just giving science away. (Kok and Kleinhout 1999)

Students at the Eindhoven science shops seem to view the science shop as primarily a representative model organization that delivers scientific information to the public.

Amsterdam Chemistry Science Shop

For more than twenty years there were two science shops at the University of Amsterdam. The centralized Amsterdam Science Shop created an empire of an organization, collaborating with the different academic faculties at the university, trade unions, and with civil servants in the municipality of Amsterdam. The Chemistry Science Shop (*Chemiewinkel*) was connected to a strong movement of left-leaning chemists in the Netherlands and also to the trade unions. The Chemiewinkel organized as an office within in the department of chemistry, a move which earned it heavy criticism from the centralized science shop, who argued that a central office was needed to intermediate between the whole university and client organizations (de Boer 1998).

Nevertheless, scientists and undergraduates from the Chemiewinkel answered questions from environmental groups, labor unions, and neighborhood associations on topics such as occupational safety and health, water, air, and soil pollution. Years went by, however, and they tired of receiving the same kinds of questions from their clients. Pieter van Broekhuizen, the director of the Chemiewinkel since 1980, explains they were looking for ways to expand their practice.

> We were just waiting for questions to come to us, and it seemed like they were all the same. It was irritating. Is it a risk to have this chemical in the soil? And, will it harm my children? Or, are the people living near this factory at risk from their emissions?

> To answer these questions properly would require an extensive risk assessment—a lot of work and no guarantee of being useful. (van Broekhuizen 1998)

It was not the amount of work van Broekhuizen and his colleagues found objectionable, nor was it the similarity of the questions. They felt the questions were not exactly designed to provide answers informed by chemical knowledge or research.

> People were asking questions that were different from what they really wanted to know. They were trying to mobilize human health as an argument for environmental protection. Risk however, is an extremely complicated issue. Risk assessments are not necessarily proactive either. We wanted to do work that would have a greater impact on industrial chemical processes. (van Broekhuizen 1998)

In the interest of doing work that could have a far-reaching impact on the kinds of chemicals and chemical processes used in industry, the Chemiewinkel opened itself to paid work from government, industry, and trade unions, who in the meantime had become very strong actors in Dutch society.

Today, the Chemiewinkel employs four full-time and three part-time researchers, plus a secretary and student interns. The interns answer the smaller questions not requiring extensive research. At any given time, there are from two to four doctoral students doing their research in connection with the science shop. Financial support comes from the European Community, the Dutch government (especially the Ministry of Environment), multinational companies (such as Shell and Proctor & Gamble), trade unions, and the larger environmental non-profits. Although their budget is not publicly available, they do report that the university provides a quarter of the science shop's income (Chemiewinkel 1997). The English translation of their name is the "Consultancy and Research Center on Chemistry, Work and Environment." [41] They perform research for the publishing, metals, pharmaceutical, and washing detergent industries. The results of the research are used to identify the harmful environmental or health effects of certain industrial processes, and to find less toxic or non-toxic substitutes. The

Chemiewinkel works with companies, trade unions and government bodies to identify gaps in current knowledge and to research environmentally benign chemical processes.

This arrangement fits with van Broekhuizen's sensibilities about how to influence the direction of university research and industrial practices. He sees the evolution of his science shop as a natural extension of several social phenomena, including the science shop, environmental, and labor movements.

> The trade unions and environmental groups were developing their own expertise. They no longer needed the science shops. We became proactive about working with industry, and our real mission now is to change the use of chemicals in society. We are an important actor in the Netherlands regarding substitutes for organic solvents. We are working with the Ministry of Social Affairs, trade unions, and multi-nationals, and we are making a difference in the acceptance of new chemical processes in industry. (van Broekhuizen 1998)

Because undergraduates are not equipped to work at the professional level, van Broekhuizen hired professional chemists to work in the science shop. The poor job-market in the 1980s for chemists worked to his advantage, providing him with a cheap labor source of professional chemists who had time to develop research projects and incentives to pursue funding. Today, the Chemiewinkel is a professional, environmentally-oriented think-tank within the department of Chemistry.

The Chemiewinkel's Annual Report exemplifies some of the differences between this science shop and others. On the topic of criteria to accept a question, it states simply, "For us to accept a question, it should require at least a half day's worth of research" (Chemiewinkel 1997: 1). Their budget is confidential, so they only provide information about the percentage of income derived from different sectors (university, private sector, government). More emphasis is placed on describing the research projects, rather than on the nuts and bolts of how the science shop operates or their criteria for accepting questions.

In 1997, the Chemiewinkel completed a research project on the occupational health hazards for pharmacy workers. Many chemicals used in the preparation of medications pose risks to the people who handle them. Using a model developed by the Corporation for Pharmacies (*Stichting Bedrijfsfonds Apotheken*), the Chemiewinkel created a risk classification scheme for 250 different substances. The substances were classified by risk, ranging from mild skin irritation to cancer from long-term exposure. The results were written up into a handbook for pharmacy employees. They also published a brochure explaining the risk classification model in basic language to distribute to public pharmacies nationally (Chemiewinkel 1997). van Broekhuizen is concerned less that the project is for the pharmaceutical industry than he is with the idea he is helping to reduce occupational health hazards for people in that industry: "As long as you have your heart in the right place," he explains, "that is what's important" (van Broekhuizen 1998).

It might be argued the Amsterdam Chemiewinkel is less effective at sending an "early warning signal" to society about social problems than other science shops that work for disenfranchised social groups (de Boer 1999). Nevertheless, its staff is in hot pursuit of one of the original goals of the environmental activists who started science shops: to direct university research in a way that serves the interests of the environmental movement.[42] This science shop has managed to maintain a university presence in the face of downsizing in the 1980s, and an increased reliance by many university departments on money from the private sector. The Chemiewinkel devotes a portion of its resources to assisting the more traditional science shop customers–neighborhood associations, environmental groups, and other interest

[42] Some readers may point out that making industrial processes more environmental friendly disregards the overall problems associated with multi-national chemical companies, globalization, and capitalism. These are valid concerns, but at an immediate, practical level, there are many environmentalists who are happy to hear about industries adopting environmental practices.

groups–while engaging professional chemists in work that is having immediate and lasting impact.[43]

Conclusion

Decentralized science shops have co-evolved with centralized science shops and the two are much more similar than they are different. Both are very strong representative model organizations. The extent to which either kind of science shop is an engagement model organization depends more on the staff or students at the science shops than on the organizational structure: both work as third-party intermediaries between students and client groups and both get involved in the political aspects of their clients' work. The most significant difference between the two types of science shops is that scientists at decentralized science shopes have a more significant role in the scientific content. At centralized science shops, staff may have higher degrees (masters or Ph.D.s), but the science shop projects in their field are a smaller percentage of the total projects.

Intermediators at decentralized science shops work to generate research questions students can answer based on client inquiries (representative model). Depending on the time available, their interest, and the perceived social need, staff scientists will also provide scientific information directly to the client. The former mode of science shop operation is more common. Its success is contingent on the ability of science shop staff to frame research projects so they interest students, and so students can complete them in a time frame that suits their academic schedules. But at decentralized science shops the latter happens more frequently—especially if the client's needs are minimal and an employee can respond after a

[43] At the end of my interview with Pieter van Broekhuizen, after all my questions about whether the Chemiewinkel was still fulfilling "science shop" goals, he told me he was going to revisit the idea of changing their Dutch name.

few hours of work. Either way, the decentralized science shops, being there to mediate between interest groups and university students, steer university research toward representative model research.

The engagement model function of scientists at decentralized science shops may be somewhat stronger than at centralized science shops, not because of any institutionalized difference, but more because staff scientists at decentralized science shops take on added responsibilities with respect to the research projects, especially when they are also the faculty advisor for projects. The Eindhoven case, like the Nijmegen and Twente cases, illustrates students' reluctance to become involved in something they perceive to be political. Centralized science shops rely more on under-supervised undergraduates who are less apt to join in political actions or discussions. The example from the Groningen Chemiewinkel in which Mulder attended a meeting between the interest group, political representatives, and the county health department, contrasts the example in Twente where the student was reluctant to speak to the press about her project. Both cases presented opportunities for scientists to act in the public sphere, but because there was a science shop employee in Groningen who saw it as part of his work to follow the interest groups interactions with the municipality, the science shop had a stronger engagement model function. Because the involvement of science shop employees varies so widely from project to project however, there is no compelling reason to conclude decentralized science shops perform a stronger engagement model function than centralized ones.

The Groningen case study showed how the presence of a staff scientist has the potential to alter science shop practices. When they mentor science shop projects directly, staff scientists can demand a higher quality of student research and write-up. They are also able to intervene directly, which is especially important when a client needs the results to use in a political context. It may be easier for a staff scientist to push a project through given the limited student time available, oversee the student's work, use the research to educate students about politics, take on engagement model responsibilities, and develop collaborative strategies that challenge science practices. Whether this actually happens depends, as at centralized science shops, on the skills and interest of science shop staff. This points to the role of the scientist in improving communication—the public understanding of science is not merely about publics learning scientific facts and conventions but also about scientists learning the craft of communication.

Both decentralized and centralized science shops refrain from partnership model approaches for reasons that defy simple explanation. Decentralized science shops were thought to be closer to scientific practice than the centralized science shops (who were thought of as intermediators removed from actual science practice), hence the assumption decentralized science shops would be better able to involve layperson in production aspects of scientific knowledge. However, all science shops shy away from this type of practice because of concerns over objectivity (or the perception of objectivity). Partnership functions tend to be limited to the intermediation and report-editing processes, rather than the participation of clients in the details of research design, incorporating client-based projects into classroom activities, or developing projects with interest groups to collect and analyze scientific data. The opportunities for these kinds of activities are under-explored in Dutch science shops in favor of the representative and engagement models, but there is no reason that, in certain circumstances, this kind of collaboration would necessarily fail. I discuss this potential further in Chapter 6 because it has implications for how the science shop model can be utilized outside of the Dutch context.

CHAPTER 6: Portability & Continuity of Science Shops

Science shops have captured the attention of community advocates, university administrators, students, and scholars, inspiring some to write about their significance to democratic science institutions and others to pioneer science shops or similar organizations of their own.[44] This interest is especially remarkable given the limited availability of English-language sources on science shops. A consideration of how Dutch institutions have influenced Dutch science shops will complement a growing network of those interested in democratizing expertise. This chapter opens with a discussion of why science shops are important now, especially with respect to past and current university-community initiatives and against the backdrop of trends in geo-political systems, control of research budgets, and recent thinking about fabric of science. Next, it returns to the original research questions to review science shops' accomplishments. The following section highlights how new social movements, the university system, and Dutch political culture influence science shops and discusses the ramifications of Dutch factors for the portability and success of science shops. The chapter concludes by making recommendations for science shops.

Why Are Science Shops Important Now?

The trend in the United States to tie university research more closely to community needs is not exactly new. The Morrill Act of 1862 established land-grant colleges and universities

[44] The widespread interest in science shops is to a great extent due to good publicity. This is the result of work by Dick Sclove, Jill Chopyak, and others at the Amherst, MA-based Loka Institute, some hardworking, internationally-minded Dutch science shop workers such as Caspar de Bok, Maaike Lürsen, as well as articles appearing in *Nature, Science,* and *The Chronicle of Higher Education*.

by giving land to states that would provide engineering, agriculture, and traditional academic education. Cooperative extension services

> …plan, execute, and evaluate learning experiences that will help people acquire the understanding and skills essential for solving farm, home, and community problems. This objective is met through educational programs that make use of research findings emanating primarily from the U.S. Dept. of Agriculture and the state land-grant colleges and universities. (Columbia University Press 2000)

Land grant colleges and universities, along with cooperative extension services have typically intended to distribute university resources but not challenge the production of knowledge or the primacy of expertise (Mayfield 2001) or perform research specifically at the bequest of community groups. The term "engaged university" describes a recent incarnation of thinking in higher education about the need for universities in urban areas to support

> …research and teaching to address specific needs of metropolitan areas and the community; integrate the teaching, research and service functions of the university in an interdisciplinary manner; and promote partnerships with public agencies and the community for broad public affairs and civic interests. (Mayfield 2001: 231; see also National Extension Committee on Organization and Policy 1998)

The engaged university idea has religious ideological roots, most notably in Catholic sentiments about charity. Apart from these high-profile institutionalized examples, there are thousands of independent, decentralized attempts to use university resources for community interests, at many educational levels, whether through individual courses (biology students at Kingston High School survey local trees), at the administrative level (Rensselaer offers a $5,000 subsidy to new-home buyers in the City of Troy), or through university-affiliated non-profits (the Innocence Project, a non-profit legal clinic at the Cardozo School of Law, supervises law students in cases where DNA evidence may be used to exonerate convicted criminals).[45]

[45] See www.innocenceproject.org.

The idea of the engaged university has helped popularize "community-based participatory research" (CBPR) (Mayfield 2000), a notion advanced as a basis for university-community collaboration that conceives of community as a cultural, political, and economic entity (Israel, Schultz et al. 1998) and recognizes local knowledge/theory as a key to empowerment (Israel, Schultz et al. 2001). CBPR advocates have theorized criteria for good partnerships (Lehman 2001)[46] and related these criteria to general policy recommendations for community-university partnerships (Lasker 2000; Israel, Schultz et al. 2001). Hess' discussion on how communities may help pursue "alternative pathways to globalization" extends the CBPR vision of community, posturing community has potential as a "countervailing force with similar economic power to the global corporation" (Hess 2001: 13). More and more, universities and communities are realizing the potential benefits of collaboration.

The Amherst, MA-based Loka Institute has been popularizing "community-based research" through its "Community Research Network" with the aim of creating a geographically, ethnically, and disciplinarily diverse network of community development professionals from universities, NGOs, and government sectors. In 1999, the Canadian Social Sciences and Humanities Research Council (SSHRC) created the Community-University Research Alliance, a pilot program to fund research carried out jointly with community groups (13.6 million Canadian dollars over three years). In 2001, CURA supported 37 projects in urban development, environment, historical preservation, and civil justice but at this writing, has suspended the program "for evaluation" (Warme, Lauziere et al. 1996;

[46] "The partnership builds upon identified strengths and assets, but also addresses areas that need improvement; The partnership balances power among partners and enables resources among partners to be shared; there is clear, open and accessible communication between partners, making it an ongoing priority to listen to each need, develop a common language, and validate/clarify the meaning of terms; roles, norms, and processes for the partnership are established with the input and agreement of all partners; there is feedback to, among, and from all stakeholders in the partnership, with the goal of continuously improving the partnership and its outcomes; partners share the credit for the partnership's accomplishments. Partnerships take time to develop and evolve over time." http://futurehealth.ucsf.edu/ccph/principles.html

CURA 2001; SSHRC of Canada 2001). These community-based projects are finding ways to direct the flow of university resources into local communities.

The fields of health and urban development have integrated some of the principles of community-university collaboration. For example, Community-Campus Partnerships for Health, a non-profit organization affiliated with the University of California, San Francisco supports scholarship on community-university partnerships, distributes information about funding for these projects, and tries to integrate service learning into health-care curricula. Community Outreach Partnership Centers (COPCs), a program of the Office of University Partnerships (OUP) at the U.S. Department of Housing and Urban Development (HUD), are designed to help communities by supporting Empowerment Zones, incubator centers, home ownership, streetscape redevelopment, public health, and job training (OUP 1999). Another HUD program, HOPE VI, encourages design that promotes a 'sense of community'—whether in the design of streets, houses, transportation, and shopping infrastructures (HUD 1999).

Nevertheless, these movements face entrenched obstacles to changing university and science practices. Skeptics note that these "movements" come capriciously in and out of vogue. Practitioners note the difficulties of "convincing university faculty that community-based research is real research" (Eglash 2002). In many cases, administrators and faculty both in open and subtle ways deride community projects as being "mere service-learning projects" rather than high-tech or state-of-the-art research. Despite the potential for high-tech community-oriented projects, many communities are still dealing with 'old-school' social problems—like crime, poverty, and domestic violence—that lack the sexiness of High-Tech or Big Science. We need to support spaces where university and community members develop creative, innovative, and socially usable solutions that balance "technophilic" thinking with social problem-solving.

Another problem is that industry-university partnerships far outpace emerging community-university partnerships. Increasing private sector funding is making many people in industry and academe wealthy and happy. Others, however, are concerned this, coupled with a decline of government support for universities, is leading to conflicts of interest that are hidden from the public and research that is more in the corporate interest than in the public interest (Warde 2001). In the absence of radical change to funding criteria and professional reward structures, faculty who choose to do community research may be forfeiting millions of dollars in research grants. In the "market-model university…departments that make money, study money, or attract money are given priority" (Engell and Dangerfield 1998):

> Increasingly, universities are becoming two-tiered institutions with rich departments and poor departments, academic superstars and an academic underclass. (Warde 2001)

When corporations have scientific resources at their disposal, it only makes it easier for them to distort the policy process: expertise has become a favored weapon by the public relations (PR) industry, who use hired experts to plant seeds of doubt about risks from products such as tobacco, sludge, and bioengineered foods—and in some cases, to spread false information (Rampton and Stauber 2001). Corporate funding of university research is on the rise: in 1997, industry spent 1.9 billion dollars on university research in the U.S., growing at a rate of 8.1 percent annually from 1980 to 1998, aided by legislation like the Bayle-Doyle Act of 1980 which made it legal for universities to patent the fruits of government-sponsored research (Press and Washburn 2000). Although industry money may, as proponents argue, boost the competitiveness of American companies abroad, compensate for declining federal funds, increase scholarships, and add societal benefit (Warde 2001), it also threatens to pervert the university non-profit mission, introduce a whole new wave of secrecy into academic research, and keep federally-funded research from fully serving the public who pays for it (Press and Washburn 2000). These conditions demand new approaches to prevent the diversion of R&D from the public interest.

Related to the issue of who sets research agendas and benefits from them, is the after-effect of technoscience —its legacy in creating social problems. We expect science and technology to solve problems that it has either created or perpetuated (Beck 1992). Some problems, such as exposure to radioactivity from nuclear processes and nuclear waste, have been around for decades and we seem not to have advanced much toward resolution. Others, such as environmental problems caused by “persistent organic pollutants” will take years to comprehend, measure, and evaluate (Colborn, Dumanoski et al. 1997). Science and technology have the ability to cause effects on an unprecedented scale.
New ways of thinking about science can help by giving communities the tools to assess the negative consequences of science, to think differently about what science can deliver, and to deal with the inevitability of scientific uncertainty (Howard 1997). Realizations about problems intrinsic to science, its organization, and political, economic, and cultural systems suggest that we need flexible institutions to help us cope, think, and act differently.

What Have Science Shops Accomplished?

More than anything else about science shops, what many people want to know is what have they accomplished, and ultimately, whether they are successful. The answers to these questions will affect how people interested in changing the relationship between scientists and citizens design new institutions. I return to this question in Chapter 7. First, however, I discuss what science shops have accomplished with respect to my first three research questions, putting special emphasis on the contributions of intermediation.

> *Research question 1. Are science shops successful at getting scientists to take on projects of importance to the community, and what factors shape scientists' willingness to do so? (representative model)*

When science shops started out, they were concerned with giving the weakest societal actors access to knowledge and with steering research in more socially responsible directions. They were reluctant to be proactive about developing questions; they wanted citizens to come with concerns of their own. The problem, as they quickly found out, was that there is a lag between citizen concerns and what scientists find to be interesting questions. For example, while biologists and chemists may have at first been very interested in using new methods to analyze soil, water, and air samples for pollution, these methods quickly became 'old hat'—while citizen concerns persisted. Science shops adapted to this by professionalizing the role of mediator who would do the gatekeeping work to prevent certain questions from reaching scientists and/or to shape citizen questions to be more appealing to scientists.

In this sense, science shops may have over-estimated the amount of scientific questions "out there" in society, or what Valenduc and Vendramin call a "latent social demand" (Valenduc and Vendramin 1995). Speaking about early science shops, they write:

> Many investigations were founded on an implicit belief that civil society had a "latent social demand" for research. The generally accepted hypothesis was that social groups and individuals had a large number of questions of a technical and scientific order, revealing the existence of a gap between academic knowledge and practical requirements…
>
> This approach to the relationship between science and social demand can be roughly outlined as follows:
>
> - There is a "latent social demand" which is simply waiting to surface but needs adequate structures to allow it to do so.
> - There are also scientists who are willing to leave their ivory towers and meet this demand, once they are made aware of the social interest of their work
> - The types of interfaces needed between research and society are therefore meeting places and mediation procedures. (Valenduc and Vendramin 1995)

Science shops had a difficult time adjusting to the realization that community problems do not present themselves as "ready made" research questions. Some responded by shifting focus towards getting *students* rather than *scientists* to do research for community groups as part of the regular academic curriculum. This necessitated fleshing out the position of a professional intermediator. Mediators could spend time transforming a client question into a student research project and even adapt it to different disciplines depending on the student researcher. A few science shops took a different direction altogether, choosing to work more with scientists or professional researchers to steer their fields far beyond what is possible using student research. In general, science shops are more successful at getting students to take on research rather than scientists or professional researchers. But even by this measure success is highly variable. It takes a lot of work to develop research projects. Successful intermediators do this by drawing on a wide base of skills, including marketing, intellectual creativity, and knowledge of community events. Even if science shops *could* afford to hire scientists or professional researchers for all projects, the need for a professional mediator to link experts and communities would persist. Decentralized science shops seem more capable of getting scientists involved in matters of concern to citizens, mostly because scientists work at the science shop. This does not necessarily have to be the case. If centralized science shops employed more scientists, or if they had more money to pay for professional scientists and researchers, the performance of both kinds of science shops might be more similar.

Early literature on science shops reflects the hope that science shop projects would lead to longer-term faculty-led research projects and change scientific curricula (de Boer 1991). Researchers studying the University of Amsterdam Science Shop interviewed university researchers about whether science shop projects led to conference presentation, journal publications, and follow-up research (Leydesdorff 1985; Zaal 1986; Zaal and Leydesdorff

1987). The researchers sited lack of time and the applied character of science shop projects as reasons science shop projects do not have a stronger connection to university research programs, and recommended universities put more effort towards understanding the impact of science shops (Zaal 1986: 100.) Beyond the immediate effect on those involved in science shops, however, these changes are difficult to measure (Ree 1999). Often, it is not possible to discern whether a science shop project was the original impetus for scientific research. The authors of SCIPAS Report No. 6, "The Impact of [European] Science Shops on University Curricula and Research" concluded:

> It is not possible to point to a blueprint strategy on how to obtain most impact on curricula and research. Scientific staff as part of the science shop seems, however to be the best basis for obtaining impact. Impact is then a question about utilizing those occasions that show up and can be used for strengthening the role of the science shop and the role of community orientation and engagement methods at the university. (Hende and Jorgensen 2001: 6)

Scientific staff or professional researchers enhance the impact of science shops on communities by improving their scientific credibility and making the science shop a more desirable place for students and mentors to invest their time. Additionally, scientific staff may be available to mentor research and oversee longer-term research projects.

Science shops have created university offices that work for community development across disciplines in social, natural, and technical sciences. They established university-funded offices at nearly every Dutch university, many of which lasted the span of three decades—despite major political, economic, and cultural pressures to close. The fact that many survived a period of downsizing that coincided with a mild cultural backlash against the social and cultural changes from the 1960s and 1970s shows how they fought successfully for a place at universities. The place has always been marginal, however, and many science shops have closed.

Research question 2. Do science shops provide a good model for increasing participation of scientists and citizens in matters of science and technology policy? (engagement model)

Phrasing this question slightly differently better captures what science shops do best. Science shops do not necessarily provide a good model for increasing *scientist* participation in political arenas as much as increasing *student*, *researcher*, or *expert* participation in political arenas. Science shops have made political involvement an integral part of their projects, although this varies by science shop and by project, depending on factors such as clients needs, science shop interest, science shop skills, student's personality, media appeal, or project design. Even when students are relatively uninterested, they become exposed to the political aspects of client work over the course of their work for science shops.

Science shops increase citizen participation in public policy by providing research in a form that is suited to the political arena. Science shops assist with organizing press conferences, attend political meetings, and in general pay attention to how their clients can shape public policy. In doing so, they increase expert-citizen collaboration and help create environments where experts and citizens can explore less adversarial modes of interaction. Among the many intentions of the science shop founders was that by working with social interest groups to gauge community needs and interests, science shops would act as a mechanism for making some of the biggest science policy decisions regarding how tax dollars should be allocated to scientific research (Leydesdorff 1988). Over the years, however, this original goal has been sublimated to more pressing problems of organizational survival (Ree 1996; Bodewitz 1988). Beyond helping their client groups and lobbying their universities to renew support, science shops have little leftover time to connect their work to policy-making agendas. Efforts to change science policy take the form of a recommendation section in science shop reports, but rarely do they pool resources to achieve policy change.

Occasionally, science shops connect to national science and technology policy, as a result of staff initiatives or even through their client groups.

> *3. Do science shops provide evidence of, and suggestions for how to develop increased public participation in the content of science, including agenda setting and research process? (partnership model)*

Many people, myself included, thought science shops do participatory action research in a way that is intended to challenge conventional science practices. This study demonstrates that science shops involve the public in the content of science, including agenda setting and research process but not necessarily by giving them responsibilities such as data collection or data analysis (as in participatory action research, community based participatory research, and popular epidemiology). Community groups, by way of intermediation, serve as part of a steering group for most science shop projects. Although this does not go as far as many critics of science practices would like, clients often prefer this configuration, particularly in politically charged situations. Science shops encounter difficulties sustaining public participation in the content of science because of how objectivity is defined by student researchers, by the press, and by clients. Through intermediation science shops create conditions in which experts and laypersons can interact in less confrontational circumstances. Given political goals of social interest groups, the demands of science shop professionalization, and nuances of Dutch political culture—all described below—science shops have developed their own language and reasons for this kind of practice. Science shops do provide evidence and suggestions for public participation in the content of science, but not in the way that this has been framed in participatory action research and related practices.

Intermediation

Intermediation is one of the biggest accomplishments of science shops (Farkas 2000). It lies outside the three research questions but includes all of them. Mediators foster student interest in socially derived topics and enable them to produce usable research. They diagnose goals of different stakeholders and develop research projects that interest all parties involved, including themselves. Intermediation illustrates that science shops do not simply match university students or scientists to ready-made research questions. The transformation of a community need into a research project is perhaps the most significant facet of science shop work.

How Dutch Are Dutch Science Shops?

European, North American, Asian, and African science shops are living proof that people are compelled by the concept enough to go out and engineer science shops of their own. But will these efforts endure? The Dutch science shops have weathered innumerable challenges—even in a country as evolved on the issue of social welfare as the Netherlands. It is critical to understand the aspects of Dutch society that have enabled or blocked science shops to draw lessons from these experiences for science shops in other contexts. This is the purpose of the next section, which relates three societal factors, the new social movements, university structures, and political culture, to their influence on science shops in the Netherlands.

Social Movements

The social movements of the 1960s and 1970s had a formidable and lasting impact on science shops.[47] First, these movements became a vector for challenges to entrenched ways of setting university research agendas. Thousands of university students and staff joined social movement organizations (inside and outside the university) with a common goal of calling university and scientific practices into question. They advocated redirecting scientific inquiry and democratizing university decision-making bodies. They started discussion groups on topics related to science and society, developing those into STS courses such as *Biology and Society*, *Chemistry and Society*, *Physics and Society*, and later, into degree programs (Bodewitz 1988). The peace movement made a singular contribution to science shops: conscientious objectors substituted their 18-month military service requirement with slightly longer terms at science shops. In doing so, they made science shops increasingly professional by providing institutional memory, standardizing procedures, creating training materials, and securing longer-term financial commitments from university administrations (van Diepen 1988; see also discussion in Chapter 3).

Second, as these movements evolved into professional interest groups, they strengthened science shops by submitting research questions compelling to scientists ("high cognitive compatibility") (Leydesdorff and van den Besselaar 1987). This was especially evident in the environmental movement where those concerned about soil, water, noise, and air pollution found natural scientists (through physics, biology, and chemistry science shops) eager to develop and perfect techniques for identifying pollutants, extracting them from the environment, and understanding their long-term effects (Bol 1988). Also, umbrella groups representing multiple interest groups centralize information and therefore both direct people to science shops and filter out questions that may be uninteresting for researchers. Thus the presence of a strong interest group network helps prevent science shops from being overwhelmed with questions that do not map easily onto scientists' interests and research trajectories. Because interest groups work at the frontier of new inquiry, often on topics with multi-disciplinary angles and implications, they channel "good" questions to science shops.

[47] These movements were happening across Europe and North America, and not limited to the Netherlands.

Interest groups influenced science shops in many ways, but curiously, their professionalization sent science shops scrambling to stake out a position in this new political landscape. Early science shop members and their supporters felt science shops should work only for society's weakest members, defined chiefly as interest groups unable to pay for scientific research (Weerdenburg and Pennings 1987). The corollary was that science shops should *not* work with groups who could afford to pay. This sentiment became an obstacle to science shops' partnerships with strong interest groups. What made this such a dilemma for science shops, especially as they institutionalized and became dependent on student research, was they found excluding professionalized non-profits or even for-profit ones from their client base meant forfeiting interesting research opportunities. Science shops managed this dilemma by reevaluating the way they implement criteria for accepting projects (Weerdenburg 1987). Today, when choosing among client questions, science shops weigh a number of factors: Does the project strive toward greater societal equity? Will the group be able to implement the results? Is this an interesting project for students? Will this make an interesting article in the press? It is unfortunate and somewhat counterintuitive that professionalization of their original client base compounded the difficulty for science shops to justify their right to exist. These issues divert staff attention away from more innovative work.

In addition to providing compelling research questions (representative model), strong interest groups also effectively channel scientist participation in political arenas (engagement model). Because they possess intimate knowledge of certain political processes, strong interest groups inform science shops and scientists about where expertise can be effectively injected into political debates (for example the faxing of the Maastricht science shop airport project to Parliament). Interest groups may orchestrate press conferences or meetings between political leaders, community members, and scientists or students as a way to amplify their political goals. Working with strong interest groups, science shop employees become more effective political players and pass this knowledge along to other clients.

Strong interest group organizations, as opposed to weaker organizations or individuals, are often in a better position to collaborate with scientists in science practices (partnership model). These groups may have staff scientists, field workers, or others who understand the basic premise of designing scientific research, and the "burden of proof" intrinsic to the scientific method. The success of the new social movements in the Netherlands, however, seems to be one reason the partnership model is not a more substantial part of science shop research. Even though science shops are still very much concerned with empowerment, the idea is outmoded in today's political climate. Many of the social movements who worked towards "empowerment"—for women, minorities, labor, handicapped, the elderly, housing, etc.—are widely regarded as having succeeded (judged by the presence of national interest groups, support services at all levels of government, etc.). In the years since the 1960s, empowerment waned as a pressing public issue, and so did cries for greater layperson involvement in scientific processes. (This is also related to the value the Dutch ascribe to 'newness,' explained in below in the section on political culture). The authors of SCIPAS Report No. 1 use cultural factors to explain why European science shops do not involve community groups to the extent that U.S. advocates of community-based research would:

> The strong US tradition 'to do it yourself,' to get involved, to empower people, to solve problems themselves, is not as obvious in the EU member states. In Europe, self-confidence seems less developed and trust in scientists may be higher. Cultural traditions may be stronger, systems more settled, and therefore less permeable. This all adds up to a greater distance and less communication between established groups and systems, like the relationship between university and civil society. The demand for participation during the research process is less openly expressed. (Gnaiger and Martin 2001: 55)

There is potential to extend partnership model collaboration with both strong and weak interest groups. Interest groups have learned about the tradeoffs associated with collaboration on research projects. Cultural and social constructions of objectivity are also likely determinants of the degree to which interests groups collaborate with experts so that it balances other goals.

University System

The Dutch university system has extensively shaped science shops and their practices, helping science shops with material resources as well as student researchers, professional researchers, and faculty advisors. The academic system requires students to write a thesis based on original research (similar to an honor's thesis or a master's thesis in North America). Students may choose their research trajectory independently, as long as they find a professor to be their advisor. Science shops work within this system by offering students a research topic—especially valuable to a certain percentage of students who have difficulty choosing their own—and a supportive organizational structure. Some speculate that efforts by science shops to locate at trade schools never materialized because students at trade schools do not have the final research project and also because the science shop was more intellectually connected to university life (Dohmen 1999; Fokkinga 1999). Science shops have relied on final research projects as a way of demonstrating why their activities fulfill university goals, even though helping client groups was always a more pressing science shop concern. This justification is not always sufficient to prevent universities from closing science shops—the university in Leiden rejected this claim, arguing students, in the absence of science shops, find research topics just as easily by conventional methods (van den Sigtenhorst 1999; Wachelder 1999).

Science shops also draw on a pool of university researchers (AIOs and OIOs, graduates with few teaching responsibilities).[48] Science shops may hire researchers when clients' budgets permit or for internal research projects. The projects often have longer lasting policy impacts and are more interesting to science shop employees. Because this work is paid, there is more accountability and reliability built into the research process. Projects can be conducted more professionally and predictably because they are not dependent on students. Science shops can use these projects to build their reputation, develop stronger partnerships with interest groups, and stimulate innovation in research and policymaking. Professionals may be in a better position to develop partnership model collaboration, although this also depends on personal interests.

Yet while Dutch universities have facilitated representative and engagement models, they seem to inhibit the partnership model. For students, the emphasis on performing original research keeps them from experimenting more with client involvement in research. This may be more of a perceived than real problem because the partnership model does not exclude scientific or technical innovation. Further, as pressure increases for students to complete their studies in fewer years, students are discouraged from taking on projects that might prolong the research process. This also may be more of a perceived rather than a real danger, because the support network available to students through the science shop may help students finish their research faster. This situation is especially unfortunate because it stifles methodological and theoretical innovation stemming from community partnerships.

Other pressures stemming from the university environment concern professional incentives for scientists and professors. On paper, professors are responsible for the scientific content of the students' work, but in practice they often have limited time and interest to

[48] See Chapter 2, section on Dutch life.

closely supervise students. As government subsidies to universities and students decrease, universities are encouraging faculty more and more to find funding in the private sector. Science shops are in effect competing with national and multinational corporations for scientists' attention, who offer not only more money, but also an elevated social status. There are incentives for professors to publish in professional journals, but no comparable ones for them to conduct research for marginalized groups (Martin 1984). Science shops must demonstrate their contribution to university goals year after year in a way other departments do not (though that too may be changing). In this respect, qualitative reporting on their accomplishments disadvantages science shops; their contributions are better described qualitatively. Feeling pressure to keep their numbers high (e.g., number of reports finished, number of students working, number of clients helped) they may accept client questions not necessarily consistent with the most pressing social issues of equity or change.[49] Further, universities have changed their rhetoric since the 1970s regarding 'social service.' In the past, social service was associated with furthering the goals of interest groups such as labor unions, patient associations, and environmental groups. By the turn of the 21st century, the same term tropes economic development and many students perceive work at multinational companies to be a larger-scale version of what they would be doing at science shops (Mourits 1999; Adrichem 1999).

Though science shops have benefited from university structures, their achievements seem more related to their dexterity at capitalizing on institutional structures and incentives, rather

[49] Market surveys exemplify this dilemma. Because they have more of a definitive beginning and end than many other types of research projects. The abundance of marketing students in need of practical projects, coupled with the perception that these projects are not as "political" as many other science shop projects, science shops seem to have an easier time attracting students to such projects. As a result, there are pressures for science shops to accept such client questions even when they do not address the top social priorities of the science shop. Some science shop employees take issue with the science shop using its resources on these projects even while recognizing they may be used to help groups whose goals are consistent with science shops (e.g. in Twente a

than to something uniquely Dutch. Science shops have become skilled at meeting multiple interests and at spinning their activities differently as university rhetoric and incentive structures changed. Centralized science shops have responded by incorporating as different offices in the university system (from public relations to student services to external services). Decentralized science shops have assumed teaching responsibilities, developed working relationships with academic research groups, and integrated into student life (e.g. the Eindhoven student-run science shops). Science shops outside universities may be better poised to work collaboratively with client groups (Gnaiger and Martin 2001) but non-university science shops may be less positioned to make professional contributions to scientific fields (data and methods), especially new collaborative methodologies, and would have to compete as any other non-profit for money or else become a for-profit consulting firm. The main point is universities are diverse places, with diverse missions—there are positive and negative consequences of working within the university environment and science shops at universities in other countries seem as likely as those in the Netherlands to encounter both.

Political Culture

'Consensus culture,' a centuries' old tradition in the Netherlands in which political matters are negotiated face-to-face, with the understanding creative compromise helps meet the most needs of the most people (Lijphart 1968), has influenced science shops in a number of ways.[50] Discussion-based meetings (*overleg*) are the backbone of consensus, because they allow for people to ponder ideas and craft creative solutions (van der Horst 2001). Generally,

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market survey investigated the potential market for a woman's radio station, and in Maastricht a market survey helped document the demand for a municipally supported daycare program) (Haesen 1999).

[50] The 'polder model,' often used synonymously with "consensus culture," refers more specifically a series of economic reforms in the late 1980's whose implementation relied on negotiation and conciliation between

the Dutch accept the considerable time and energy consensus requires, and so for example, skipping a meeting is tantamount to relinquishing some say in the final decision (van der Horst 2001). Some argue consensus culture can be explained historically by the need for compromise when Dutch society was organized by pillars (Lijphart 1968). Others suggest it also has to do with the Dutch need for water management, which demands tight coordination and cooperation (van der Horst 2001).

At science shops, some vestiges of consensus culture are manifest in the power of expertise. Science shops use expertise's legitimacy to negotiate on behalf of their clients (engagement model) without compromising their independent status. This is possible because consensus decision-making processes confer on experts the authority to arbitrate disputes. By absorbing or deflecting conflict, experts prod stakeholders towards consensus.

> An important part of the underlying consensus is the regard in which experts, facts, and figures are held…. "experts matter because they provide a common framework and acceptable data, evidence of a pervasive ideology of social partnership" [Katzenstein in Andeweg and Irwin]…The role of the expert goes beyond keeping the debate between opposing parties or interest groups honest. They are often instrumental in forging a consensus where none previously existed, as technocratic findings seem to take precedence over ideological values. (Andeweg and Irwin 1993: 232-233)

In this context, expertise has an agency that allows it to transform conflict into conciliation. Experts are expected to help resolve controversy, and to provide a "last word" on a subject in order to bring negotiations to closure. This technocratic-based method of decision-making makes it more acceptable for scientists to take on political responsibilities at a reduced risk of being accused of bias. Understandably, however, some sources of expertise are valued over others—research originating at universities seems to have more credibility than if it comes from consulting firms (often derided as "science for hire").

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employers and employees and are attributed to the drastic turn around in the Dutch economy (also called "the Dutch Miracle") (Visser and Hemerijck 1997; Ministerie van Economische Zaken 2001).

Dutch ideas about social engineering and tolerance, closely intertwined with notions about consensus, also have ramifications for how science shops engage scientists in political activities on behalf of clients (engagement model). Tolerance has been widely misunderstood to mean the Dutch are a lenient or decadent society (think prostitution or marijuana). The opposite, however, is more apt: tolerant policies stem from a desire to control undesirable behaviors (van der Horst 2001). The underlying premise is a belief in social engineering as a reliable remedy for society's ills. Political structures encourage different political actors, especially scientists, to collect information about public policy and to target areas for experimentation and improvement. Faith in social engineering has been related to the unique ecology of the Netherlands, which was, with man-made dikes and canalways, basically 'rescued' from the sea—control over society is presumed to be "equally as controllable as the course of rivers through the flat delta lands of Holland" (van der Horst 2001: 121)—and also to a paternalistic mentality. Science shops, by gathering scientific information and channeling it directly into political processes, perform a sanctioned function in Dutch political culture that relies on expertise and social engineering (Vuijsje 1997).

Similarly, prevailing attitudes about the Dutch legal system also validate the idea of scientist participation in politics (engagement model). The value placed on the Dutch legal system as a tool for change encourages experimentation with new policy based on scientifically gathered information. Loopholes are regarded as opportunities for experimentation and improvement. For example, *Women on Waves*, a Dutch abortion/family planning rights organization, provides contraception, education, and abortions in international waters off the coasts of countries restricting abortions. Sarah Corbett, the founder and leading physician, explains the strategy: "In the Netherlands, we operate in the gray areas of the law. It's how we accomplish change" (Corbett 2001). Such thinking values expert input into political institutions, without necessarily exposing scientists to university censure or even litigation.

Insofar as consensus decision-making requires extensive contact between people of diverse backgrounds, it supports layperson involvement in scientific processes (engagement model). Steering committees, made up of student, faculty advisor, science shop staffperson and client, are the vehicle for developing research questions and trajectories, correcting problems, and discussing practical implementation of research results. Science shop employees oversee steering committee meetings to ensure good communication between members for the duration of the project. The process is rooted in notions about consensus: a good mediator or expert can guide multiple parties towards compromise. Through face-to-face meetings, phone calls, or by jointly reviewing drafts of research proposals and research results, citizens become more familiar with the basics of scientific theory and methods. When necessary, science shop staff will intervene either to steer the research back to the client's original goal, or append/rewrite student reports to be released to a wider public. Client group representatives pass important information to scientists about collecting information and interpreting results, and in the process, become more informed about what it takes for research to meet the necessary supporting conditions to draw conclusions consistent with scientific standards.

Nevertheless, Dutch political culture does not protect citizen collaboration in scientific processes from other limiting factors. Students often opt out of political tasks because of personal reasons (shyness, aversion to conflict), or because they view these activities as extraneous to the scientific core of their work. Science shop employees counter by filling in gaps—by writing an introduction and conclusion to a report to give it political context and relevance, or shopping the research project to the press. Science shop staffpersons distance themselves from traditional experts in order to cultivate better relationships with client groups, but also use the credibility of scientific research to negotiate on their clients' behalf. Scientists and science shop employees temper their use of jargon so as not to alienate laypersons, but at the same time, rely on expertise to elevate their political stature, which means they must possess (or at least be perceived to possess) knowledge and skills inaccessible to laypersons.

In some ways, consensus culture inhibits layperson involvement in the content of science. In consensus, the idea that expertise helps resolve political debates hinges on the idea of scientist as independent agent. Experts, by virtue of their scientific objectivity, have the credentials to steer decision-making bodies towards consensus and compromise, and so the stakes for being perceived as objective are high. This realization is not limited to researchers—clients are equally reticent about collaboration befitting of the partnership model. Some clients shy away from collaboration by virtue of being more focused on political goals than scientific processes. For many, scientific methods and theory are a means to an end: a professionally printed report with the university logo on the cover they can use in the political arena (such as taking to meetings with political officials or as occasion for a press conference). As such, clients emphasize the report as being "from the university"—and downplay that it was done by an undergraduate student. These political considerations help explain the significance of flexibility to successful intermediation. Depending on the clients' interests, skills, and goals, science shops accommodate layperson involvement in research design, data collection, and analysis.

Other aspects of Dutch society besides consensus culture lend themselves to a better understanding of how science shops operate and what resources they use to be successful. The Dutch have a long history of servicing society's underprivileged groups, exemplified by the Catholic doctrine of giving charity to the poor but not limited to the Catholic church (Peters 1999; van der Horst 2001: 62). One unstated stipulation is people must be proactive about finding help—support services do not necessarily seek people out (van der Horst 2001: 266). The science shops have a place within this broader network of support services, but the attitude that people must take initiative before being helped may partly explain why science shops have historically been reluctant about developing research questions without first being approached by a client (de Kool 1979a; de Kool 1979b; Wetenschapswinkel Maastricht 1989).

Yet another aspect of Dutch political culture with ramifications for science shops is the high value placed on newness. One of the graver insults among the Dutch is to accuse someone of being trapped in The Past. Given this, it is critical science shops demonstrate their value with respect to larger social trends. To prove (and re-prove) their relevance, science shops have taken steps to avoid being perceived as outdated, including redesigning their logos and press materials, changing their rhetoric (e.g. dropping terms such as "financially disempowered groups"), and focusing on the social value of research topics rather than on the source of the question (i.e., accepting questions from financially stronger groups providing their goals fit other science shop criteria). The Dutch Science Shop Forum has periodically considered scrapping the name "science shop" altogether, not only because it tends to be misleading (people think it is an actual shop) but also because people have negative associations with 1960s and 1970s. In general, the tactic of favoring pragmatic approaches over ideologically polemical ones helps science shops preserve a broader community and university support network.[51]

[51] Leen Dresen's comments on this subject were very helpful to me.

Elements of Dutch political culture have influenced the foundation and development of science shops, but are not solely responsible for their survival or success. Consensus decision-making has lent structure to science shops but is not the primary determinant of success or failure. Expertise has a certain role in political life, but is not unconditionally accepted as a source of resolution in consensus culture. Religious doctrines about charity to the poor bestow science shops with added credibility at Catholic universities (such as Nijmegen and Tilburg), but also do not guarantee success—the Nijmegen Science Shop underwent major cutbacks in 2001. Science shops maneuver to avoid criticism regarding bias, although, as for example in the airport case study in Maastricht, they are not immune from it. No matter how highly esteemed consensus and conciliation, confrontation is still a fact of Dutch political life.

Summary of Positive and Negative Influences on Science Shops
Related to Dutch Societal Developments and Institutions

Social Movements

Positive	Negative
Students and scientists from social movements founded science shops in an effort to democratize university expertise.	Questions were not always interesting to scientists and students
Members of social movements strengthened science shops’ position at universities	Professionalization of client groups made it more difficult for science shops to justify research as being for underprivileged groups
Conscientious objectors from peace movements gave science shops institutional memory and helped secure long-term resources	Students are reluctant to take on tasks in political arenas
Interest groups submitted interesting, researchable questions	Students are wary of being “influenced” by social interest groups

University Systems

Positive	Negative
Academic research system accommodates science shop goals	Entrenched research methodologies discourage innovation based on citizen involvement
Professional researchers available	Lack of professional incentives for professors and scientists to do science shop research
Universities provide material infrastructure	Changed university rhetoric no longer supports science shop goals to same extent as earlier

Political Culture

Positive	Negative
Consensus culture supports face-to-face negotiation and expert advice	Ideal of scientist as independent agent discourages citizen research
Social engineering is a valued method for change	High value placed on newness disadvantages science shops when they are associated with The Past
Catholic doctrine supports care for underprivileged	Expertise is valued in consensus model, but does not always lead to conflict resolution
Attitude that legal system is a means for experimentation	“Experts for hire” may undermine consensus processes

Recommendations for Science Shops

In this section, building on the considerations of Dutch institutions and culture, I make recommendations for science shops.

Create flexible organizations. The case studies in chapters 4 and 5 illustrate how successful science shops are flexible with respect to the needs of their clients. Mediators help design research projects and then help bring the results into political arenas. Science shops will be more successful when they create a middle ground that balances the needs of different stakeholders and the tensions created by different goals. The process of research design is an important point during which a science shop, clients, and researchers may make important decisions about the project, but processes need to be flexible to respond to dynamic political and scientific conditions.

Create support networks. Science shops need to a level of institutionalized support that allows them to be close to expertise and frees them to concentrate on work besides fundraising. For additional support, science shops can create advisory boards comprised of faculty and administrators who will defend the science shop, work to represent the science shop in university policy decisions, keep the science shop informed about university developments, and form alliances with a diverse range of university groups. Including community members on such advisory boards adds another level to university-community cooperation.

Locate close to networks of experts. Some science shops may choose to locate outside of universities (like the German and Austrian science shops). Neither configuration is immune to financial or political pressures. Given the difficulty of surviving as a non-profit, however, science shops might enjoy greater success as marginal university organizations, or even non-profit university affiliates, rather than as outsider organizations. Another advantage of this is that as long as universities maintain their reputation for objectivity and their (public and private sector) funding, university science shops can mobilize both to assist clients. The Institutes for Socially Oriented Research in the Netherlands failed partly because they were outside the university network and could not piggyback on universities for resources.

Network with similar organizations. In addition to inter-university support networks, science shops should strive for national and international collaboration. The Dutch National Science Shop Forum is a vital part of creating a science shop identity for employees and contextualizing their work in the larger project of democratizing expertise. Similarly, the international network of science shops will "…facilitate interaction among science shops, their client groups, and other strategically important groups in order to increase the quality of their products and the effectiveness, stability, number, and geographic distribution of individual science shops" (Lürsen and Sclove 2001: 15):

> **Why build a network?**…
>
> *Increased visibility and accessibility*
> Once comprising an interactive network, science shops become more accessible to potential client groups and thus the benefits they provide become more generally available
>
> *Collaboration*
> Collaboration among science shops draws upon a broader base of previous experience and yields synergy. It also becomes more practicable to undertake citizen group-driven studies on transnational issues
>
> *Quality control*
> A network enables standardization in documenting, evaluating, archiving and retrieving science shop research results
>
> *Shorter learning curves and greater stability*
> More systematic and standardized documentation of science shop activities, coupled with higher levels of interaction among science shops, will facilitate the creation of new science shops, shorten their learning curves, and stabilize and strengthen the performance of established science shops

> *Dissemination of results*
> Research results become more widely disseminated, including internationally. Successful research models can be replicated and further developed (emphasis in original). (Lürsen and Sclove 2001: 5)

Networks create a shared identity that theorists argue is part of the success equation for social movements (Laraña, Johnston et al. 1994). Networks facilitate the exchange of personal experiences and lessons learned about how the science shop model might be adapted to different countries.[52]

Keep current on trends in higher education and research. Science shops work best when they follow local community developments. But the more science shops know about trends in higher educations the more better they can connect researchers and clients. Science shops may create a “knowledge atlas” of the university landscape that documents faculty interests. Student representatives from each faculty may connect science shops to university developments. The higher density and diversity of ‘people traffic’ at science shops the higher their chances of knowing about events and trends that could affect them.

Standardize procedures. Science shops must be able to provide professional support services. Standardized procedures, such as protocols for responding to potential clients, establishing steering committees, and signing student and client contracts, improve the overall credibility of science shops, making them a more desirable place for university community members to work. In addition to standard protocols for conducting intermediation, science shops should keep research materials for a certain length of time (at least for research that may be controversial). Files for each project containing items such as

[52] Though they did not receive an immediate renewal of grant funding, the members of the SCIPAS study were, in 2001, maintaining contact through their existing listserv (an electronic communication set up to administer SCIPAS) and scoping out a future for collaboration. Meanwhile, a spin-off consortium of people from five European science shops (or organizations with similar interests) who met as a result of the SCIPAS work started INTERACTS, a research project to document and improve relationships between science shops and client organizations (Jorgensen, Gnaiger et al. 2001).

related correspondence, meeting minutes, and contracts are invaluable for institutional memory.

Develop training materials. Science shop employees engage a combination of resources—intuition, rote procedures, local knowledge/theory, student interests, and familiarity with community events and goals—to fashion research questions. Some science shops provide manuals or training workshops for their staff, but these materials are scarce. Information about how science shops work, including training and internal work procedures, will aid both current and future programs (de Bok 2001b; Mulder, Auf der Heyde et al. 2001). The creation of training manuals also has the potential to help science shops theorize and understand their work differently by making implicit assumptions explicit.

Document accomplishments. Science shops should always be ready to explain their work and accomplishments to outsiders. The Dutch science shops produce annual reports. The best reports give quantitative *and* qualitative data about science shop work. For instance, charts of the numbers of projects received and completed can be accompanied by one in-depth story about a research project and its implementation.

Market accomplishments. Marketing is one of the most important facets of science shop work, yet also one of the most difficult. Science shops need high visibility among different audiences: prospective clients, prospective students, the university administration and local communities. Science shop employees may do wonderful projects but then miss out on opportunities for great press coverage at the end. Science shops may hire employees who have marketing skills and journalism experience—those who are most capable of developing a solid research projects are not necessarily the ones who know how to market the project or chaperone them through political processes.

Establish academic credibility. Academic credibility helps science shops attract students and faculty members. It also gives their work standing in political processes. Not all science shops may need to worry about this equally; good relationships between science shop staff and clientele may be more critical to science shops' success in some cultures over others. The authors of SCIPAS Report No. 2 concluded that "cultural contexts seem to determine whether success or failure of science shops depends more strongly on the status and stature of academics in society, or the (personal) relationships…between science shop workers and their clientele" (Mulder, Auf der Heyde et al. 2001: 57). Science shop staff should keep up with research trends in their field, attend departmental lectures, and try to stay connected to academic culture.

Make work interesting. As stressed above and throughout the case studies on science shops, successful mediation depends on the ability of science shop employees to create research projects that are interesting to science shop staff, students, and professors. Frans Sijtsma, of the Groningen Economics Science Shop, explains his perspective:

> A client question is never a research proposal. What you do with that client question depends on your own style and interests. I try to think about what would make for an interesting story for the press. Economics students like to do research on international issues. It is about figuring out what you can get a student to do, but it also has to be something that makes your own heart beat a little faster. (Sijtsma 1999)

The peer-based models of Nijmegen and Eindhoven are examples of how the organizational structure of science shops can be an important factor in constructing overlaps in interest. This technique may also address problems such as a lack of science shop questions in certain disciplinary areas. By clustering several projects around one theme, such as the Grensmaas Project in Maastricht, projects become more compelling to staff, with the added benefits of targeting projects to current policy issues and promoting inter- and multidisciplinary collaboration. Science shop staff should be encouraged to follow current events and develop projects based on their own interests. Graduate students may help intermediate questions and their presence may help make the science shop a more exciting intellectual space.

Connect research to policy-making. The basic infrastructure exists for science shops to make a significant contribution to national agendas, but until a more concentrated effort is made in this direction, such activities are likely to be eclipsed by more immediate science shop tasks (Bliss 2001).[53] Occasionally, science shops have the opportunity to connect to national science and technology policy, as a result of staff initiatives or even through their client groups.[54] National organizations for science shops, such as the Dutch National Science Forum, could set up policy committees based on research interests (e.g. health policy, traffic policy) or hire additional permanent staff. Their annual conferences, for example, might be able to link with national interest groups and policy-makers in different topical areas as a way to initiate this dialogue. Clustered, long-term, and/or professionally performed research projects may promote collaboration among various interest groups, who, by dividing work and sharing costs may direct their efforts to regional and national change. But there are tradeoffs—longer-term questions are not always the best way to address their clients' needs (de Bruin 1991) and professional researchers may be even less patient to sit through many meetings with clients to define the research project (Cramer 1988).

Use scientific method to stimulate reflexivity. The scientific method may serve as an organizing principle for provoking greater reflexivity about science practice. This allows science shops to build on one of the strengths of action research—it acknowledges "…science

[53] In her comments as a reviewer of the SCIPAS conference, Joan Bliss commented on this topic and made constructive suggestions for linking the International Network of Science Shops to national policies on public understanding of science. Her comments inform my recommendations in this section.

[54] For example, the Advisory Service for Traffic and Transport, a division of the Ministry of Traffic and Waterways, recently asked the science shops to help them make an inventory of public concerns regarding health and traffic, particularly with respect to emissions and noise. The Ministry wanted the information for the first phase of a project to compile a general portrait of the relationship between public health and traffic (de Bok 2001).

as a human system, governed by human behavior and values" (Greenwood, 1998: 63; see also discussion in Chapter 1). As students proceed with research projects, science shop staffpersons could encourage deeper reflection on the human factors impacting the scientific method. They might emphasize the importance of students articulating what it means to work with a client (perhaps as a standard introductory section of their final report). By encouraging a multi-dimensional analysis of the scientific method, science shops may be able to elicit concerns with respect to the ramifications of collaborating with laypersons. The discussions might be aimed at understanding the deeper tensions between different models of democratic expertise. Students worry about bias as a result of *outside* influence on their work. Students also want ownership of their work and are troubled by how their work is represented in the press. Science shops may address these issues through discussion and/or by requiring students to write a section of their final report covering such questions as: How did you incorporate the expertise of the client group into your final report? Were there tensions as a result of you performing research for a client? If so, how did you resolve these? There is an opportunity here for further research into the extent to which science shops change students' experience of the scientific method.

Improve communication skills. One way to encourage student reflexivity might center on improving student communication, organizational, and research skills. This work might help narrow the gap between what is required for a report to pass for a student's master's thesis and what is required to best serve a client. Courses, such as the Utrecht Biology Science Shops' *Community Based Research*, could combine STS and science shop insights pertaining to expert-lay collaboration in scientific and political realms (possibly using the three models of democratic expertise as anchor). Science shops might be able to partner with writing professors to introduce communication skill-building as a permanent element of the science shop experience, rather than leaving it to chance based on the individual students' skills. Similarly, adding a research methods component to research projects might help students better organize their research; a clear research design helps keep projects moving forward and helps students avoid becoming mired in the research process. (This is constrained, of course, by students' capabilities, interests, and time.) Taking the idea of communication further, science shops are a likely venue for broader discussions about the direction and impact of research and development, including consensus conferences and public debates. Events could take place in the course of internal science shop activities (such as the forum on Islam and organ donation at the Nijmegen Science Shop) or at the national level (e.g. during the national science shop conference).

Study intersection of science and media. Because so many science shop projects enter the media they are a prime opportunity for studying the intersection of science and the press. This was particularly illustrated in the Twente and Maastricht case studies which both attracted significant media coverage. Students could take on peripheral responsibilities such as writing press releases and following the issue as it moves through the press. Because of local political schedules, this may be better explored as a classroom case study (in STS, communication studies, or in the discipline of study). Students have the chance to gain a political perspective through engagement activities at the science shops, though are often resistant to taking on such activities either because of their personality, or because of a dissonance between ideas of scientific objectivity and public interest work. For this reason, it might be better to hire science shop employees who have journalism or marketing experience. Staffpersons could fulfill engagement model tasks, but explore their choices and actions with students—a theoretically-based exercise which would reduce risk for both student and science shop.

High staff involvement. Science shop projects work best when staff are highly engaged. For example, staff intercede so projects move forward and meet client or outside deadlines. This point was illustrated in the Maastricht Science Shop case, when the staff stayed late to help fax the report to a member of parliament, and at the Groningen Chemistry Science Shop case, when an employee came in on his day off to prepare a report so it would be ready in time for a public hearing. Students learn more when they have strong mentors. Rodenhuis, of the traffic study in Twente, explained she had not understood politics was intended to be part of her science shop experience:

> Science shops might be a good way to teach students about the political consequences of scientific work, but for that you need to give the student a lot of extra guidance. At the time I did my science shop project, I was not aware I was supposed to have a political role, and I believe that the science shop could have done a lot more to help me see that. First, I needed someone to recognize I was not receiving good mentoring from my advisor. I needed someone who could listen to me, and evaluate the process as it unfolded. I needed someone who could create the space for me to gain experience, someone who could help me get a handle on the whole political game as it was being played out. (Rodenhuis 2001)

A great challenge to the science shop is to be able to read these kinds of situations, and figure out who needs help, with what.

Collaborate with STS departments. An expanded STS role in science shops might enhance students' understanding and engagement with political consequences of science shop work (engagement model). Unfortunately, the STS community, beyond its early support for science shops, has tended to overlook possibilities for collaboration. Interaction with science shops occurs more through personal contacts rather than through institutionalized mechanisms (e.g., STS students and faculty serving on science shop advisory boards and delivering speeches or essays at the occasion of science shop anniversaries) (Bodewitz 1988). A more institutionalized relationship between science shops and STS departments could help science shops integrate science critique and reflexivity into their projects—the STS

Department at RPI has, for example, received funding for a Community Outreach Partnership Center it intends to fashion into a science shop of sorts.

Understand the legal environment. Future science shops should be conscious of the legal ramifications of their work. For example, the U.S., unlike the Netherlands, is a particularly litigious society, where controversies like the one over the airport study in Maastricht would be potentially more common—for instance the dispute in Convent, Louisiana, over the citing of a poly-vinyl chloride (PVC) plant by Shintech, a Houston-based company, in an area already known as “Cancer Alley” (Breen 1997; Allen 1999). In 1997, Governor of Louisiana Mike Foster reprimanded the Tulane environmental law clinic for their legal representation of St. James Citizens for the Environment and 17 other citizen groups protesting the plant, calling them “modern day vigilantes” and threatening to rescind the clinic’s tax-exempt status (as an university-affiliated non-profit) (Replogle 2001).[55] Shintech eventually withdrew its bid to build in Convent, although it continues to investigate alternate sites up-river. Meanwhile, Governor Foster signed a law prohibiting the Tulane Law School from representing: any group with revenue exceeding $10,000; communities if more than half their members earn more than $10,000; and local chapters of national organizations (Brown 1998). University-supported groups around the country who represent underprivileged communities are concerned about the consequences of the restrictions on Tulane’s environmental law clinic on their work. Suppression of science shop research by legal action is a real threat, especially when science shop work is perceived to be in conflict with economic growth. Knowledge about the legal environment may help science shops avoid controversy—or create it. Also, legal knowledge may help science shops intervene more effectively in political

[55] Also similar to the Maastricht case, Greenpeace analyzed the situation for job creation, concluding that in order to find high-skilled employees, Shintech would have to hire people outside the local communities (Breen 1997).

arenas, e.g. the Groningen project that demonstrated a company was out of compliance with regulations regarding odor.

Work on cultural change. In cultures whose political systems and interest groups are organized differently than the Netherlands, science shops might be used to advance participatory democracy. Between September 1998 and September 2000, the Dutch Ministry of Foreign Affairs provided seed funding for four Romanian science shops, all in the environmental sciences, as part of the Social Transformation Program (*Maatschappelijk Transformatieprogramma* or MATRA) “for strengthening the new democratic civil society in Central and Eastern European countries” (Mulder 1997; Mulder 2001). More than a decade after the fall of Romania’s communist government, non-governmental organizations are still struggling in a country unaccustomed to civic participation through interest groups. Christina Ichimas, director of the science shop in Bacau, Romania, is using the science shop concept to develop participatory decision-making skills, her aim being to foster a scientist/citizen, empowering her students to take direct community action. She developed an environmental education workshop that was very different from the science-centered lessons that characterize other environmental education courses. In one classroom activity, she divided students into groups—mass media, non-governmental organization, or government—and gave each appropriate background about an environmental problem. Students had a lot of difficulty with this assignment. Before they started, Ichimas had to review of what the function of each of these sectors. She attributes students’ difficulty with the assignment to their lack of familiarity with civic participation and group decision-making:

> In the communist past, everything was top-down. People did not think about becoming involved. People in Romania are not used to compromise, they are only used to arguing. (Ichimas 1999)

Based on ideas about science shops from her Dutch collaborators and visits to the Netherlands, Ichimas conceives of the science shop as a place to develop civic skills by encouraging scientists to take on engagement model responsibilities. This example illustrates the potential for science shops to play some kind of role at the level of culture in the development of a participatory political system.

Explore collaboration on technical artifacts. Partnership model collaboration seems to flourish in the technical science shops, as demonstrated by the Eindhoven technical science shop case studies (see Chapter 5). Technical artifacts provide a tangible anchor around which to structure discussion with potential users. Many student engineers are very happy to use their skills and love for tinkering to invent products or product modifications people will use. Lessons from these science shops might be applied to other design settings, such as industry or urban planning.

Develop incentive structures for community collaboration. Researchers, especially in the health sciences, have been using partnership model strategies not only to improve health conditions for local communities, but also simply as a way of improving their data collection methods. Collaborative strategies are especially helpful when gathering data regarding illicit, or socially unacceptable behavior.[56] However, besides access, there are few incentives for community collaboration. Better incentive and reward structures are necessary to increase collaboration between scientists and citizens, such as making collaboration a consideration in in funding, promotion, and tensure decisions.

[56] AIDS researchers in Africa, for example, trained female prostitutes to administer a questionnaire regarding condom use to their male clients (McNeil 2001).

Summary of Recommendations

Create flexible organizations that can move between three models of democratic expertise
- Stay engaged throughout project
- Help client when student cannot

Create institutional support networks
- Find reliable mentors
- Create advisory boards
- Appoint university and community members to boards

Locate close to experts

Network with other science shops

Keep current on trends in higher education and research
- Create "knowledge-atlas"
- Student representatives from faculties
- Student intermediators (graduate students)

Standardize procedures
- Track data
- Make contracts
- Use files to track clients
- Save research in storage (especially in politically controversial cases)

Document accomplishments

Market research and accomplishments
- Issue a press release for every science shop project
- Hire people to do it
- Keep an updated inventory of the significance to university mission

Develop training materials

Establish academic credibility

Make work interesting
- Internal research projects
- Professional development
- Create thematic groups

Connect research to policy-making
- Internal and long-term research projects
- Pool resources across science shops
- Policy committees
- Hire staff to do this
- Link multiple clients in research projects

Use scientific method to develop reflexivity

Improve student communication skills
- Work with communication departments

Study intersection of science and media
- Use case studies in the classroom
- Have students write press release and follow local media

Collaborate with STS Departments

Understand legal environment

Work on cultural change

Explore community collaboration on technical artifacts

Develop incentive structures for collaboration
- Make collaborative research a priority in calls for funding proposals
- Route grants through community groups

Conclusion

Science shops are supported by the strong, specialized interest group network in the Netherlands, the organization of university research, and the collective value placed on negotiation, consensus, and helping underprivileged people. They have leveraged national policies into university support. Dutch factors have influenced their foundation and development, but are not solely responsible for their survival or success. In some ways, Dutch conditions have made science shop work more difficult, constraining democratic expertise (particularly the partnership model). Science shops have never been fully institutionalized, but their marginal position within the university has made them flexible to incorporate under a broad range of university services. Science shops have worked within Dutch society and have mobilized many resources to their advantage, but little has come easy. The list of recommendations illustrates how their success depends on how well they mobilize a myriad of skills and balance tradeoffs.

CHAPTER 7: A Framework for Democratic Expertise

This study presents the most comprehensive work on science shops to-date. By applying an STS analysis to the study of science shops, I developed three analytical categories for understanding multiple practices of democratic expertise. Taken together, the representative, engagement, and partnership models comprise a framework for democratic expertise. The first part of this chapter describes this framework. The second part suggests avenues for future research that may take this analysis further.

Relating Theory and Practice: What do three models do?

By categorizing science shop activities into three types, my work illuminates the science shop project as a multi-faceted process, whose goal extends much further than the provision of scientific knowledge to certain interest groups. Organizations capable of moving between modes of practice may be more effective at accommodating the needs of multiple stakeholders. My analysis of science shop experiences according to three models highlights the essential function of mediators to democratizing expertise: they help organizations tailor strategies to complement different needs and changing circumstances. Casting each model as part of a framework for democratic expertise makes possible the identification of tensions and tradeoffs among multiple interests. The framework illuminates issues surrounding expert-lay interactions and offers practitioners new language to explain their work and fashion future endeavors. Additionally, the framework may also be adapted to different situations regarding experts, laypersons, mediators, politics, and science.

The representative model helps identify conditions that must be met in order for experts (and budding experts) to take interest in certain social problems and invest their time and energy in them. At an organizational level, science shops have faced difficulties with survival. To be able to turn experts' attention toward certain societal sectors, science shops have had to establish their own scientific credibility. Their university positions serve them well, but these positions have not come easily—every year science shops struggle for renewal of funding. They are particularly vulnerable to changes in political climate. Centralized science shops have found ways to incorporate as different university identities. Decentralized science shops have found protection from their academic departments. Science shops that are exciting social and intellectual places attract more "traffic"—more students volunteer to do research or to assist with intermediation and more science shop staff who stay longer and become more experienced with the nuances of the mediator position.

Intermediators transform client problems into research questions or find some other way to help when they either cannot find an academic angle for a project, when there are no students interested or available, or when they feel the client would be better served by something other than research. There is a dilemma for mediators. This is not a position with a traditional career trajectory or stability. For them to stay at the science shop and continue to be effective, they need stimulation from the research. Some science shops have created thematic groups to sustain a more robust intellectual environment. Almost all have come to recognize the importance of developing projects internally instead of only waiting for them to arrive. Some have their own research budgets to initiate questions, some canvas non-profit groups to develop projects that have regional significance, and many have altered their criteria so as not to exclude interesting questions (from non-profits, for example). This may lead to a dilemma regarding the actual social significance of their research. Many science shops accept questions that do not necessarily have the potential to produce substantial social change because the research is interesting, can occupy a student, or gives students an outlet to practice and validate emerging skills.

The representative model underscores the significance of credible expertise for groups with political aspirations. Without scientific credibility, science shops cannot convince students or faculty to participate in research projects. This creates a frustrating feedback loop—without student or faculty participation science shops have trouble establishing scientific credibility. The decentralized science shops have an advantage in this respect because they are more integrated with academic life. Individual scientists at science shops add credibility to their organizations by assuming teaching responsibilities or otherwise participating in the academic culture of their departments. Multidisciplinary centralized science shops have traditionally been restricted to social science disciplines. Although the Dutch consider social scientists "scientists," they are "soft" as opposed to "hard" scientists—being social scientists working outside of academic faculties compounds difficulties attaining scientific credibility. Generally, the more involved science shop mediators are with the content of research projects the higher the quality of the research and the higher the credibility of the science shop.

Mediators work, to varying degrees, on overcoming simplified versions of the "public understanding of science" that may lurk in the ideological assumptions of the representative and engagement models. Many science shop mediators are eager to work with clients to better understand the benefits and limitations of scientific research. Sometimes however, the public understanding of science is stymied by client groups' own reluctance to become substantially involved in research topics. For instance, Peter Viehen of the Handicapped Platform of

Maastricht, explained that he has not become more scientifically knowledgeable through doing projects with the science shop:

> Oh no, I don't understand anything about science. All those theories, methods, standpoints. For us, it's really just important to be able to *use* science. (Viehen 1999)

Although Viehen is reluctant to admit these projects have helped him understand science better, his reference to standpoints hints of a deeper familiarity with the mechanics of research design. Moreover, his sentiment belies a deficiency in the "public understanding of science" concept because it says nothing of the importance of being able to use expertise towards a particular goal. Mediators are an essential bridge between science and communities. They are aware that it is not enough for communities to simply understand science better—it is equally, if not more important, to direct scientific resources to solve local problems. Science shops show the potential of representative model work to accommodate a range of familiarities with science and develop research projects in tandem with citizen needs.

The representative model, by emphasizing the importance of *accountability* to democratic expertise, points to drawbacks to the science shop system. Science shops rely too much on the willingness of experts to take on extra responsibilities and the ability of mediators to make research enticing. They lack the necessary leverage to hold experts accountable to working at the science shop. What would happen if faculties had to compete with each other to do science shop work? What if there were good incentives for professors to develop research topics in tandem with communities and then run the projects through science shops? Representive model systems need incentive structures that will help them re-direct basic and applied research.

The engagement model helps focus on the work science shops do to produce scientific research in tandem with political contexts. Science shops direct scientists or students into research projects that often have pressing political circumstances. Students may be reluctant to take time to understand factors they perceive as unrelated to the scientific core of their research. Even when scientists or students are not interested by political particulars, science shop intermediators can help their clients become more effective political negotiators. It is helpful for science shops to work with organizations that have a range of political experience. Intermediators learn skills and strategies from experienced clients and pass them onto less experienced clients. The more at stake politically, the more critical it is that science shops maintain scientific credibility. The engagement model demonstrates how the utility of expertise extends far beyond transmission of information to publics—expertise has a currency that gives political outsiders footholds into political arenas. Third party mediators are essential for linking parties and creating less adversarial and more constructive environments for lay publics and politicians to interact. In many cases, science shops have helped stakeholders establish relationships that outlast the involvement of the science shop.

Interdependencies and tensions between representative and engagement models explain some of the intricacies of science shop work. Intermediators work to keep the clients' needs present throughout the research process. If not, students may steer their research in ways that does not necessarily help the client. The final report is often the most significant contribution to clients. In many cases intermediators will intervene, adding their own foreword to a report, so that it becomes a better tool for community groups to use in political arenas. The problem with scientific credibility spans the two models—the higher the quality of the final report, the more effective the report will be as a political tool. The engagement model can also have a positive effect on science practices. Students who take part in engagement model tasks—or at least follow what is happening through the science shop—learn about communication. Students may improve their speaking and writing skills, learn how to read personal interactions, and become more conscious about how language and presentation sways public opinion. These skills may make a difference in later life for how experts interact with publics or whether they choose to take up public interest causes in their professional or personal lives. Improved oral and written communication skills are also valuable to students' own professional development—good presentation helps experts convey the importance of their work across disciplinary contexts, win research funding, and exert more control over the representation of research and results in the media.

My work exemplifies some of the tensions between representative and engagement models. This research was part of a doctoral program in STS that I entered because it seemed to be a place for people deeply concerned with the practical aspects of shaping science and technology according to "human values." This program required I become proficient in a body of literature (which I helped determine), pass exams that explore theoretical topics, and then make a contribution to the literature. Coordinators of Dutch science shops supported my work in part because they recognized that the final product could help them document their accomplishments. They will publish this dissertation in Dutch and use it to inform their practice and strengthen their position at universities—they have already used the opportunity of an American Ph.D. student studying them for publicity. They have repeatedly told me how excited they are to read my dissertation and they have communicated that they do not expect everything I say to be positive. But it has been difficult to fashion a piece of academic work in such a way that the final product is useful to people who are at science shops or want to take the science shop idea and try it somewhere else. Throughout, I have felt academic conventions and practical needs pulling me in opposite directions, threatening to make my research more accountable to people in academe but less accessible to people who work or want to work at science shops. Had I done this project as an independent researcher I might have produced a product that is more useful—a handbook perhaps, for how to start a science shop and how to measure if it is successful. This could still have a theoretical side, after all, science shops were founded on the basis of theories about science and society. But without the academic credentials (having a "home institution," letterhead, an email) it might have been more difficult to arrange funding from the National Science Foundation and access to people and paper. Also, without the academic credibility the work might not serve the Dutch science shop community as well as I hope it will. I tried to build a theoretical framework that would be supply language to people in academe and 'out there.' I am hoping this framework helps better explain science shops' contribution to democratic expertise.

The partnership model presents a way of understanding the range of possibilities for community participation in the content of science. The steering committee set up for research projects makes important decisions about the research design. Even when scientists or students are not particularly interested in collaboration, science shop intermediators can work to keep stakeholders involved. Additionally, effective mediators can compensate when researchers are reluctant to collaborate with clients out of concern for the objectivity of their work, or referee when clients' involvement threatens to prolong research past the time when students can work. Sometimes clients are not interested in participating in research, but from their position on a steering committee they gain insight into the iterative decision-making and "muddling through" (Lindblom 1990) of research. In many cases, the closer the client is to the research process the less likely they are to be dissatisfied with the science shop or the research outcome. They are also more likely to learn about the value of systematic inquiry and of different research methods.

Many community-based research advocates, for example those involved in emerging network of people of color within the Community Research Network project of the Loka

Institute, argue Dutch science shops do not go far enough in accommodating citizens in the research process and therefore challenging established scientific norms (CRN Conference 2000; SCI-PAS Conference 2000). The partnership model helps explain how science shops operationalize public involvement in science selectively, based on the unique conditions of each case. When research will be used to fortify political claims, it may be expedient for science shop clients to appear as detached from the research as possible. This leads to dilemmas, for instance when a client has a lot at stake in the political outcome—the tendency then is to become more intimately involved in the day-to-day of the research. When there are tight political schedules to which research must conform, the client may play a critical part in getting the research out in a timeframe that maximizes its utility. Mediators set standards for participation and may adjust the balance of client involvement over the course of a project to accommodate fluctuating political conditions. Such considerations of the partnership model show that science shop research does improve public involvement in science while staying sensitive to multiple goals. Intermediators soothe the process and make choices to help mitigate the additional conflicts associated with producing scientific knowledge in a public context. Students develop empathy with policymakers through personal contact and also because they are challenged to act as policy makers by making policy recommendations. Many students, uncomfortable with this role, stake out a scientific core of their research project. Science shop employees learn to counter by fostering dialogue between stakeholders, alerting students to current affairs, helping students understand the intricacies and expertise of public interest groups, and insisting students incorporate policy analysis in their work.

Like the two other models, the partnership model has potential to improve the practice of science. Because many clients possess specialized knowledge about their problems, they may improve research designs by helping to set up research questions that are answerable given the short window that science shops may have to complete a project. Depending on the level of client experience, their involvement during the project may help students overcome stumbling blocks and writer's blocks. Client representatives may be willing to think through a project with students and give fresh insight into a problem. Outsider involvement may be helpful to the gathering and analysis of data, even when their role is not formally recognized as doing so. Post-normal science, which stresses that a better framework for uncertainty and science can be a boon for both science and equity, underscores the need for institutions that can incorporate feedback from an "extended peer community" (Funtowicz and Ravetz 1999). Mode II knowledge asks that knowledge production processes take into account the context of application and "new disciplinary identities" (Gibbons, Limoges et al. 1994). Science shops respond to post-normal science by introducing new communities into processes of science, handling citizen concerns about risk, and shifting intellectual capital towards problems that have high uncertainty. By operating as outsider organizations, science shops may be more flexible with respect to academic disciplines and capable of creating awareness of application context (pace Mode II knowledge).

The three models of democratic expertise help determine benchmarks for understanding success. They also challenge STS to recognize the contribution of more technocratic approaches (representative and engagement models) to democratizing expertise, while challenging science shops to explore collaborative relationships (partnership model). This work also informs STS, insofar as it concerns the social construction of science and technology according to specific values, through an understanding of interactions between individuals and institutions. This analysis shows some of the limitations of science shops—organizations that have explicitly sought to practice (selected) STS theories—to radically transform scientific practice. Instead, science shops have created a new space where utilitarian standpoints on science and skepticism for what science can accomplish coexist. That STS discourse is not thriving in science shop practice signals a possible failure of STS to provide activists with theoretical strongholds and a potential for STS to address this need in the future.

Whereas STS is useful in explaining why scientific knowledge should be viewed on a more equal footing with other types of knowledge, these models of expertise acknowledge the value of a range of strategies for advancing community interests. In their quest to direct science and technology towards particular values, science shops have had to make tradeoffs in order to work in areas meaningful for both social interest groups and scientists. Changes in Dutch society and the university, and their experience working as an institutionalized entity within the university, partly explain the softening of science shops' rhetoric. They have forgone *critical* postures toward science that were intensely evident in their beginnings with student movements, in favor of more pragmatic postures.

Future Research

This study presented a detailed picture of Dutch science shops and case studies that help capture lessons from their thirty years of experience. It showcases science shop work in the social sciences and in cases where counter-expertise is offered on pre-existing studies. In so doing, it illustrates the value of a variety of methods to political, cultural and social change. It was limited to Dutch science shops because they are the longest running and most elaborate science shop system. Despite international efforts to model science shops on the "Dutch model," very little information was available about how they work. Because of the variety of

Dutch science shop experience and emerging science shops worldwide, there is a vast opportunity for additional research on science shops.

This study focused on case studies in which science shops performed applied research or gave counter-expertise on data collected from other sources. Case studies on science shop work in basic research will complement this study. In light of practitioners' complaints that community work is perceived as low-tech, this area might have particular value to community-based research. Additionally, this study outlines some of the research happening at the science shops that became professional consulting firms. Is this model preferable to other ways of organizing science shops if the goal is to stimulate basic research? Does this model have a better chance at achieving long-term change by directing scientific research toward socially responsible goals? Also, many science shops commission their own research projects: is this method more successful at meeting client goals and steering scientific research? Would science shops be better off raising their own funds so they have have more control over their research, or is the university-based approach critical to the creation of democratic institutions? Research that concentrates on certain kinds of science shop research may provide valuable insight into "Science" at science shops.

Some science shops do follow-up studies to assess if their research really helped their clients—though by their own admission, not enough. In the same way, follow-up research may be able to assess whether or how academic work (including this study) assists science shop intermediators. Does new language help science shops to see their own work differently? Does this translate into organizational or procedural changes? Does this help them negotiate funding networks (university, local, national, international)? One European Commission-funded study that focused on "the flow of information from society towards research when it is more common to approach the issue from the opposite angle" suggested some terms to describe information flows, although it is not yet clear whether any science shop intermediators have found this language useful to their own work (see Valenduc and Vendramin 1995). Additional research might concentrate on translation activities to formulate scientific research questions from client questions. Research that names these activities can help practitioners expand procedures to consider more information, teach their craft, and ultimately enhance their services under each of the three models of democratic expertise. New language may guide science shop work, as well as illuminate or complexify decision-making processes, such as how students fortify or challenge conventional assumptions about science and politics.

Future cross-cultural comparative research may yield more information about various strategies for constructing meaningful scientific research projects based on community resources and concerns. Towards that end, the outcome of the latest European Union-funded science shop study, INTERACTS, will be interesting as far as it promises to deliver the first in-depth comparative research on European science shops (Jorgensen, Gnaiger et al. 2001). Future research that produces case studies documenting science shop work in different countries may improve our understanding about how cultural conditions influence science shops, provide a wider range of experiences on which to draw lessons for future institutional design, build a shared identify among practitioners in diverse fields, and strengthen the support function of an international network of science shops. The extra-university European science shops may be good research sites to study issues of financial viability, steering of scientific research, multi/interdisciplinary inquiry, and scientific credibility for science shops outside of universities.

Further inquiry into how other European science shops have confronted legal issues with respect to science shop research may help glean lessons about how science shop work can successfully overcome legal obstacles. For example, none of the cases presented here had direct conflict with private companies that fund university research. As research funding from the private sector increases and funding from the public sector decreases, universities may become increasingly beholden to certain firms for large portions of their budgets. In a similar trajectory but not necessarily a study of science shops, inquiry into cases in the United States when universities have tolerated or cracked down on researchers for political reasons may reveal further lessons about how science shops could be effectively run despite unfavorable legal cultures. What happens when universities/science shops are asked for research that may have negative consequences for private industry? What if those firms pay for a significant share of university research? Will there be pressure for science shops to suppress their research findings? If so, how will universities respond to pressure (from private companies and universities) to suppress science shop work? These are difficult questions that could be addressed both at the general level of university research and the specific cases of science shop work. This avenue of study is valuable to the larger goal of understanding suppression in science (Martin 1997b).

Building on the framework of democratic expertise presented here, future research may theorize strategies for improving work in each of the models and explore how science shops use alternative configurations to expand their work in certain areas of democratic expertise. Additional research may help elaborate on whether other sciences shops show similar tendencies toward the representative and engagement models, and away from the partnership model. When other science shops (or other kinds of organizations) use partnership model tactics, what is different? What would change about science shops if they were to make partnership work figure more prominently? What are successful strategies for preserving scientific credibility while collaborating more closely with citizens in research processes?

Longer-term case studies of technical science shops will extend the understanding of science shops as a potential organizing concept for technical innovation and for improving technical students' communication skills.

Science shops are mostly focused on providing expertise in the form of advice or final reports. They concentrate on policy-making at the organization and local levels. But what about other activities which work on issues regarding public decision-making with respect to science? How can science shops more effectively link up to national policy-making? Are long-term projects better suited for meeting the goals of NGOs? Further research may also inquire about how science shops can partner with multiple interest groups to expand collaboration and inform science policy-making. Hopefully, future research will give grounded analysis that improves theoretical and practical work towards democratizing expertise.

Conclusion

In addition to a detailed history of science shops and case studies of projects in a range of disciplines at both centralized and decentralized science shops, this study dispelled some popular misconceptions about Dutch science shops.

Because of connotation of the word "science" in English, many people assume science shops do research only in the natural sciences. This work shows that science shop work extends into the social and technical sciences; the variety and scope of research projects is tightly linked to the efforts of intermediators to shape client questions, advertise the science shop, anticipate student and community needs, and develop new research projects.

Because science shops have been described as practitioners of community-based research (e.g. by Sclove, Scammell et al. 1998), science shops were thought to practice participatory action research in which citizens do scientific research alongside scientists. My work shows that for the most part, students—not scientists—do most of the research at science shops. Faculty advisors approve (or at least agree to approve) the content of the research. Intermediators moderate science shop work between several different modes of practice, of which direct involvement of citizens in scientific research is the least common. Nevertheless, intermediators facilitate closer links between students, faculty advisors, and community groups. In the process, science shops enhance both the 'public understanding of science' and the 'scientist understanding of the public' (Irwin and Wynne 1996).

In international circles, people have a tendency to speak of a Dutch model of science shops. This study illustrates that there are not only two organizational forms of science shops, but also that mediators play a significant role in the creation of a unique identify for each science shop. Communication among science shops over the last thirty years has spawned a common identity for science shops and some standardization of terms, but it has also led to an increased tolerance of multiple approaches. All science shops are university-based and follow what they call intermediation, but all science shops improvise and innovate as they go.

An international audience in STS and community-based research think of science shops as a vehicle for changing science practices, including de-mystifying science practices, stimulating public debate regarding research and development, and challenging elite monopoly of expertise. At the opposite extreme, many Dutch scholars see them as a "throwback" to the 1970s. In reality, science shops accommodate client needs in the context of student research projects—which makes it difficult to develop new research methodologies or make innovations in basic research. The decentralized science shops that employ scientists or professionals have an easier time stimulating methodological or topical innovation. But science shops are also organizations that facilitate the transfer of expertise into the hands of social interest organizations and the media. They work at the margins of academe and their work provides case studies for understanding the movement of scientific information. The idea of mediators who arbitrate the interface of publics, experts, and knowledge is a vital component of democratic expertise. Among clients, science shops cultivate both a respect for expertise and an appreciation for the political value of scientific information. Among students, science shops present a more nuanced portrait of how interest groups cope with scientific information and have the potential to help students and scientists develop critical and reflexive perspectives on their work, resulting in improved communication of scientific information.

Because of the Dutch reputation for being experimental and progressive, and because the Netherlands is a small, wealthy country with a proclivity for social welfare, skeptics wonder whether Dutch science shops are successful because of Dutch institutions and culture. The picture emerging from this research is that Dutch factors have helped and inhibited science shops. Dutch norms and institutions have influenced science shops, but are not the sole determinants of success—Dutch science shops have had to fight hard for to maintain their university positions. As science shops in countries across the world demonstrate, the idea is amenable to universities in different cultural circumstances. Even in a country that has neither a developed interest group sector nor a similar sense of social progression based on expert information such as Romania, coordinators are using science shops to stimulate the cultural change necessary to sustain participatory democracies. This work provides a baseline for thinking about community-university partnerships across different cultural contexts.

Science shops accommodate the needs of multiple parties by moving fluidly between three models of democratic expertise. They strive to project a professional image. They distance themselves from traditional experts, but claim some of science's authority in the name of their client groups. Their work raises issues about the setting of science and technology research agendas, the public understanding of science, and institutional forms that accommodate expert-lay collaboration, topics that are gaining recognition within the European Comission. For example, one working document discusses the importance of "structuring research policies around society's aims" and "involving society in the scientific venture" (Commission of the European Communities 2000). The conclusions from the European Commission-sponsored conference "Science and Governance in a Knowledge Society: The Challenge for Europe," read like a justification for science shops:

> …A better understanding of the scientific process and of uncertainty is replacing the belief that science is purely objective and free of human influence or responsibility. The complex forces shaping scientific innovation include human visions and values, which can and should be rendered more accountable in a wider democratic process…
>
> …Allowing a wider participation in the scientific process – by stakeholders and by the public alike – should not be considered a replacement of the existing democratic institutions but rather as an enrichment of them…
>
> …There needs to be a long-term process of mutual learning between the public and science, which will necessarily involve new institutional relationships and forms (emphasis in original). (Commission of the European Communities 2000: 1-2)

Science shops work at an intersection of science and politics akin to what a host of scholars have asked for of democratic science institutions—that they portray a more "honest" relationship between science and politics (Sarewitz 1996).

One thing is certain about the future of science shops: in any country, in any setting, science shops will encounter obstacles related to, among other things, funding, objectivity, bias, personalities, continuity, time, interest, university research priorities, and entrenched interests. Vested interests will continue to propel scientific research and policy toward their own goals, although public interest groups and whistleblowers may mitigate these influences. In spite of these obstacles, I hope this work inspires and assists others working at the juncture of expertise and social equity.

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________, coordinator at the University of Twente Science Shop. (1999). Interview by author. Wetenschapswinkel Twente, Enschede, the Netherlands.

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APPENDIX A

LIST OF DUTCH SCIENCE SHOPS

Amsterdam	University of Amsterdam: chemistry Free University of Amsterdam: central science shop
Delft	central science shop
Eindhoven	management civil engineering chemistry electrical engineering physics technical healthcare technology and society architecture
Groningen	economics chemistry biology education languages history physics pharmacy medicine and public health
Maastricht	central science shop
Nijmegen	central science shop
Rotterdam	central science shop
Tilburg	central science shop
Twente	central science shop
Utrecht	central point biology chemistry physics letteren pharmacy law social sciences
Wageningen	central science shop: agriculture

APPENDIX B

SCIENCE SHOP CONTACT INFORMATION

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Wetenschapswinkel Economie **RUG**
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9700 AV Groningen
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Wetenschapswinkel Geneesmiddelen **RUG**
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