

STIR: Socio-Technical Integration Research (NSF #0849101)

Erik Fisher, PI; David H. Guston, Co-PI

Annual Report for Period: 04/2009 - 03/2010

Principal Investigator: Fisher, Erik
Organization: Arizona State University
Submitted By: Fisher, Erik - Principal Investigator
Title: STIR: Socio-Technical Integration Research
Submitted on: 03/25/2010
Award ID: 0849101

I. Project Participants

Senior Personnel

Name: Fisher, Erik

Worked for more than 160 Hours: Yes

Contribution to Project: As PI, Fisher has planned, coordinated, and run all project events including two international workshops in the US and in Norway; regular lab meetings with project investigators; one on one mentoring sessions and correspondence (face to face, email, and via skype) with all project investigators; site visits to most research sites (in six countries: US, Canada, UK, Switzerland, Belgium, and the Netherlands); and various public and professional presentations on the project. Fisher has also mentored and/or collaborated with several project participants on the development of multi-authored publications involving the PI (Schuurbiens, Calleja, Ellwood, Zhu, Phelps), single- and multi-authored publications not involving the PI (Conley, Schuurbiens, Calleja, Luk, Kim), and on numerous presentations involving project participants. Fisher has also worked with project participants to gather and analyze project data from fieldwork and from archival sources, has initiated and participated numerous discussions and intellectual investigations regarding project rationales, questions, findings, and potential applications; has spent lots of time managing and coordinating project activities, including meetings with Co-PI Guston; has worked with some project participants on their dissertation plans and/or served on their thesis committees (Conley, Calleja, Phelps); has worked on several single and multi-authored publications involving non-investigator participants (Guston, Miller, Biggs, Lindsay, Jie) and non-project participants (Mitcham, Mahajan, Lightner, Functowitz) on work relevant to the project; has given numerous presentations (professional, public, and pedagogical) on the project; has organized and proposed several conference panels on the project (APSA, 4S, SNET); has sought both additional and supplementary funding to support project activities; has planned, developed and begun to implement general dissemination

strategy; and has been planning and preparing for a third project workshop in Japan.

Name: Guston, David

Worked for more than 160 Hours: No

Name: Mahootian, Farzad

Worked for more than 160 Hours: No

Contribution to Project: Developing a theoretical model of midstream modulation, attended project meetings

Name: Miller, Clark

Worked for more than 160 Hours: No

Contribution to Project:

In addition to contributions that are typical of most PhD advisors participating in the project, Miller has advised the PI on mentoring the doctoral students regarding the comparative elements of their work.

Graduate Students

Name: Stavrianakis, Anthony

Worked for more than 160 Hours: Yes

Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Phelps, Robin

Worked for more than 160 Hours: Yes

Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Zhu, Qin

Worked for more than 160 Hours: Yes

Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Calleja-Lopez, Antonio

Worked for more than 160 Hours: Yes

Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Luk, Christine

Worked for more than 160 Hours: No

Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Kim, Byoungyoon

Worked for more than 160 Hours: Yes
Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Schuurbiers, Daan
Worked for more than 160 Hours: Yes
Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Conley, Shannon
Worked for more than 160 Hours: Yes
Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Thoreau, Francois
Worked for more than 160 Hours: No
Contribution to Project: Conducted/ing field work, attended project meetings, participated on website, etc.

Name: Ellwood, Paul
Worked for more than 160 Hours: Yes
Contribution to Project: Conducted/ing field work, attended project meetings, submitted internal report, participated on website, etc.

Name: Hansen, Birgitte
Worked for more than 160 Hours: No
Contribution to Project: Conducted field work, submitted internal report, participated in special (online) training.

Name: Lucivero, Federica
Worked for more than 160 Hours: No
Contribution to Project: Conducted/ing field work, attended project meetings, participated in special training sessions (online and in person).

Name: Van Oudheusden, Michiel
Worked for more than 160 Hours: No
Contribution to Project: Conducting archival research, participated in project meetings and website.

Organizational Partners

University of California at Berkeley
- This organization has a subcontract with ASU for the STIR award

University of Colorado at Denver

- This organization has a subcontract with ASU for the STIR award

Colorado School of Mines

Rensselaer Polytechnic Institute

University of Seville

University of Leeds Technical

University of Delft

University of Liege

Dalian University of Technology

Copenhagen Business School

University of Twente

Other Collaborators or Contacts

In addition to doctoral student investigators participation in the STIR project, their PhD advisors have participated in Workshop 1 and in fieldwork planning. Other collaborators include: laboratory directors at most field sites, laboratory researchers at these sites, and faculty including Clark Miller, Arie Rip, Bruna De Marchi, and Roger Strand.

II. Activities and Findings

Research and Education Activities

Laboratory engagement studies (14). Fieldwork has been completed at the following sites:

1. Arizona State University
2. Arizona State University
3. Arizona State University
4. Arizona State University

5. Broomfield, Colorado
6. Delft Technical University, The Netherlands
7. ETH Zürich, Switzerland
8. Golden, Colorado
9. Lawrence Berkeley National Laboratory
10. Leeds University, United Kingdom
11. Seoul National University, South Korea
12. University of British Columbia, Canada
13. University of Copenhagen, Denmark
14. University of Oxford, United Kingdom

Workshops (2) for Ph.D. students and project collaborators:

1. STIR Workshop 1: Constructing Foundations, Arizona State University, January 17-19, 2009
2. STIR Workshop 2: Inquiry as Intervention, Vatnahalsen Hoyfjellshotell, Norway July 4-7, 2009

Findings

Initial results from STIR project field studies are in some cases strongly suggestive of both the possibility and the utility of conducting hands-on, lab-based socio-technical integration activities between social and natural scientists.

For instance, STIR investigator Daan Schuurbiens' paired laboratory engagement studies in the Netherlands and the United States sought to explore how PI Fisher's framework of midstream modulation could be applied to encourage biological science and biotechnology researchers to reflect on the socio-ethical context of their work. As he demonstrates in an article submitted to *Science, Technology and Human Values*, the results of his engagement studies confirm the utility of midstream modulation in encouraging both first- and second-order reflective learning. In particular, the potential for second-order reflective learning—in which underlying value systems become the object of reflection—is significant with respect to addressing social responsibility in research practices. Schuurbiens has found that midstream modulation

served to render the socio-ethical context of research visible in the laboratory and encouraged research participants to critically reflect on this broader context. Midstream modulation could therefore, Schuurbiens concludes, prove a valuable asset in the toolbox of interdisciplinary methods aimed at responsible innovation, as defined by various national and regional science policy bodies.

In another case, STIR project investigator Shannon Conley, who conducted engagement studies in genetics laboratories Canada and in the United Kingdom, was able to acquire not only interactional expertise but also contributory expertise, despite being initially completely unfamiliar with much of the scientific theory and material practices of genetics research. Conley's consistent use of the STIR protocol enabled her to "cross over" and become adept at laboratory experiments in polymerase chain reaction (PCR). This modest acquisition of what were seen by her genetics research collaborators as noteworthy technical skills in a short period of time allowed Conley to achieve recognition, build trust and social capital, and probe deeper and more effectively into broader societal dimensions and practices relevant "inside" the laboratory during her first engagement study. Moreover, it allowed her to better understand and communicate broader social, ethical and policy implications involving the type of research the laboratory conducts with actors "outside" of the laboratory—including clinical experts, policy practitioners, patients, activists and people involved in pertinent legal proceedings. Her hands-on experience also provided Conley with a firm basis for commencing her second engagement study, both in terms of her ability to dialogue with laboratory researchers and, in some cases, to develop insights into how they might gain more desirable experimental results.

Initial research—such as that being conducted by STIR investigators Robin Phelps and Paul Ellwood—into local, regional and national science policies that either explicitly or implicitly call for or encourage one or more forms of socio-technical integration suggests that there are essential tensions that underlie these policies. In other words, "integration mandates" seem to entail one or more central science policy dilemmas. We find that often these tensions and dilemmas can be productively acknowledged and engaged through the STIR protocol and through conducting the "laboratory engagement study." For instance, discourse around the "responsible innovation" of emerging science and technology (such as nanotechnology), which has received attention in science policy documents in both the United States and the European Union, reveals notable divergences between the notions of "responsible" and of "innovation." While these and other tensions are often reproduced at the micro-level of socio-technical discussions in the laboratory, we find that the nature of these discussions can change over time and can begin to take more factors into account, often in more reflexive ways. According to the midstream modulation framework, more reflexive modes of thought and of discourse are posited as prerequisites for more socially robust forms of material and other science and engineering practices. Initial results from the STIR project appear to provide some measure of empirical validity to this theoretical position.

Based on the results of socio-technical integration activities we have thus far observed in the work of Schuurbiens and Conley—not to mention other project investigators including

Antonio Callejas, Byoungyoon Kim, Christine Luk, Anthony Stavrianakis and Qin Zhu—the following outcomes are not unlikely: improved methods for conducting laboratory engagement studies; a more robust theoretical basis for midstream modulation of technological trajectories; a more informed general rationale for conducting laboratory-based participant-observation as a form of expert practitioner engagement. (Specific rationales and any subsequent policy recommendations for socio-technical integration are likely to differ from one another depending on the local, regional or national policy motivations, political contexts, and epistemic cultures encountered in each of the twenty laboratories that make up the international set of research sites located in ten countries on three continents.)

The project has produced results that indicate that laboratory engagement studies that employ the STIR protocol and follow the framework of midstream modulation have demonstrated to junior (and in some cases senior) laboratory researchers in a real-time, hands-on manner—and in a variety of contexts—the pervasiveness of social, ethical, and political dimensions within their work. What may count as common knowledge among Science, Technology and Society (STS) practitioners can in fact be much more ambiguous among material practitioners, who often tend only over the course of several weeks of observation and engagement to acknowledge their own agency and participation in decision and other social processes. Occasionally, such acknowledgement occurs in tandem with shifts in material practices or with changes in other aspects of laboratory practices. These developments are often unexpected and creative responses to problems that were either not previously recognized by laboratory practitioners or that were not taken up as problems to be addressed from within the scope and purview of the laboratory. *STIR investigators are helping to change this.*

Midstream modulation proposes that the acknowledgement of social and ethical dimensions of their work by science and technology practitioners can constitute a prerequisite for an increased capacity on the part of these practitioners to effectively take such broader dimensions of their work into account, and for their more reflexive participation in what can be thought of as ongoing socio-technical experiments—and the STIR project appears to provide evidence supporting these intuitions.

Training and Development

Doctoral student investigators have been trained in conducting laboratory engagement studies - integrative fieldwork that supplements more traditional lab-based participant-observation - through two workshops organized by the PI, through regular STIR lab meetings run by the PI, through individual meetings and sessions with the PI, and through site visits made by the PI. Most students have completed at least one of two paired engagement studies, each one of which, in nearly all cases, takes place in a different nation. Doctoral students have made presentations to one another at the workshops and lab meetings, and in most cases they have made presentations to the laboratory research groups with whom they collaborate.

Outreach Activities

STIR project public and academic outreach activities have taken the form of (1) a project website, (2) publications and presentations meant for more general audiences, and (3) plans and efforts to participate in and help develop a documentary film.

(1) The STIR project website contains basic information about the project, its personnel, its activities, and its publications. The URL is <http://cns.asu.edu/stir/>

(2) General information about the project and its societal relevance have taken the form of news and travel stories, a letter, and various public talks. For instance, a general audience story reports on the initial project award:

- Cathy Arnold (2009). '\$500,000 NSF Grant Boosts Center for Nanotechnology in Society.' ASU Insight. 29(32):2. April 10.

A second general audience story (in Dutch) details the personal experiences of one of the doctoral student investigators:

- Maartje de Gruyter (2009). 'Ethiek op de werkvloer: Bewustwording is het toverwoord.' CSG-magazine LEV. Vol 2: 18-22. November.

A third publication, a correspondence piece in a high profile journal, is meant for a wide audience of academic natural scientists and engineers:

- Fisher. E., Biggs, S. Lindsay, S. & Jie Zhao (2010). Research thrives on integration of natural and social sciences.? Correspondence. Nature Vol 463. 25 February.

(3) PI Fisher has had extensive conversations and interactions with a Belgian documentary film maker about including project activities and interviews in a planned documentary on modern laboratory life, as well as contributing creatively to and disseminating the final product. 'Lab-Life' is a documentary directed by Frank Theys and produced by Savage Films (Belgium) and Cobos Films (The Netherlands) in a coproduction with the public broadcaster ZDF/ARTE (Germany/France), supported by the Flemish and the Dutch Film Funds, the European MEDIA program and the CERA Art Foundation. The film will have a cinema release (90 min.) and a 60 min. or series version for television and will be distributed by Autlook Films (Austria).

III. Project Publications

Journal Publications

1. Antonio Calleja López (December, 2009). "Ciencia e integración: el proyecto STIR (Socio-Technical Integration Research)." *Argumentos de Razón Técnica: Revista española de ciencia, tecnología y sociedad, y filosofía de la tecnología*, v. 12: 157-165.
2. Shannon N. Conley. Forthcoming. On the Front Lines of Socio-Technical Integration. Commentary on "Constructing productive engagement: Pre-engagement tools for emerging technologies" by Haico te Kulve & Arie Rip. *Science and Engineering Ethics*.
3. Daan Schuurbiens & Erik Fisher. 2009. "Lab-scale Intervention." *European Molecular Biology Organization (EMBO) Reports* 10(5): 424-427.
4. Qin Zhu & Christine Luk (Translators). 术 调节 进 ("Midstream Modulation of Technology: Governance from Within" by Erik Fisher, Roop L. Mahajan, and Carl Mitcham, 2008). Submitted to the (Chinese) *Journal of Engineering Studies*.
5. Daan Schuurbiens. Submitted. In and Beyond the Lab: Applying Midstream Modulation to Encourage Socio-Ethical Reflection in the Laboratory. *Science, Technology and Human Values*.

Book Chapters / Other Separate Publications

6. Phelps, R. & Fisher, E. (accepted). "Legislating the Laboratory? Tracking Promotion and Precaution in a US Nanomaterials Company." *Biomedical Nanotechnology, Methods in Molecular Biology Series*. Humana Press, USA.
7. Antonio Calleja-López. Forthcoming. "Reflexive Modulation." *Encyclopedia of Nanoscience and Society*. David Guston & J. Geoffrey Golson (Eds.). SAGE Reference.
8. Daan Schuurbiens. Forthcoming. "Midstream Modulation." *Encyclopedia of Nanoscience and Society*. David Guston & J. Geoffrey Golson (Eds.). SAGE Reference.

Periodic Publications / Conference Proceedings / Other One-Time Publications

9. Fisher, E., Biggs, S. Lindsay, S. & Jie Zhao (2010). "Research thrives on integration of natural and social sciences." Correspondence. *Nature* Vol 463. 25 February.
10. Antonio Calleja López & Erik Fisher. 2009. "Dialogues from the Lab: Contemporary Maieutics for Socio-Technical Inquiry." *Converging Technologies, Changing Societies. Proceedings of Society for Philosophy and Technology*. University of Twente, The Netherlands. July 7-10.

11. Ramón Queraltó. 2009. "El impacto ético de las actividades científico-tecnológicas. El caso de la Nanotecnología y el proyecto STIR." Asociación para el Diálogo. Sevilla, Spain.
12. Ramón Queraltó. 2009. Boletín Interno de Noticias de la Universidad de Sevilla. March 11.

Other Publications

13. Cathy Arnold (2009). "\$500,000 NSF Grant Boosts Center for Nanotechnology in Society." ASU Insight. 29(32):2. April 10.
14. Maartje de Gruyter (2009). "Ethiek op de werkvloer: Bewustwording is het toverwoord." CSG-magazine LEV. Vol 2: 18-22. November.

Professional Presentations and Conference Papers

1. Anthony Stavrianakis. 2010. "Modalities of Fieldwork in Synthetic Biology." SynBERC Retreat. JBEI Emeryville. February 28.
2. Erik Fisher. 2010. "What is Midstream Modulation?" Reflexive Systems Biology Kick-Off Meeting University of Bergen. Bergen, Norway. February 27.
3. Erik Fisher. 2010. "TA-Trends in the USA." Keynote lecture. Instituut Samenleving & Technologie. Flemish Parliament. Brussels, Belgium. February 26.
4. Erik Fisher & Derrick Anderson. 2009. "From Lab to Legislature: Public Value Mapping of Nanotechnology Science and Innovation Policy Making." *The Dupont Summit on Science and Technology Policy*, Carnegie Institution for Science, Washington DC, December 4.
5. Erik Fisher & Antonio Calleja López. 2009. Reflexive modulation of laboratory practices for the governance of science and technology. Society for the Social Studies of Science, Annual Meeting. Washington DC, October 28-31.
6. Krsto Pandza, Paul Ellwood & Erik Fisher. 2009. "From Social Aspirations to Organizational Capability: Identifying Micro-Foundations and the Role of Strategizing." *Interactive Strategy Process Work-in-Progress Workshop/ SMS Pre-Conference: Advancing Strategy Process Research*. Washington D.C. October 11.
7. Daan Schuurbijs. 2009. "Leuk idee, maar wat hebben we eraan?" Centre for Society and Genomics Research Days, Berg en Dal, The Netherlands. October 1.

8. Erik Fisher. 2009. "Integration and Reflexivity: Integrating Social Science and Humanistic Work with Laboratory Research in Emerging Science and Technology." S.NET Pre-Conference Workshop: Real-time Technology Assessment and Anticipatory Governance, University of Washington, September 8.
9. François Thoreau. 2009. Integrated Research and Protected Spaces: A New Role for STS? Society for the Study of Nanoscience and Emerging Technologies Inaugural Conference, University of Washington, Seattle. September 8.
10. Erik Fisher. 2009. "Laboratory Engagement. STIR: Initial Project Results." TA NanoNed Annual Meeting. Utrecht, The Netherlands. June 30.
11. Erik Fisher. 2009. "The 'Two Cultures' in Science Policy." Center for Science and Technology Policy Research. University of Colorado. Boulder, Colorado. June 25.
12. Erik Fisher. 2009. "Integrating Science and Society in Nanotechnology Laboratories." *The Nano Renewable Energy Summit*. Denver, Colorado. June 22-23.
13. Erik Fisher. 2009. "Integrating Ethics and Engineering in the Laboratory: Reflections of an Embedded Humanist." GILEE Workshop on *Integrating Ethics and Societal Issues into a Graduate Curriculum*. Virginia Tech. Blacksburg, Virginia. June 8-9.
14. Erik Fisher. 2009. "The 'Two Cultures' in Science Policy Today." University of Colorado-Denver, School of Public Affairs. Denver, Colorado. May 7.
15. Erik Fisher. 2009. "Socio-Technical Integration Research." Workshop on *Research Funding and the Good Life*. University of Twente. Twente, The Netherlands. March 18.

Laboratory Presentations (partial list)

16. Erik Fisher. 2009. "Science and Society in the Laboratory? Reflections of an Embedded Humanist." Colorado Fuel Cell Center. Colorado School of Mines. Golden, Colorado. June 24.
17. Daan Schuurbiers. 2009. "In and out of the lab". Center for Bioenergy and Photosynthesis. School of Life Sciences, Tempe, Arizona. May 4.