DR ERIK FISHER

Causing a STIR

Dr Erik Fisher discusses the collaborative crossover project Socio-Technical Integration Research (STIR), which is bridging the gap between ethics and scientific endeavour, policy and the lab

To begin, can you explain what Socio-Technical Integration Research (STIR) entails?

STIR provides an experimental platform for scientists and engineers to incorporate the methods and perspectives of the social sciences and humanities, while going about their normal work. The project uses a collaborative, hands-on approach that I developed as a member of a nanoscale engineering laboratory. To date, the project has embedded social scientists in over 30 university and private sector labs across a dozen nations on three continents. The social researchers work for 12 weeks with their laboratory counterparts to unpack the social and ethical dimensions of research and innovation in real time and to document and analyse the results.

How would you define the main aims and objectives of your current research?

The main objective is to understand the conditions under which science and engineering research practices can be responsive to social and ethical concerns. Policies for 'responsible innovation' and 'upstream public engagement', which are found throughout the industrialised world, have called for this kind of responsiveness. STIR aims to provide an empirical basis for designing and evaluating effective programmes based on these policies. The project also explores the reproducibility and generalisability of a novel set of techniques for fostering socio-technical integration and collaboration.

Your initial Laboratory Engagement Study established a protocol from which further investigation has developed. Why do you believe there has been so much interest?

I think researchers and innovators recognise that expectations for them to deliver public value and to consider ethical acceptability have increased. STIR requires scientists and innovators to commit to a process of collaborative inquiry, but what else happens is up to them. It is an experimental investigation of the possibility and utility of responsible innovation on the lab floor, and so it appeals both to sceptics and pragmatists. Policy makers and funding agencies are, I believe, attracted to the possibility of cultivating the relationship between scientific creativity and social responsibility.

What do you consider to be the greatest success of the project so far?

The project has provided proof-of-concept for the possibility and utility of socio-technical integration. It has found a correlation between observation, engagement and the alteration of research practices for the better. These concrete and tangible examples of changes in laboratory practice, whether in the form of social and ethical deliberations or technical breakthroughs, hold significance for the prospect of building longer-term socially responsive capacities in science. And these findings are not limited to a single national culture or a single scientific field; they appear across diverse pairings of natural and social science in multiple laboratories within multiple countries.

What have been the greatest challenges?

Usually, they come at the beginning of the studies, when the lab is still deciding what to make of the 'outsider' who has joined them. The 'STIRers', as I like to call them, often have to put up with a lot of suspicion and misunderstanding, at least initially. They have been called 'the politician', 'the shadow', 'the psychoanalyst' and 'spies' among other things. These initial tensions are usually diffused once the embedded scholar proves to the rest of the group that he or she is actually capable of serious, systematic research and is able to question his or her own results and take criticism. But STIR investigators have shown admirable perseverance and restraint, and once they start the integrative process they stick with it, as do nearly all of the participating scientists.

In your opinion, what is the outlook for the role of science in society?

I think the international calls for 'responsible innovation' offer real opportunities to deepen the way we train scientists and enhance the knowledge that scientific decision makers have of human and social dimensions. If we are not careful, however, attempts to implement these policies could all too easily result in well-meaning yet counterproductive measures. Rather than reinforce divisions of moral labour, in which scientists attend to the health of science and social scientists and others attend to the health of society, we need to appreciate the ways in which science and society co-produce each other. In the long run it will only become more necessary, and I am optimistic that science and society dialogues can allow for open-ended inquiry, critical reflection, and productive differences of opinion.

Midstream transformation

A team led by **Arizona State University** has been empowering researchers and other 'midstream' workers by allowing them an ethical and societal perspective on their research, with surprising results

WITH FUNDING INCREASINGLY hard to obtain for many scientists, and public concerns about research frequently making headlines, ethical issues are at the forefront of discussion. Governmental finance continues to be focused on projects which, it is believed, will have real social benefit, and represent direct value for the taxpayer. However, the communication between those who allocate the funding for research, and the individuals who conduct it, is frequently fraught, with scientists feeling harangued by the controlling influence of the state, and promises not always fulfilled. Outside the lab, public concerns are amplified by the press, and include genetically modified foods and disease epidemics. The split between the public, the political, and the scientific requires interventions which will recast the way in which the science and society relationship is conceptualised by these parties. Dr Erik Fisher's work at Arizona State University is aimed at productively bridging these gaps. His methodology focuses on 'midstream modulation'.

> Midstream modulation is able to affect changes in how scientists view their own work; adjustments which can lead to the improved communication between researchers, the general public and policy makers

In effect, what Fisher proposes, is embedding the awareness of social and ethical issues within science. Midstream is what happens between the upstream political decisions about funding priorities, and downstream decisions about use and regulation. It is here where lab work takes place, and where Fisher challenges scientists, engineers and other practitioners, to actively consider the potential outcomes of their work whilst it is being conducted. Although labs are not simply policy instruments, they do help shape social outcomes, and are in turn affected by political decisions. The process he proposes is multi-stage, and can induce an overall change in the attitude to research. This should begin to raise awareness about how lab decisions are both enabled and constrained by a number of intricate human and social factors. As their reflexive awareness grows, it becomes an integrated part of the daily research process as it develops and moves forward. This has led to readjustments in research practice which take into account social and ethical considerations.

In this way, midstream modulation is able to affect changes in how scientists view their own work; adjustments which can lead to improved communication between

STIR RESEARCHERS IN ARIZONA

researchers, the general public and policy makers. These adjustments can also contribute to improvements in the ways in which scientific research is conducted, from experimentation to dissemination. Fisher has conducted in-lab research which has led to the development of the methodology. After nearly three years as an 'embedded humanist' in a University of Colorado lab and having conducted numerous interviews, Fisher was able to identify social, material and cognitive 'modulations' that influenced research decisions. He then interacted closely with three graduate engineers for 12 weeks in 2006, identifying modulations as they arose, and discussing their broader relevance with them. Although the study was not focused on ethical concerns, it was clear that the researchers were interested in them, and sometimes quickly integrated them as additional parameters into their work. What was interesting was that researchers did not consider Fisher's questions to be an imposition on their work; instead, participants found that the exercises broadened their decisions, opening up new possibilities for their research: "It is not that these questions slow down your progress in technology," explains lab director Roop Mahajan; "actually it is often out of these questions that wonderful, innovative solutions come along".

MODULATING RESPONSES

STIR has since been practiced in over 30 labs around the world, with similar results. Modulating their decision-making process can empower researchers, helping them to perceive new considerations and possibilities. Fisher offers a perspective on this finding: "Lab activities are replete with social and ethical dimensions, but these are not necessarily visible to the scientists who are in the midst of them". By asking fundamental questions about what is being investigated, why certain choices are made, what could be done differently and who will be impacted by the research, STIR narrows the gap between lab work and non-specialists. Again, Fisher is clear on the outcomes of the idea: "By revisiting these questions on a regular basis as research develops, the perception of societal dimensions and the perception of technical alternatives can simultaneously expand". The technique revolves around a provocative idea: just because it is not always clear what the social and ethical impacts of emerging research and technology will be, it does not mean that these impacts are not influenced by decisions which are made in the lab. By considering the points of contact between any individual piece of research and society as a whole, it is possible to begin to construct strategies for the fruitful interaction between emerging research and the context into which it emerges. Given that current science and engineering education fails to impart a sophisticated understanding of the history of technological development, it is unsurprising that many researchers find this concept alien to their own pursuits. However, by enhancing the awareness of those conducting research, wider concerns can more easily be incorporated into the research.

One explanation for how Fisher and his team are able to amplify laboratory modulations, is that the presence of social scientists makes the lab aware that it conducts 'boundary work'. This pertains to the demarcation of research boundaries between research fields. This is an important exercise in quantifying what research is being done, and which elements are most closely related to that research. But sociologist, Tom Gieryn, has also noted that the demarcation of science from other intellectual activities is, in part, a function of how professional scientists perceive their own pursuits. As such, boundary work is often activated early in the STIR process, when individuals characterise what they do, and state that it has no relation to social science,

INVESTIGATING CYANOBACTERIA

CARBON NANOTUBE SYNTHESIS IMPROVED

policy makers or the public. However, this marking of boundaries can swiftly transform, and what is initially about creating separation can lead to a greater understanding of the holistic nature of research. Fisher is excited by the prospects which this brings: "As the engagements continue and knowledge builds on both sides, the dialogue can get more sophisticated, and demarcation turns into integration". What the STIR team often encounters is an initial resistance to the idea that lab work has any ethical or societal aspects, but over a short period of time a far more complex understanding of the connections between research and society is outlined. Fisher understands that this marks an important point for the work of the project: "The scientists thus begin to see what their work looks like through social scientific and humanistic paradigms, and this can trigger new insights and research directions". Concurrently with this, the social scientists have first-hand experience of lab culture, as political scientist Shannon Conley points out: "The laboratory members genuinely appreciated that I was willing to do the same things that they did on a daily basis". Conley and other members of the STIR initiative hope that their crossover work will lead to greater understanding and synergy between different fields.

COMMUNICATIVE OUTCOMES

An important element of the continuation of the STIR group's work is the dissemination of the results achieved by the teams with which they have worked. Their publications are wide-ranging, including commentaries, editorials and news stories aimed at the general public, as well as publications in industry magazines and peer-reviewed journals. They even have an animated video produced by the Consortium for Science, Policy and Outcomes in order to assist in conveying their message. Of course, for a project which is focused on issues arising from the interactions between scientific work and society, good communication is essential. As well as being asked to present project results in a number of organisations across the US, Canada and Europe, Fisher has been involved with public workshops. Based in various policy venues and the Centre for Nanotechnology in Society at ASU, these have been an important aspect of involving the public in the work which is being done by the team. In fact, the integration in STIR is a crucial component of the Centre's vision to develop anticipatory governance of emerging technologies. The researchers have


STIR WORKSHOP IN TOKYO

also presented their findings in a number of high profile venues, and have brought their results to the Woodrow Wilson International Centre for Scholars, an important result for a team which hopes to bridge research and policy in their work.

SWIMMING AGAINST THE STREAM

The inspiring results of the collaboration is matched by an awareness of the amount still left to be done. A number of challenges remain for groups like STIR, and negotiating the connection between scientific research and society is likely to be a complex, dynamic and ongoing process. Given that social and natural researchers are always likely to have different outlooks, alternative ways of approaching problems and finding solutions, it is necessary for the dialogue between them to continue to be driven by the kind of work that the team demonstrates is possible. It is still likely that boundary crossing attempts will evoke suspicion in many researchers, and such work could well be seen as an attempt to force research to conform to a political agenda. Modulating ethics inside the laboratory is only one way of increasing the integration between science and wider issues – education programmes and a greater understanding of the way in which scientific research functions are also critical. The participants in STIR will continue to aim for these hard to attain goals, hoping to improve the methods deployed in and beyond the lab.

NETWORKING

One of the innovations which the team has been able to formulate is the creation of an international network for responsible innovation. This has emerged directly from work conducted with scientists, who have expressed an interest in maintaining the contacts and collaborations after the formal study has been completed. This desire to include STIR objectives in longer-term research goals has been an exciting testimonial for the effectiveness of the project. The network idea was announced in a 2011 public workshop with the Wilson Centre's Synthetic Biology Project which brought together lab directors, bench scientists and policy officials from around the world in order to discuss the value of approaches which are being progressed by the STIR initiative. The notion was brought up that, in order to make the practical contribution of socio-technical collaborations more immediately felt, scientists worldwide could participate in a broader effort to strengthen ties between science, policy and society. The prospect of interdisciplinary and international collaboration is an exciting one, and it is hoped that the initiative will soon be helping to realise this goal.

INTELLIGENCE

STIR: SOCIO-TECHNICAL INTEGRATION RESEARCH

OBJECTIVES

The aim of the project is to identify and compare expectations, demands and capacities for laboratories to engage in responsible innovation.

KEY COLLABORATORS

Lab Directors: **Simon Biggs**, **Robert Bowman**, **Ed Boyes**, **Stephen Johnson**, **Roop L Mahajan**, **Stuart Lindsay**, **Astrid Lægreid**, **Neal Sullivan**, **Wim Vermaas** and **Jie Zhao**

David Guston (co-PI), **Mike Gorman**, **Maja Horst**, **Farzad Mahootian**, **Bruna De Marchi**, **Clark Miller**, **Carl Mitcham**, **Rune Nydal**, **Krsto Pandza**, **Ramón Queraltó**, **Hannot Rodriguez** and **Roger Strand**

Private Sector: **The Pilot Plant** ('De Proeffabriek')

NGO: **David Rejeski**

STIR doctoral students: **Antonio Calleja-Lopez**, **Shannon Conley**, **Paul Ellwood**, **Steven Flipse**, **Cecilie Glerup**, **Federica Lucivero**, **Christine Luk**, **Miao Liao**, **Robin Phelps**, **Anthony Stavrianakis**, **Brenda Trinidad**, **Byoungyoon Kim** and **François Thoreau**. Master's student **Bastien Miorin**. STIR alumni: **Birgitte Hansen, Michiel van Oudheusden, Daan Schuurbiers** and **Qin Zhu**. Postdoctoral researchers: **Ana Delgado** and **Dorothy Dankel**

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