Studies of New and Emerging Technologies

S.NET 005

Innovation and Responsiblity: Engaging with New and Emerging Technologies

edited by
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IOS Press

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Bibliographic Information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie.
Detailed bibliographic data are available on the Internet at https://portal.d-nb.de.

Publisher

Akademische Verlagsgesellschaft
AKA GmbH
P.O. Box 41 07 05
12117 Berlin
Germany
Tel.: 0049 (0)30 79 74 05 55
Fax: 0049 (0)30 81 82 73 03
info@aka-verlag.de
www.aka-verlag.com

Distribution outside Germany, Switzerland and Austria

IOS Press BV
Nieuwe Hemweg 6B
1013 BG Amsterdam
The Netherlands

Tel.: 0031 20 688 3355
Fax: 0031 20 687 0019

www.iospress.nl

Reproduced from PDF supplied by the editors
Printer: Bookstation GmbH, Anzing
Printed in Germany

ISSN 2197-084X
ISBN 978-3-89838-697-5 (AKA)
ISBN 978-1-61499-430-5 (IOS Press)

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Studies of New and Emerging Technologies / S.NET

Publications

Vol. 004 K. Konrad et al. (Eds.), Shaping Emerging Technologies: Governance, Innovation, Discourse. 2013

Vol. 003 H. van Lente et al. (Eds.), Little by Little. Expansions of Nanoscience and Emerging Technologies. 2012.

Vol. 002 T. B. Zülsdorf et al. (Eds.), Quantum Engagements. Social Reflections of Nanoscience and Emerging Technologies. 2011.

Vol. 001 U. Fiedeler et al. (Eds.), Understanding Nanotechnology: Philosophy, Policy and Publics. 2010

Preface

In October 2013, the School of Public Policy and Urban Affairs and the School of Law at Northeastern University collaborated to host the fifth annual meeting of the Society for the Study of Nanoscience and Emerging Technologies. S.NET, as it is known, is an international community of scholars dedicated to describing, theorizing, and debating the societal aspects of emerging technologies, extending beyond nanotechnology to include synthetic biology, geoengineering, artificial intelligence, robotics, and more.

The 2013 meeting, held on the Northeastern University campus in Boston, Massachusetts drew nearly 150 participants from around twenty countries. Scholars, students, and professionals participated in more than forty-five panels, plenary sessions, films, a "pop-up" theater performance, and other activities, including a pre-conference "emerging scholars" workshop and poster session on responsible innovation organized by Sally Randles of the University of Manchester, UK. The conference co-chairs (myself and Michael Bennett of the Northeastern University School of Law) also wish to acknowledge support by the National Science Foundation (SES-1343126), which enabled S.NET to extend financial assistance to more than thirty graduate students, postdoctoral scholars, and other young researchers—the future lifeblood of this and any other intellectual community.

This volume is the fifth in a series of edited volumes featuring selected material from the S.NET meetings. The editorial team reflects the interdisciplinary roots and international composition of S.NET at large, and the volume itself reflects the society's continued investment in new generations of emerging technology scholars. The chapters in this volume capture a range of topics discussed by participants in S.NET 2013. Other publications from the meeting are anticipated to appear in such journals as *Review of Policy Research*, *NanoEthics*, and the new *Journal of Responsible Innovation.* These publications demonstrate the breadth and depth of scholarly debates on the diverse ramifications of emerging technologies.

It was a pleasure to sponsor the 2013 S.NET meeting. Seeing the fruits of that meeting in this volume is evidence that, in an age of instantaneous electronic communications, gathering together physically still matters in building an intellectual community.

Christopher Bosso
Boston, MA

Contents

Responsibility, Innovation, and Emerging Fields of Technoscience

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Introduction

Over the past half a decade, S.NET has developed from an academic society focused on nanoscience and nanotechnologies into a community of scholars and practitioners engaged with a wide variety of new and emerging fields of technoscience. This process has been recorded in the previous titles of the S.NET book series: *Understanding Nanotechnology: Philosophy, Policy, and Publics* (Fiedeler et al. 2010), *Quantum Engagements: Social Reflections of Nanoscience and Emerging Technologies* (Zülsdorf et al. 2011), *Little by Little: Expansions of Nanoscience and Emerging Technologies* (van Lente et al. 2012), and *Shaping Emerging Technologies: Governance, Innovation, Discourse* (Konrad et al. 2013).

Like its predecessors, the fifth volume of the book series captures the broad thematic scope, strong interdisciplinarity, and plurality of research interests that characterize S.NET as a society. This volume again documents the unique character of the S.NET community, in which representatives from diverse disciplines and backgrounds cultivate an exchange about new and emerging sciences and technologies, creating common ground even if their research interests or approaches may be very different.

At the same time, the volume also shows that the historical starting point of S.NET remains highly relevant today; after all, many of the chapters deal specifically with nanoscience and nanotechnology. The S.NET community has conducted numerous studies and engagement activities concerning nanotechnology research and development over the last several years. It is clear that such projects have strongly influenced the discourse and practice of responsible innovation in this area.

Recently, the coupling of innovation and responsibility has gained further momentum due to new discourse on responsible research and innovation (RRI) in Europe and elsewhere (see, for example, Owen et al. 2013). This significant development was already a key topic in the fourth volume in this series (Konrad et al. 2013). The presentations and discussions at the 2013 S.NET conference in Boston, on which most of the chapters of the present volume are based, took place under the heading "Innovation, Responsibility, and Sustainable Development", testifying again to the relevance of responsible innovation, especially in the context of research and technology policy.

The contributions to the current volume engage with manifold aspects of responsible innovation, reflecting on its history and its current form, reporting on success stories and critical discussions, pointing out shortcomings and obstacles, and analyzing the grand narratives that shape discourse on new and emerging fields of technoscience. They scrutinize the roles of major actor groups and "stakeholders", including regulators, scientists and civil society organizations, while also addressing key issues of public engagement and participation.

An essay by *Chris Bosso* sets the scene. He looks back to a "Decade of Nano", focusing in particular on scholarly analyses of risk governance that pertain to environmental and health issues. Bosso discusses insights concerning risk governance obtained from these analyses, considers the emergence of "soft law" approaches, and assesses the extent to which such approaches are afforded space within the regulatory regime of the United States. Harking back to a core element in the genesis of policy and academic discourse on societal aspects of nano, he also examines the applicability of the "GMO analogy", concluding with thoughts about the contributions of the "Decade of Nano" to the larger task of balancing technology's benefits and possible risks. While Bosso points out that the prefix "nano" may soon lose its meaning as it gives way to a more accurate focus on function, his essay shows that the community that has formed around nano risk governance and its history is highly relevant with regard to embedding responsibility in innovation processes.

In their chapter, *Sally Randles*, *Bärbel Dorbeck-Jung*, *Ralf Lindner* and *Arie Rip* provide a report on a roundtable on responsible innovation held at the S.NET 2013 conference in Boston, in which they had the role of interlocutors. They point out that research into responsible innovation, as an object of study, is currently enriched by a number of different disciplinary perspectives, normative underpinnings and approaches. Randles and colleagues suggest that the roundtable put into practice the idea that responsible innovation performs a boundary-object function, creating space for a range of academic and other actors (policy makers, businesses, and civil society) to collectively pursue a dialogue on what it means to undertake research and innovation in a responsible way. The authors also report on challenging interjections from the audience attending the roundtable. These challenges revolved around the questions of whether responsible innovation only serves as a veil for "business as usual", or whether engagement in discourse on responsible innovation might be a kind of "reputation-enhancing window-dressing" or even a "responsibility-wash". The discussion of these challenges forms an important element of the report on the roundtable.

Maria Fernanda Campa, *Amy K. Wolfe*, *David J. Bjornstad* and *Barry L. Shumpert* explore in-practice manifestations of what happens at the nexus of a specific policy goal—namely, the bioenergy future of the United States—and responsible innovation. Taking the U.S. Department of Energy's BioEnergy Science Center at Oak Ridge National Laboratory as their case, the authors analyze the interplay among policies, policy objectives, and the scientific research and development process. They focus on institutional elements that shape scientists' choices and behaviors when scientific innovation is a necessary intermediary between a policy and the achievement of policy goals. The analysis sheds new light on responsible innovation and raises questions about how related concepts of responsibility might be measured when translated into practice.

Victoria Sutton discusses the U.S. regulatory framework for a future hydrogen economy as a model for regulating emerging technologies. Against the historical background of regulation concerning the biotechnology field, she reflects on lessons learned

from the development of the hydrogen regulatory framework in the United States. Sutton argues that a coordinated process of consensus building concerning the regulatory framework for an emerging technology should take place at the earliest stages of technology development and include public information activities, participation from a variety of stakeholders as well as an international dimension. She also emphasizes that the success of an emerging technology often depends on the government being an early adopter and subsidizing the market by providing financial incentives to utilize the technology. In Sutton's view, the use of a regulatory framework for emerging technologies along with a coordinated process involving stakeholders will optimize resources while reducing costs and impediments to reaching the technology goals.

Michael Reinsborough and *Gavin Sullivan* emphasize that public involvement in the regulatory process for emerging technologies can provide a greater diversity of perspectives and may thus improve the success of early regulatory discrimination. However, parameters of regulatory systems affect how easily civil society stakeholders can access information, engage with regulatory processes and provide meaningful signals back to the regulatory system. In their view, it is important for RRI to consider not just an emerging technology by itself but also the existing balance of forces within the regulatory system. Taking the regulation of new nanomaterials as their example, and more specifically a public-interest legal challenge against the British Health and Safety Executive for failure to properly enforce the European Biocidal Products Directive in relation to nanosilver consumer products, Reinsborough and Sullivan analyze obstacles to effective public involvement in political processes around new and emerging technologies. The authors argue that civil society suffers from barriers to effective participation in governance already in a low-innovation system, warning that an increasingly higher rate of innovation may aggravate the imbalance of forces.

According to *Franz Seifert* and *Alex Plows*, the fact that, contrary to common expectations, nanotechnology has never attracted the attention of a wider public is not the result of the hegemony of the promotional discourse on nanotechnology. In their view, it is rather due to an erratic social dynamic that determines whether a movement grows, stagnates, or withers. Taking as their case a cluster of social-movement organizations that have taken issue with nanotechnology in the United Kingdom and in Germany, they show that this cluster was a "spin-off" from the preceding movement against agro-food biotechnology, but which never succeeded in creating comparable policy impact or public responsiveness. Seifert and Plows argue that the stagnation of these organizations can be explained by low policy impact and low public responsiveness. In their view, this case more generally sheds light on the prospects of democratizing technology policies by enriching them with deliberative and participatory practices. They argue that, even if potential critics are brought to the table, their influence still hinges on decision makers' readiness to reconsider policy orientations and the broader public's responsiveness. Exercises in public dialogue thus do not compensate for a lack of critical public opinion.

Studies concerning public opinions about nanotechnology are important elements for the S.NET research community. In their chapter, *Lauren Copeland* and *Ariel Hasell* present the results of an experiment embedded in a nationally representative survey of 2,200 adults in the United States. They examine how exposure to risk-and-benefit frames influence people's willingness to purchase nano-enabled consumer products. Their findings provide additional support for the familiarity hypothesis, demonstrating that familiarity with nanotechnology moderates the effect of risk-and-benefit frames, but they also suggest that media coverage of nanotechnology applications, and Internet

and television news media in particular, may explain some of the variation in people's willingness to purchase nano-enabled consumer products.

In her contribution, *Kathleen Eggleson* suggests that a number of developments in new and emerging fields of technoscience have safety and security implications that represent challenges to existing governance systems. While she focuses on the military domain and nanoscale science and technology, her chapter also contextualizes the relevant technologies in the nonmilitary realm with respect to prevailing societal, scientific, and technological factors, in order to explore resultant governance challenges. Discussing the security implications of developments at the intersections of nanotechnologies and biotechnologies as well as other developments in new and emerging sciences and technologies, such as do-it-yourself biology, Eggleson argues that evaluation of technological security implications should build upon the framework of anticipatory governance and require empirical anticipation.

Frederick C. Klaessig points out that the transition from an emerging technology to one that has commercial products and acceptable applications brings together groups in institutional settings, arguing that the nature of an emerging technology means that the initial steps focus on data, its interpretation, its classification and its compilation. The premise of his chapter is that the transition from normal science to a form of "official science" is now visible for nanotechnology. Focusing on Europe and the United States, Klaessig argues that the creation of databases for nanomaterials constitutes a double challenge, concerning the properties of nanomaterials that need new terminologies and characterizations, and with regard to the newly established communities that have to share data and collaborate. He discusses the role of various epistemic communities and policy implications in this context.

In his chapter, *Louis-Étienne Pigeon* deals with new and emerging technologies in the context of environmental philosophy, engaging above all with John Baird Callicot's ideas concerning older conceptions of a "land ethic". According to Pigeon, Callicot's environmental philosophy could serve as a new paradigm in discourse on sustainable development and beyond. This paradigm would imply a symbiotic relation between society and its natural spaces through the development of a new type of technology. Pigeon argues that being truly innovative would have to mean being innovative also in terms of culture and ethics. From such a perspective, nanotechnology and other high-tech fields, such as robotics and information technologies, do not appear to help solve problems. As a normative set of principles, a land ethic would value beauty over efficiency, quality over quantity and sensitive contact over industrial land management.

Jan-Jurjen Koksma engages with the fashioning of "neuromyth". He aims to redefine this concept and to complement the toolkit of "critical neuroscience". To this end, Koksma contrasts fragments of visionary discourse on the EU-funded "Human Brain Project" (HBP) with the viewpoints of Vladimir Nabokov, who had a successful professional life in both the arts and the natural sciences. Based on this comparison and against the backdrop of the "Two Cultures" debate, Koksma argues that the success of the critical neuroscience project depends on the ability of scientists to reflect critically on their own discipline's practice and principles, and to appreciate them as products of historical and social factors. In his view, the normative turn in science, which also drives RRI discourse, is a good thing—but scientists should be more specific about how applications of the research can improve the lives of their prospective users.

Harro van Lente and *Colette Bos* question the notion of "grand challenges", which is increasingly influential in science and innovation policy, both at EU and national levels, and also in RRI discourse. The authors analyze this notion by looking at mythic

archetypes in which grand challenges require courageous journeys of heroes. In a second step, van Lente and Bos examine how grand challenges appear in funding programs on nanotechnology, focusing on the issues of "sustainability" and "healthy aging". Analyzing ten policy reports on nanotechnology and reflecting on the notion of challenges, they argue that grand challenges introduce a dramatic structure of problems, solutions and urgency. In nanotechnology, with its generic and open-ended promises, the dramatic structure frames decisions, agendas and coordination.

As these brief summaries of the chapters may demonstrate, the diversity of the S.NET community continuously helps create multi-faceted pictures of recent developments in science and innovation, while at the same time furthering intellectual exchange across disciplines and professions. The present volume will again be of interest to anyone broadly interested in societal, philosophical, political and other aspects of new and emerging technologies, and of nanoscale science and technology in particular. Moreover, it contributes to current discourse on responsible innovation by bringing in an exciting range of topics, perspectives, approaches and expertise.

We want to express our gratitude to S.NET, the Karlsruhe Institute of Technology (KIT), and the numerous reviewers who greatly helped us to bring the volume together in a very short timeframe. Many thanks to Colette Bos for assisting with the production process. The editorial team would especially like to thank Silvia Woll for her manifold contributions to this publication project.

We are delighted that this volume includes a report on the S.NET 2013 conference in Boston, written by *Jonathan Hankins* and first published in the *Journal of Responsible Innovation* (Hankins 2014). We would like to express our sincere thanks and appreciation both to the author and to the publisher of this Routledge journal, the Taylor & Francis Group, for permission to reprint this excellent conference report.

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Nano Risk Governance, Soft Law, and the US Regulatory Regime

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Abstract. This paper looks at a decade of scholarly analysis of environmental and health risk governance concerns posed by nanotechnology, discusses insights about risk governance obtained from that literature, considers the emergence of "soft law" approaches as mechanisms for dealing with conditions of uncertainty about risk, and assesses the extent to which such approaches are afforded space within the formal/legal contexts of the US regulatory regime. It finds an evolution in the literature from a focus on nano as unique to concerns about system capacity to address possible risks generated by any technology. It then examines the applicability of the "GMO analogy" to the problem of nano, and concludes with thoughts about the contributions of the "Decade of Nano" to the larger task of balancing technology's benefits and possible risks.

Keywords. Nanotechnology, governance, regulation, soft law, policy.

Thinking Over a Decade of Nano

What follows is a bit of intellectual history. If we review the scholarly literature on nanotechnology and risk governance in the decade since 2003, when the United States Congress passed the *21st Century Nanotechnology Research and Development Act* (Public Law 108-153), what overall themes do we observe, and what broader lessons about risk governance do we obtain?

To answer these questions I reviewed nearly 90 scholarly works published in US and European journals, edited volumes, and reports between 2003 and 2013 that addressed some element of risk governance as it related to nanotechnology broadly understood.[1] The publications selected were those likely to be seen by scholars interested in the intersection of nanotechnology and risk governance, ranging from broad spectrum journals like *Issues in Science and Technology* and *Regulation and Governance* to the more sector-specific *Journal of Nanoparticle Research* and the various studies issued by the Woodrow Wilson Center's Project on Emerging Nanotechnologies. Many of these works were by the most active and well-known scholars in what became the nano and risk governance domain. To help focus my thinking, most of the literature examined addressed environmental, health, and safety (EHS) concerns, as versus, for example, the ethics of technologies of human enhancement or nanotechnology as a driver of economic development. My larger goal was to use nanotechnology *per se* as an analytical lens to tease out general insights about governance under conditions of rapid technological change and parallel uncertainty about risks to humans and the environment. In this regard, my review is not so much systematic—it is not a con-

[1] A full list of the papers examined is available on request.

tent analysis of abstracts, for example—as it is impressionistic. It is my take, as it were, on what we as a community have been thinking about over the past decade.

In early years (~2003–2005), most writers focused on explaining nanotechnology and outlining its potential (and sometimes hyped) benefits across a range of applications and sectors (Berube 2005). They also stressed a need to avoid repeating purported errors of past, whether with respect to governance of synthetic chemical pesticides, civilian nuclear power, or, most frequently, genetically modified organisms (GMOs). That widely shared view (e.g., Balbus et al. 2005, Kalpin and Hoffer 2005) was most famously expressed in the joint Environmental Defense Fund / DuPont NanoRisk Framework (Krupp and Holloway 2005), which exhorted, "Let's Get Nanotech Right."

Taken as a whole, this early literature wrestles with the dilemma of *uniqueness*. That is, while there has long been theoretical awareness of potential breakthroughs at the nanoscale (see Richard Feynman's retrospectively famous 1959 lecture, "There's Plenty of Room at the Bottom"), the Age of Nano did not commence until the ready availability of technologies to enable the observation and manipulation of matter at a billionth of a meter. So nano effectively *was* new, and early analysis focused on the challenge of balancing nanotechnology's potential, even revolutionary, benefits with a parallel need to protect the public health and welfare from any possible adverse effects (direct and indirect) generated by novel technologies (Baird and Vogt 2005). While opinion about the challenges ahead ranged between techno-optimists for whom the benefits of innovation outweighed possible harms to techno-skeptics for whom precautionary approaches to (if not bans on) nanotech commercialization was warranted until more was known about potential risks, most scholars expressed a need for mindful balance lest, as Segal (2004, 302) put it, "substantial societal benefits may be lost if a regulatory structure is either too lax or too strong."

Lurking beneath such statements was evident concern that paying insufficient up front (even precautionary) attention to any potential side effects of revolutionary technologies might prompt a public backlash that would only stifle technological, economic, and social progress. Indeed, one sees throughout this early literature near universal evocation of some version of the "GMO analogy," typically framed as a sobering tale of an ill-informed (even technophobic) public lashing out against a technology of great promise, thereby strangling its societally beneficial potential (e.g., Reynolds 2003, Kulinowski 2004). Bennett (2004, 28), reviewing an analysis by Canadian bio-ethicists Mnyusiwalla, Daar, and Singer (2003) on the societal impacts on "nanotechnoscience" (NTS), observes: "Chastened by the global backlash against genetically modified organisms, the ethicists are more concerned with safeguarding the blossoming of NTS from similar pitfalls than with any particular legal framework, set of ethical guidelines, or social vision. Their clearly stated goal is dodging a repeat of the biotechnological academic-enterprise network's skirmishes with non-governmental organizations (NGOs), juridical hurdles, and other regulatory holdups."

Given such framing, the solution to the problem seemed straightforward: educate the public (or at least key *attentive publics*) to better understand and, one presumes, accept new nanotechnologies. Public buy-in is pivotal, argued Rice University chemist Kristen Kulinowski (2004, 19), for whom fellow technologists "ignore public concerns at their own peril. No nanotechnologist wants the field to go the way of GM foods, which are largely viewed as the poster child of misguided public policy." Fears of reliving the GM experience (however interpreted), and worries even about popular culture depictions of techno-dystopia in books like Michael Crichton's *Prey* (2002) or films like Will Smith's *I, Robot* (2004), were reflected in early government efforts to