Responsible Innovation Subject Aid

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Description

A short guide to some key resources and readings on the topic of responsible innovation.

Body

Innovations — new ideas, methods, or products — in science and technology have resulted in increased knowledge and tangible improvements in human and environmental health; however, new technologies have also produced an array of unintended and undesirable consequences. Emerging technologies for applications as diverse as genetic engineering, geoengineering, and communications now provide unprecedented potential for intervention into social and environmental systems and human and non-human bodies. Their long-term impacts are often highly uncertain and they frequently emerge without clear processes for governing their development or use. **Responsible innovation** (RI) (also referred to as Responsible Research and Innovation, or RRI, in Europe) is a framework that attempts to fill these gaps by integrating ethical reflection and diverse perspectives into the innovation process.

RI builds on a long history of scholarship on the relationship between science and

society and on other frameworks for making science and technological development more ethical, inclusive, socially-relevant, and sustainable. One formulation stipulates that "responsible innovation means taking care of the future through *collective* stewardship of science and innovation in the present" (Stilgoe et al. 2013, p. 1570; italics added). RI thus differs from or enlarges engineering ethics to focus less on individual innovators and more on the larger innovation system in which individual researchers operate. RI aims to prompt researchers, but also funders, regulators, businesses, and end users to consider the *purposes* of science and technology — why innovation is being pursued and whether or not its ends are in the public interest.

RI has been conceptualized in many ways (see Subject Overviews below), but its definitions consistently focus on connecting science and technologies to their potential future impacts and democratizing the governance of innovation. Stilgoe et al. (2013) have identified four dimensions:

> *Anticipation:* While acknowledging the uncertainty that characterizes new technologies, RI requires imagining how a given technology might impact human and environmental systems. Rather than attempting to predict the future, anticipatory processes like scenario planning and technology assessment open up discussion about the futures that are possible, plausible, and desirable in relation to innovation.

> *Reflexivity:* Moving beyond personal self-reflection, RI requires the institutions that fund, regulate, and conduct science to examine how values and assumptions that may not be universal shape scientific research. Reflexivity has been fostered through codes of conduct and moratoriums, as scientific communities pause to consider the risks and benefits of emerging research. It has also been achieved through the placement of social scientists and humanists in science and engineering laboratories; scientists have come to see their work in a new light as these embedded researchers ask questions about their activities.

> *Inclusive deliberation:* Since emerging technologies can impact a wide range of people, scientific experts have limited knowledge, and their values may differ from the values of other stakeholders, RI requires including diverse lay and expert voices throughout the innovation process. Mechanisms for inclusion have ranged from small focus groups and consensus conferences to

national debates and discussions organized by government agencies. To be effective, public dialogue must be organized to facilitate democratic decision-making around science and technology (rather than designed to convince the public to accept a given innovation).

Responsiveness: In order to actually shape innovation, anticipation, reflexivity, and inclusive deliberation must be used in ways that allow those processes to inform the design of technologies or the direction of research. This often means that RI is most useful early in the innovation process, when a change is still possible; it also allows RI to be dynamic and adaptive, able to incorporate new information or perspectives as they emerge.

While RI provides a framework for integrating societal values into the innovation process, it does not prescribe the appropriate goals of innovation because they will vary by time and place. Thus RI may be used in a wide variety of contexts by groups with different priorities and motivations, including corporations, non-governmental organizations, and academic research groups.

This entry draws from **Stilgoe, Jack, Richard Owen, and Phil Macnaghten. 2013. "Developing a framework for responsible innovation."** *Research Policy* **42, no. 9: 1568-1580.**

Also see the "Social Responsibility" subject aid (Contributed: 12/16/2016 OEC, Accessed: 4/16/2017) and the "Responsibility" entry in the Glossary (Contributed: 1/31/2006 OEC, Accessed: 4/16/2017).

Subject Overviews

Davis, M., & Laas, K. 2014. "Broader Impacts" or "Responsible Research and Innovation"? A Comparison of Two Criteria for Funding Research in Science and Engineering. *Science and Engineering Ethics* **20, no. 4: 963-983.**

This article compares and contrasts European ideas about RRI with the concept of "broader impacts," which is used to evaluate funding proposals by the National Science Foundation in the United States. It also distinguishes RI from

"Responsible Conduct of Research" (RCR). The authors describe the history of these concepts and their relevance for public science funding, and suggest that the notion of broader impacts might be useful as the European Union attempts to integrate dimensions of RRI in its science funding decisions. Davis and Laas also consider why certain definitions of RI have not resonated in an American context and propose a modified definition of RI that might be more useful in a European context as well.

Owen, Richard, Phil Macnaghten, and Jack Stilgoe. 2012. "Responsible research and innovation: From science in society to science for society, with society." *Science and Public Policy* 39, no. 6: 751-760.

Owen, Macnaghten, and Stilgoe describe the history of RI (and RRI) as a distinct framework for science governance, including its position in European policy and growing attention to the concept in academic and political spheres. They reflect on emerging work on RI from workshops, policy documents, and publications in order to distill three key features of RI. First, the purposes and targets of innovation should be identified in ways that are inclusive and democratic. Second, RI is an iterative, flexible, and adaptive process that should be embedded in existing science governance systems so that it can actually shape innovation. And third, RI requires reframing and expanding historical notions of scientific responsibility, moving beyond the ethical obligations of individual scientists to include other actors in the innovation process such as funders, universities, businesses, policy-makers, and public audiences.

Stilgoe, Jack, Richard Owen, and Phil Macnaghten. 2013. "Developing a framework for responsible innovation." *Research Policy* 42, no. 9: 1568-1580.

This article presents a definition and framework for RI that includes attention to the dimensions of anticipation, reflexivity, inclusive deliberation, and responsiveness (see the Introduction to this Subject Aid). Stilgoe, Owen, and Macnaghten emphasize that these dimensions, and the specific activities used to facilitate them, must be integrated to accomplish RI and that this integration distinguishes RI from other forms of science and technology governance. This RI framework was developed in part through empirical work with a geoengineering project funded by the UK Research Council. The authors

describe the project and how an RI framework was applied in that context. They then reflect critically on the ability of RI to impact the trajectory of science and technology; in this case, the combination of RI processes and their application early in innovation changed research culture and altered the future of the geoengineering project.

Von Schomberg, Rene. 2013. "A vision of responsible research and innovation." In *Responsible innovation: Managing the responsible emergence of science and innovation in society*, edited by Richard Owen, J. R. Bessant, and Maggy Heintz, 51-74. Chichester, West Sussex: John Wiley & Sons Inc.

This chapter provides an overview of RRI in the context of European policy, beginning with an historical account of the relationship between society and technology and the role that notions of responsibility have played in technological decision-making. von Schomberg proposes a more detailed and slightly different conceptualization of RI than that suggested by Stilgoe, Owen, and Macnaghten (2013). He goes on to suggest that RI is characterized by the set of expectations that apply to the products and process of innovation; responsible products are ethically acceptable, sustainable, and socially desirable, while responsible processes are multidisciplinary, inclusive, responsive, and adaptive. von Schomberg argues that in a European context, RI (or RRI) should be guided by the values that underpin policy in the European Union, specifically those of Horizon 2020 programme, and used to address grand challenges in realms such as public health, agriculture, energy, and water and food security. The other papers in this edited volume present additional empirical and theoretical engagements with RI.

Policy and Guidance

Engineering and Physical Sciences Research Council (EPSRC). 2017. Framework for Responsible Innovation. Accessed April 17, 2017. <https://www.epsrc.ac.uk/research/framework/>

The EPSRC, one of the largest public funders of research in the United

Kingdom, formally included a commitment to RI in its research policy in 2013, and it now expects all funding recipients to embrace and implement RI; the council also considers the integration of RI principles as they assess new funding proposals. The EPSRC framework for RI is very similar to the one described by Stilgoe, Owen, and Macnaghten (2013). These scholars provided EPSRC with recommendations on how to conceptualize and implement RI. This Framework defines RI as an approach to science that seeks to anticipate, reflect, engage, and act (AREA) throughout the innovation process. Aside from this AREA framework, the EPSRC's approach to RI is open-ended and does not require funding recipients to implement RI in a specific way, acknowledging that RI will likely be enacted differently in different research contexts. The EPSRC emphasizes the importance of collaboration between scientific researchers and other disciplines and practitioners in order to develop the skills necessary for RI.

For more information, see Owen, R. 2014. "The UK Engineering and Physical Sciences Research Council's commitment to a framework for responsible innovation." *Journal of Responsible Innovation* 1, no. 1: 113-117.

National Academies of Sciences, Engineering, and Medicine (NASEM). 2016. *Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values*. National Academies Press. http://nas-sites.org/gene-drives/

This NASEM report on gene drive research uses responsibility in innovation to organize the entire report. Chapter 4 specifically discusses the role of human values in guiding the development and use of gene drive organisms designed to spread in shared environments. Chapter 7 covers public engagement; it explains reasons for engaging affected communities, stakeholders, and other public audiences; presents challenges that might appear in engagement efforts; describes a NASEM framework for engagement; and makes specific recommendations for researchers and institutions working on gene drive research.

United Nations Educational, Scientific, and Cultural Organization (UNESCO). 2010. "4.5: Engineering studies, science and technology and public policy." *Engineering: Issues, Challenges and Opportunities for Development,* **165-182. Paris, France: UNESCO. http://unesdoc.unesco.org/images/0018/001897/189753e.pdf. Accessed September 5, 2016.**

This section of this UNESCO report reviews the history and priorities of the field of engineering studies, placing it in the context of international development. Engineering studies emphasizes the ways in which non-technical dimensions are a necessary part of engineering, which means that engineering solutions should incorporate non-engineering expertise. The section also reviews the development of the field of science and technology policy and its increasing understanding of the ways in which science, engineering, and technology intersect the policy process. Subsequent sections in this chapter focus on engineering ethics and the inclusion of women in the field. Two other chapters in this report are particularly relevant to RI: chapter 2, which discusses the social responsibility of engineers, and chapter 6, which covers the application of engineering to societal challenges like those embodied in the Millennium Development Goals.

Bibliography

Virtual Institute for Responsible Innovation (VIRI): VIRI Library. Available at http://cns.asu.edu/viri/library, accessed April 17, 2017

The Virtual Institute for Responsible Innovation (VIRI) is an NSF-funded project housed in the Center for Nanotechnology in Society at Arizona State University. This initiative facilitates collaboration among a global community of scholars and practitioners with the aim of defining and disseminating responsible innovation practices. The VIRI Library includes an extensive bibliography of responsible innovation publications in a wide range of journals and textbooks.

VIRI has also compiled a list of blogs and other resources (accessible here: **http://cns.asu.edu/viri/blogs**

) relevant to responsible innovation and ethical issues in science and technology more generally. This list includes the *Journal of Responsible Innovation*, a peer-reviewed journal with articles that engage with a variety of ethical, political, and social dimensions of innovation in science and technology. Authored by scholars in the humanities and social sciences as well as natural sciences and engineering, this journal includes case studies of responsible innovation in practice, theoretical engagements with the framework, and critiques of its limitations. Many articles, including those in the entire first issue, are open access. Available online at http://www.tandfonline.com/loi/tjri20#.VXq85vnWvGE

Res-AGorA project: RRI Resources.
Available at https://morri.res-agora.eu/rri-resources/, accessed April 17, 2017

The Res-AGorA project (Responsible Research and Innovation in a Distributed Anticipatory Governance Frame. A Constructive Socio-normative Approach) is one of five projects in the EU working to develop a framework for RRI through case studies, workshops, and monitoring. RRI resources in the site's bibliography include a list of EU-funded RRI projects, articles, blogs, reports, and organizations relevant to responsible innovation, especially in an EU context. This bibliography also includes citations for key textbooks and edited volumes published on responsible innovation to date.

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