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SCIENCE COMMUNICATION AND INNOVATION: ZOOMING OUT FOR MICRO-LEVEL INSIGHTS CLOSE TO REALITY

Science communication and Responsible Research and Innovation. How can they complement each other?

Victor Scholten, Jeroen van den Hoven, Eefje Cuppen and Steven Flipse

Abstract

In today's society a variety of challenges need attention because they are considered to affect our well-being. Many of these challenges can be addressed with new innovations, yet they may also introduce new challenges. Communication of these new innovations is vital. This importance is also addressed by the concept of Responsible Research and Innovation. In the present commentary we draw on a dataset of 196 research projects and discuss the two research streams of Science Communication and Responsible Research and Innovation and how they are complements to each other. We conclude with suggestions for practitioners and scientists.

Keywords

Citizen science; Participation and science governance; Public understanding of science and technology

Introduction

In today's society a variety of challenges need attention because they are considered to affect our well-being. Examples that are often mentioned include the growing population, accelerating urbanization, scarcity of specific materials and energy, climate change, and — most importantly — the fact that consumers are increasingly demanding healthy, affordable, as well as socially and environmentally responsible products. Innovations and technology development are important to address these challenges. Simultaneously these innovations bring about new challenges with regards to the responsibility and influence they have towards other stakeholder groups. For example, decentralized energy production through wind turbines or solar farming is in some aspects environmentally friendly but it may be harmful to the landscape and in some instances be unfavorable for the tourism sector.

Science communication has played a vital role in communicating new technology developments. This communication is more than encouraging scientists to explain their research, making the public aware of and helping them understand technological advances. It is also about developing opinions and forming and reforming science related matters among science practitioners, government

officials, industry and the general public [Burns, O'Connor and Stocklmayer, 2003]. This involves the use of a set of appropriate skills to articulate and communicate science and concurrently the involvement of stakeholders and a learning orientation to reflect on the present methods, communication channels and engagement [Trench, 2008]. Hence, science communication resonates with the capability perspective, which reflect the organization's ordinary ability to perform a set of activities, generally embedded in organizational routines and standard operating procedures [Teece, Pisano and Shuen, 1997]. Especially, when the learning orientation is included, science communication becomes a dynamic capability, which includes for instance the ability to collect opinions, analyse current practices of communication, reflect on them and then effectuate change to modify these practices.

More recently, following the developments in the field of science communication and building on the capability view of building, integrating, and reconfiguring internal and external competences to address rapidly changing environments, the notion of Responsible Research and Innovation has emerged [Stilgoe, Owen and Macnaghten, 2013]. In order to address the societal challenges effectively with new technologies, these technologies may develop into innovations which may bring about new challenges and issues for specific stakeholder groups. Hence, in order to face the challenges of today's world, it is also necessary to think about them in terms of social and collaborative schemes, co-creation and explore how social innovations can enhance support and technological innovation. It is not only about the things we do, but also why we do them and being clear and transparent about on how we do them it and, with whom we collaborate and why we include them.

The concept of Responsible Research and Innovation has been subject to varying opinions concerning its definition, its implementation in organizations and effect on business performance. There is common agreement that Responsible Research and Innovation (RRI) draws from the same reasoning provided by Brundtland [1987], who defined sustainability as 'a development which satisfies the present needs without compromising the ability of future generations to satisfy their own'. The sustainability agenda follows this definition by addressing the impact of innovations in view of sustainability, which translates into social, economic and environmental impacts also known as the Triple Bottom Line [Elkington, 1998]. Policy makers grabbed the concept of responsibility to give direction to their subsidy programs in research and innovation. In 2011, the European Commission [European Commission, 2011] defined the responsibility of organisations which goes beyond the compliance with rules and regulations. It requires that organisations should have an integral approach when innovating to maximise the creation of shared value for owners/ shareholders and or their other stakeholders and society at large. Especially it is emphasised that organisations should identify, prevent and mitigate the possible adverse impact of their innovations.

The application of new technologies in innovations to address societal challenges can challenge the balance between risks and benefits and open up relevant dilemmas about their use. In particular, considering the multidisciplinary and multifaceted nature of these technologies, the request for an ever faster, competitive and efficient research and innovation process and the increasing demand and expectation for responsibility and responsiveness toward society is needed. The central question in Responsible Research and Innovation is how to best link

innovation with responsibility to make it more anticipatory. New methods and models of interactions amongst stakeholders as well as novel tools for governing the research and innovation process are under investigation by different institutions worldwide. Several stakeholders, both in the science and business domain, are engaged in the concrete implementation of RRI practices, though scattered in scope, approaches and (technology) sectors. Promoting problem-oriented, interdisciplinary and participatory/inclusive approaches, engaging stakeholders all along the research and innovation process, enhancing scientific knowledge, creativity and societal responsiveness, encouraging reflexivity on key risks and ethical values, are amongst the elements taken into consideration to this end.

The debate over what Responsible Research and Innovation (RRI) is has emerged into an understanding that it is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim of fostering the design of inclusive and sustainable research and innovation [Von Schomberg, 2013]. The concept is especially relevant for scientific research that is carried out using public money, i.e. government-funded research. The rationale is that when society's money is spent on innovation, the outcome of the innovation should benefit society in return, and therefore cannot be at the expense of other stakeholder groups.

Various scholars have investigated what responsible innovation is and there is common agreement that it is a governance approach to innovation where anticipating and gaining knowledge of possible consequences and building capacity to respond to them is central [Stilgoe, Owen and Macnaghten, 2013; Van den Hoven, Lokhorst and Van de Poel, 2012]. Stilgoe, Owen and Macnaghten [2013] have identified four dimensions that reflect an organisations RRI: anticipation, reflexivity, inclusion and responsiveness. In their study they argue that anticipation reflects the extent to which researchers are re-thinking the detrimental implications of their work and assess their technology in order to be resilient and re-shape the research agenda. Reflexivity refers to the extent the researcher is reflecting on the activities and being mindful that others may have a different perception of the activities undertaken. The third dimension is inclusion and indicates the extent to which stakeholders are included in the decision making process regarding the research agenda and its outcome. Finally, they articulated the dimension of responsiveness, which indicates the extent to which researchers and organisations respond to new knowledge as this emerges and to new emerging perspectives, views and norms. These dimensions reflect a capability of an organisation to engage stakeholders, absorb their knowledge and learn from it [Scholten and van der Duin, 2015]. Research among organizations that conduct R&D and innovation have already developed practices of responsiveness towards each other and towards society at large, such as business codes, international guidelines for responsible conduct, social corporate responsibility. When analysing Science Communication projects and compare them with the literature on common RRI practices we better understand how the two approaches are similar and can complement each other. The methods and practices used to carry out RRI differ from more traditional methods for conducting research and innovation. After all, RRI requires the inclusion of diverse stakeholders, anticipates and reflects on multiple values, communicate open and transparent, and respond or adapt based

on feedback that is received in order to accommodate the wider range of stakeholders and their viewpoints that exist today and in the future.

The two research streams on science communication and responsible research and innovation are closely related and have overlapping goals. They share similar methodologies which are used among user and stakeholder groups. Drawing on a data set of research projects that were submitted for an award for Responsible Research and Innovation, we investigate more closely the differences and similarities between the two research streams and identify how they can complement each other.

The EFARRI award

To analyse how the research streams of Science Communication and Responsible Research and Innovation complement each other we investigate a data set of projects that were wsubmitted for EFARRI. The EFARRI award is a joint initiative of the King Baudouin Foundation, La Fundacio la Caixa (Spain), Fondazione Cariplo (Italy), Lundbeck Foundation (Denmark), the Robert Bosch Stiftung (Germany) and the European Foundation Centre Research Forum. In total 216 projects have been submitted from various EU countries, of which 196 could be used for analyses. The projects were eligible for the award if they were ongoing or have been finalised not earlier than 2013 and were conducted by a university, research centre, industry, civil society organization within the European Research Area. The projects were submitted by research groups from eighteen member states of the EU and we identified 9 distinct fields of research of which the Health, Cleantech, Humanities and Agri-food are most frequently represented. Among these projects we identified: Science Communication Projects (SCP) that focused on the communication of science and engaging citizens into science, Core Research Projects (CRP) that primarily focused on the conduct of scientific research and RRI Methodology Projects (RMP) which had a goal to develop better methods and understanding of Responsible Research and Innovation.

To analyze the projects we combined the dimensions by Stilgoe, Owen and Macnaghten [2013] into two indicators. These are 1) Inclusion and Transparency which reflects the extent of engaging stakeholders, involving them in the research and communicate with them in a transparent way, and 2) Anticipation and Responsiveness which reflect the extent the researchers in the project engaged the stakeholders proactively and in a systematic way in order to collect information and anticipate new developments or respond to them by changing the approach and methods used in their research project. These indicators were measured on a 5-point likert scale.

The main findings are presented in Table 1. The number of applications for science communications projects was 92, 75 Core research Projects were submitted and in total 29 RRI Methodology projects were submitted. The Science Communication Projects had the highest average score (ave.=3.3) for inclusion and transparent communication with stakeholder groups and were scoring highest (ave.=2.0) also for Anticipation and Responsiveness together with the RRI Methodology projects. Although the scoring of Science Communication Projects was highest on both indicators for RRI, the projects could score higher on the 5-point scale. This raises the question what can be learned from each approach.

Table 1. Responsible Research and Innovation of research types.

Research type	N	Inclusion & Transparency	Anticipation & Responsiveness
Science Communication Projects	92	3.3	2.0
Core Research Projects	75	2.3	1.3
RRI Methodology Projects	29	2.8	2.0
Grand Total	**196**	**2.8**	**1.7**

Discussion

The projects regarding Science Communication that were submitted for EFARRI make use of methods and approaches to engage and communicate with their audience which distinguish from the other projects that were submitted for EFARRI. The Science Communication projects are very communicative and use languages which are closer to the audience groups and stakeholders involved. In some of the projects, before the communication started, research was conducted to identify themes and examples of practical cases that could be used to illustrate the message used in the communication. The use of metaphors and the positive framing of the improvements that can be achieved through the application of the technology. The projects in Science Communications also were actively engaging the user and stakeholder groups. Involving them in the development of cases, building the stories and articulating the narratives was vital to make strong connections to the audience and increase the public understanding in general. This positive and pro-active approach to bring about messages and engage user and stakeholder groups can be fruitful to Responsible Research and Innovation methodologies. The RRI approach tries to prevent and mitigate the possible adverse impact of their innovations. This may induce that within the communications with and engagement of stakeholders, more emphasis is put on situations that are unwelcome or need to be avoided. Hence the RRI methodology can learn from the Science Communication projects to develop more positive narratives and develop examples that resonate well with the abilities of user and stakeholder groups to understand what is at stake. This will increase the extent that user and stakeholder groups can absorb the complexities and repercussions of the new technologies that are developed and introduced.

Conclusion

Analysing the research projects that were submitted to the EFARRI call allowed us to identify how science communications projects and Responsible Research and Innovation are related and can complement each other. The analyses provides insight for practitioners to further their methodologies but also provides understanding to the scientific debate how the two can benefit from each other. For future research on both Responsible Research and Innovation as well as on Science Communication models we advocate that it would benefit each research stream to learn from the methods and approaches each is using and understand the context in which these are used.

References

Brundtland, G. (1987). *Our Common Future — Report of the World Commission on Environment and Development*. New York, U.S.A.: United Nations General Assembly.

Burns, T. W., O'Connor, D. J. and Stocklmayer, S. M. (2003). 'Science communication: a contemporary definition'. *Public Understanding of Science* 12 (2), pp. 183–202. DOI: 10.1177/09636625030122004.

Elkington, J. (1998). Cannibals with Forks: The Triple Bottom Line of 21st-Century Business. Gabriola Island, BC, Canada: New Society Publishers.

European Commission (2011). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*. URL: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0681&from=en (visited on 14th December 2012).

Scholten, V. E. and van der Duin, P. A. (2015). 'Responsible innovation among academic spin-offs: how responsible practices help developing absorptive capacity'. *Journal on Chain and Network Science* 15 (2), pp. 165–179. DOI: 10.3920/JCNS2015.x005.

Stilgoe, J., Owen, R. and Macnaghten, P. (2013). 'Developing a framework for responsible innovation'. *Research Policy* 42 (9), pp. 1568–1580. DOI: 10.1016/j.respol.2013.05.008.

Teece, D. J., Pisano, G. and Shuen, A. (1997). 'Dynamic capabilities and strategic management'. *Strategic Management Journal* 18 (7), pp. 509–533. DOI: 10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.

Trench, B. (2008). 'Towards an Analytical Framework of Science Communication Models'. In: *Communicating Science in Social Contexts. New models, new practices*. Ed. by D. Cheng, M. Claessens, T. Gascoigne, J. Metcalfe, B. Schiele and S. Shi. Dordrecht, Netherlands: Springer, pp. 119–135. DOI: 10.1007/978-1-4020-8598-7_7.

Van den Hoven, J., Lokhorst, G.-J. and Van de Poel, I. (2012). 'Engineering and the Problem of Moral Overload'. *Science and Engineering Ethics* 18 (1), pp. 143–155. DOI: 10.1007/s11948-011-9277-z.

Von Schomberg, R. (2013). 'A Vision of Responsible Research and Innovation'. In: *Responsible Innovation*. Ed. by R. Owen, J. Bessant and M. Heintz. New York, NY, U.S.A.: John Wiley & Sons, Ltd, pp. 51–74. DOI: 10.1002/9781118551424.ch3.

Authors

Victor Scholten is Assistant Professor in Technology-based Entrepreneurship and director of the Delft Centre for Entrepreneurship at Delft University of Technology, the Netherlands. His current research interests are in academic entrepreneurship, technology transfer and new business venturing. He is particularly interested in the networking activities and the interplay between entrepreneurship and responsible innovation: how societal challenges and new technology developments provide opportunities and require a responsible approach to innovation to ensure societal benefit. E-mail: v.e.scholten@tudelft.nl.

Jeroen van den Hoven is Full Professor of Ethics and Technology at Delft University of Technology, he is editor in chief of Ethics and Information Technology. He was the first scientific director of 3TU.Ethics (2007–2013). He won the World Technology Award for Ethics in 2009 and the IFIP prize for ICT and Society also in 2009 for his work in Ethics and ICT. E-mail: M.J.vandenHoven@tudelft.nl.

Eefje Cuppen is Associate Professor at the Faculty of Technology, Policy and Management (TPM) of TU Delft. She holds a Ph.D. in policy sciences from VU University (Institute for Environmental Studies; 2010), and was expert member of the EU 2020 Advisory Board of the Future and Emerging Technologies working programme 2016/2017. E-mail: E.H.W.J.Cuppen@tudelft.nl.

Steven Flipse is Assistant Professor in the Department of Science Education and Communication at the Delft University of Technology. Steven studied Life Science & Technology at the University of Leiden and Delft University of Technology. He specialized in bioprocess technology and the social and ethical aspects of industrial biotechnology. In his Ph.D. research, he developed a measuring and benchmarking system to assess the quality of Responsible Innovation.
E-mail: s.m.flipse@tudelft.nl.

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