

This corresponds to an entry in the above mentioned encyclopedia.

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From the responsible development of new technologies towards Responsible Innovation*

The institutional and societal learning processes with the introduction of new technologies since World War II have culminated in specific large-scale initiatives to promote the '*responsible development*' of a new technology under public policy. Nano science and nanotechnologies constituted the first historic case in which a technology, in its infancy, is being addressed by such large-scale, multi-billion dollar/euro, mid to long-term programs at both sides of the Atlantic. Since 2001, The National Nanotechnology Initiative (NNI) is the U.S. Federal Government's interagency program for coordinating research and development and enhancing communication and collaborative activities in nanoscale science, engineering, and technology. Among its four major goals features the support of 'responsible development of nanotechnology' (Nanogov. National Nanotechnology Initiative). The European Commission has adopted a European strategy and action plan which emphasizes the '*safe, integrated and responsible*' development of nanosciences and nanotechnologies (European Commission, 2004). The 'responsible development of nanotechnology' is under both the American and the European initiative addressed by:

- Identification and management of ethical, legal, and societal implications
- Incorporation of safety evaluation of nanomaterial into the product life cycle and allocation of budgets for identification and study of risks
- Identification of knowledge gaps and regulatory needs
- Involvement of stakeholders and engagement in international dialogue

Reflections on an appropriate governance framework for the responsible development of technologies have led to the call for specific requirements of such a governance process:

- Anticipatory governance: an adequate governance framework should anticipate the intended and unintended impacts of new technologies in economic, environmental, social and ethical terms. This requires extensive use of technology foresight and technology assessment (Karinen and Guston, 2010).
- Deliberative governance: This implies inclusive governance, one based on broad stakeholder involvement and early public intervention in research and development leading to responsive public policies (Owen et al, 2013) or even a required commitment of stakeholders with a view on particular social desirable outcomes.(Von Schomberg, 2013).
- An ethics of co-responsibility: The outcomes of research and innovation are the result of institutional and collective actions which often lead to consequences which can hardly be traced back to the actions or intentions of any individual. Both for the intended and unintended

outcomes societal actors and innovators have to assume shared responsibility (Von Schomberg, 2007).

- The systematic use of normative principles for the design of technologies. Ethics becomes a driving force for innovation rather than a constraint. “Privacy by Design” is the most prominent example of such a normative principle, and Stahl and others have used this and other principles for devising a responsible governance of ICT (Stahl, 2011).
- Whenever appropriate, the integration of social science and humanities within interdisciplinary research practices to increase reflexivity (Fisher et al, 2006).

However, Responsible Research and Innovation has been articulated not only with a view on the anticipation and good management of possible risks of new technologies but also with a view on the ‘right impacts of research’. In other words: what do we want to get out of (publically) funded research and innovation? In the European Union this has been articulated by a call to direct research and innovation towards the Grand Challenges of our times: climate change, food security, ageing populations etc. Even more broadly formulated, responsible research and innovation can be seen to be responsive to basic public values or benefits for humanity (Ozolina et al, 2012) or fundamental rights and constitutional normative anchor points (Von Schomberg, 2013), thus driving innovations towards social desirable outcomes.

Von Schomberg (2013) has proposed the following definition consistent with an ambitious vision of innovation governance:

‘Responsible innovation’ is ‘a transparent, interactive process by which societal actors and innovators become mutually responsive to each other regarding the ethical acceptability, sustainability and social desirability of the innovation process and its marketable products ‘.

‘Responsible research and innovation’ shifts the focus from research and development of particular technologies and or particular risks towards the whole innovation process, and its governance which is neither technology-specific, nor solely risk-focused.

Some European Innovation Partnerships, for instance the partnership on ‘Healthy Ageing’ implicitly seem to practice RRI to the extent that a societal desirable objective (in this case, the increase of life-expectancy by 2 years in 2020) is pursued with multi-optional technological means as well as by means of social innovation, having public and private bodies committed to overall-normative objective within flexible and adaptable research and innovation trajectories.

Coupling the Grand Challenges and RRI seems to be an obvious choice. However, to identify what is a “Grand Challenge”, and which are the accompanying Research and Innovation priorities, is in the global context anything but consensual: “Healthy Ageing” is an issue for many Asian, European and American states, but not for Africa. For the most populated countries in the world, China and India, “Internal Grand Challenges” may be prioritized. China, for example, sees “Urbanization” as a Grand Challenge facing the arrival of a 13 million new urbanites each year. India has impressed us with ‘inclusive innovation’: doing more with fewer resources for more people, such as providing a 120 dollar artificial foot. Possibly, innovation may come increasingly from the “South”.

The articulated focus by Indian experts on 'inclusive innovation' constitutes an activity hardly ever practiced in the west, namely to overcome and address income disparities by specific innovations rather than 'western', mostly ideologically inspired macro-economic approaches towards 'inclusive economic growth', which have up to now been counterproductive (actual income disparities have become larger than ever before over the last two decades, particularly in the USA but also within member states of the European Union).

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