proEthics

Deliverable

D1.2 Paper Manuscript on Participatory Practices and Ethics Issues in Innovation

Project	PRO-Ethics – Participatory real life experiments in research and innovation funding organisations on ethics
Project Acronym	PRO-Ethics
Project Number	872441
Deliverable:	D1.2
Submission Date:	28.07.2020
Responsible Author(s)	Kalli Giannelos, Bernard Reber, Neelke Doorn, Philipp Hövel, Dirk Lanzerath, Lisa Tambornino.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Document Control Sheet

Work Package Number	WP1
Work Package Title	Ethics of Innovation: Conceptual Framework
Task Number	T1.1
Task Title	Theoretical Framework
Deliverable Number	D1.2
Deliverable Title	Paper manuscript on Participatory Practices and Ethics issues in Innovation
File name	D1.2_Theoretical framework_final
Number of pages	100
Dissemination level	Public
Main author	Kalli Giannelos
Contributors	Bernard Reber, Neelke Doorn, Philipp Hövel, Dirk Lanzerath, Lisa Tambornino
Quality Assurance	Madeleine Gabriel, Gerda Geyer, Sabine Mayer, Juliet Ollard

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Versioning and Contribution History

Version	Date	Author	Co-Author	Notes
_v01	17.05.2020	Kalli Giannelos	Bernard Reber, Neelke Doorn	First draft
_v02	29.05.2020	Kalli Giannelos	Bernard Reber, Neelke Doorn, Philipp Hövel, Dirk Lanzerath, Lisa Tambornino	Feedback and internal review
_v03	15.06.2020	Kalli Giannelos	Bernard Reber, Neelke Doorn, Madeleine Gabriel, Gerda Geyer, Sabine Mayer, Juliet Ollard	Feedback and internal review
_final	28.07.2020	Kalli Giannelos		Finalisation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Executive Summary

Aiming at designing a comprehensive approach to ethics and participation, this study encompasses general features and configurations of ethics in the field of research and innovation, to further connect them with participatory practices broadly understood. Taking stock of the overall blurred vision that R&I literature and practices manifest in regards with participation, this critical review faces this challenge by opening up the meanings of participation and offering a multi-layered approach, combining theoretical considerations with policy-making and empirical forms. Participation can be considered as the epitome of innovation ethics, provided its multidimensionality, and the depth and nature of the involvement, are clarified at the outset.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Table of Contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

INTRODUCTION

The scope of the project

Setting the ground of the PRO-Ethics project's rationale, this first deliverable consists of a theoretical framework, bringing a critical review of multi-level regulatory dimensions of participation and ethics practices. Combining scientific and grey literature on ethical practices in R&I, this theoretical framework aims at unveiling general principles and methodologies of participatory practices in innovation, matching them with the basic features and concerns of contemporary ethics in the field of R&I, regulatory gaps and potential controversies.

This study stems from the challenge to merge the complex field of Research & Innovation (R&I) ethics with the even more blurred landscape of participatory processes: participation does not allow for a single definition and, at its deepest, the Babel Tower resulting from the various ways to embrace it in publicly-funded R&I questions the very possibility of a comprehensive framework. By opening up the meanings of participation, PRO-Ethics overrides this difficulty by methodically settling the boundaries of the knowledge basis with the gaps and intricacies, which remain unresolved. Although the legitimacy of participation in R&I can be seen as self-evident, the lack of definition may lead to poorer forms of participation if the question of the purpose and the participants' role are not clarified.

Further to reflections undertaken in the field of ethics of technology and also - and foremost - through the EU's Responsible Research and Innovation (RRI) framework, participation will be addressed here beyond its identification as a pillar of procedural nature. While taking stock of existing reflections, regulations and policies, participation will be analysed through a methodical opening up of its dimensions and implications, also considering the very connection of ethics with participation, which is not a self-evident assumption, depending on the ways participation is dealt with. To address public concern over the impact of emerging technologies and innovations, participation can be thought beyond technology assessment procedures as they exist, in order to include a broader array of participants and allow interested or affected parties to take part in discussion and decision-making. The extension of the science-society discourse towards co-production is supporting a new pathway to confront the complexity and unpredictability of innovation with shared responsibility.

The overall scope of this theoretical investigation of ethics of innovation and participatory approaches is limited by PRO-Ethics' angle, which is publicly funded research and innovation. This implies that this work does not reflect general views on innovation processes in general, but only those supported by public policies. The focus on policy-making brings into consideration the institutionalisation process, while it also includes analysis that falls beyond that. The interaction of innovation with society is a constant reciprocal adaptation, as scientific and technological innovation continually remakes society, which in turn, accommodates, manages, and redirects innovation[1]. Focusing on publicly funded R&I[2], PRO-Ethics explores the challenges and opportunities of using funding as a policy lever to achieve better social outcomes through participation. In the fast-evolving course of innovation – and especially technological innovation – participation can be leveraged as an ethical safeguard to confront new features with social and economic development.

[1] Guston, D. H., & Sarewitz, D. (2002). Real-time technology assessment. *Technology in Society, 24*, p. 93.
[2] Even though the scope of this study is publicly funded innovation, this analysis can also be relevant for the private sector – to the extent that it can be involved as beneficiary or adjunct to the funding processes; or to the extent that publicly-funded R&I frameworks can be considered as good practices.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

What is the responsibility of governance structures in setting R&I priorities in view of ethical concerns and participatory approaches? What is the capacity of new innovation configurations to integrate participatory approaches? Should regulations be applied to new forms of participation in R&I? What should be the scope of a European ethical framework for new participatory approaches in publicly funded R&I? The various underlying questions that will be addressed aim to define ways to better include ethical, legal and social issues through participatory approaches in order to deliver desired outcomes, to identify the role of stakeholders as well as their involvement in R&I, and to deliver insights on how R&I processes might be advanced through a proper inclusion of participation in public funding.

Connecting ways to facilitate ethically acceptable and sustainable innovation with the notion of participation comprises some blind spots: such as the way to deal with minimum standards in the field of emerging technologies (e.g. AI, bioethics), primarily concerned by the boundaries of uncertainty. In light of moral pluralism and the issue of responsibility in innovation, the contribution of PRO-Ethics seems all the more important considering that, in this sense, that there might be "no normative baseline on which we could judge the positive impacts and benefits of technologies"[3].

Methodology

Guided by the initial contribution of RRI to the promotion of public engagement as a pillar of an ethical approach to innovation, the development of this study expands in the direction of the analysis of all possible understandings and levels of participation. Combining theoretical resources with the analysis of existing policies, regulations and R&I contexts, the common thread in this exploration is the critical review and classification of the various overlapping dimensions.

In the first chapter, emerging innovation approaches will address new configurations reshaping the landscape of R&I processes, and explore the depth of the connection between responsibility and ethics, while regulations and policies analysis reveal a well-developed field in regards to the law / soft law complementarity, and the significant epistemological contribution of ethics reviews to the field of responsible innovation.

The second chapter deals with participation, addressing its intricacies at the roots of its staggering multidimensionality, attempting to define it across types and configurations, considering the overarching values it bears as a common denominator. Various levels compete in participatory processes, although deliberation stands alone as a pillar, which, although different from participation, aspires to efficiently fulfil its main promises. In the absence of regulations specifically relating to participation in R&I, soft law indicates the practical gaps and the complexity of policy-making, although some fields are better circumscribed than others.

The combination of ethics requirements with the complexity of participatory practices appeals to the reinforcement of existing institutionalisation processes in the direction of classifications and indicators. The third chapter focuses on ethics from the viewpoint of binding and non-binding legal frameworks, identifying how regulations and recommendations deal with ethics and the gaps and challenges in EU recommendations, regulations and indicators for participation. The analysis of the way regulatory bodies across Europe deal with participation will underline the difficulties and limits

[3] Understood here in the scope of moral pluralism. See Von Schomberg, R. (2013). A Vision of Responsible Research and Innovation. In R. Owen, M. Heintz, & J. R. Bessant (Eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. Chichester: John Wiley & Sons, p. 55.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

policy-making is facing. These challenges can be faced through criteria and good practices that can indicate directions for future frameworks, amongst which the upcoming PRO-Ethics framework is located.

The equal proportion of scientific and grey literature in this deliverable does not quite cover some major gaps stemming from the uncertain and complex ground on which R&I evolves. The identification of varying levels of discourses also underlines this difficulty to have a single view on the subject. Indeed, as some resources interchangeably use diverse terms referring to participation, the adoption of a methodological step-by-step approach seemed indispensable. Moreover, the often vague or extremely diversified understanding of participatory practices and their use in R&I can also be problematic within the same context of actors. This obstacle has been identified at the outset of this research, as PRO-Ethics consortium members had diverging practices and ways to consider the notion of "participation", or that of "participants", with varying approaches of the project. To cope with this polysemy, a short survey has been conducted internally within the consortium so as to identify the diversity of types and modes of participation as well as the needs of participatory practices and the outcomes[4]. Serving as basis also for the subsequent deliverable – on the participatory practices of RFOs in Europe – this initial survey preceding this study has been particularly helpful in opening up the meanings of participation so as to embrace the whole array of dimensions and uses, serving also as the premises on which the final outcome of the project will be outlined.

Taking stock of this difficulty, this theoretical deliverable aims at clarifying the levels, angles, and approaches, as to better understand the standing point with regards to ethics, innovation, and participation, in each discourse and practice. In spite of the great advancement at EU level on ethics assessment and participatory issues in R&I, through projects supported by Horizon 2020 and in particular "Science with and for Society" (SwafS) programme, the extent of the remaining blind spots confirms the need to connect the findings of previous research and achievements on the matter with a renewed questioning. A selective approach has led to the direct connection with the conclusions of a few past RRI EU-funded projects[5] covering the various dimensions of the current project, either from the perspective of RRI and innovation ethics, or from the point of view of stakeholders and civil society engagement as forms of participation. Accompanying grey literature on RRI and ethics of innovation at EU level has been gathered in a selection of legal frameworks, either on ethics or soft law considerations on participation.

[4] This will be presented in the second deliverable of PRO-Ethics, focusing on empirical practices of research funding organisations in Europe.
[5] The following EU projects have been selected for this review: CONSIDER (http://www.consider-project.eu); EGAIS (https://cordis.europa.eu/project/id/230291); MORRI (http://morri-project.eu); SATORI (https://satoriproject.eu); SIENNA (https://sienna-project.eu).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

I - ETHICS ISSUES IN INNOVATION

The identification of key ethics issues in innovation faces diversity according to the type of innovation considered, the new features of innovation it may relate to, and also the sectoral specificities raising priorities among ethical concerns. We will here focus on innovation approaches and configurations, which will bring us closer to participatory approaches. Amongst various kinds, a few features of novel or emerging innovation approaches and configurations will be selected for their connection with participatory practices, so as to identify common ethical features – prevailing patterns of innovation[6].

Emerging innovation approaches and societal challenges

Innovation approaches and configurations

Across the great variety of ways to define innovation, some key characteristics can be identified in the emergence of new creation or significant improvement to existing practices. As innovation can be applied to both an activity and its outcome, it can generally be defined as "a new or improved product or process (or combination of thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)."[7]. Innovation creates more than a new set of techniques: it is a "future-creating activity" that brings, "ultimately new social practices and even institutions that transform the ways in which human beings interact with the world around them", and by doing so "changes the world itself", either incrementally or radically[8], creating added value for society[9].

Innovation is not necessarily of technological nature, its main characteristic being the change it brings, that can be various kinds: from incremental to radical change, innovation can provide a different good or service (product innovation), or apply new methods in the production of a good or service (process innovation), or can combine a change in both a product and a process[10]. While technological innovation creates new products, processes or features, non-technological innovations are "usually social or organisational in nature" and create "new strategies, organisational forms and ideas that strengthen civil society"[11].

Innovation strategies could be outlined in the following four dimensions[12]:

- *product* innovation: changes in the products/services;

[6] Howaldt, J., & Schwarz, M. (2010). Social Innovation: Concepts, research fields and international trends. *IMO International monitoring*, *5*, Aachen: IMA/ZLW.
[7] OECD, & Statistical Office of the European Communities (2018). *Oslo manual: guidelines for collecting, reporting and using data on innovation* (4th edition). Paris: OECD, p. 20. According to this publication, the term "unit" refers to the actor responsible for innovations, in any sector.
[8] Von Schomberg, R. (2013). A Vision of Responsible Innovation. In R. Owen, M. Heintz, & J. R. Bessant (Eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. Chichester: John Wiley & Sons, p. 119.
[9] Shelley-Egan, C., Brey, P., et al. (2015). *Ethical assessment in research and innovation: A comparative analysis of practices and institutions in selected other countries*. SATORI Deliverable D1.1, p. 20
[10] Kaplinsky, R. (2014). "Bottom of the pyramid" innovation and pro-poor growth. In Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.), *Making Innovation Policy Work: Learning from Experimentation*, Paris: OECD and The World Bank, p. 52.
[11] Shelley-Egan, C., Brey, P., et al. (2015): 20
[12] See Francis, D., & Bessant, J. (2005). Targeting innovation and implications for capability development. *Technovation, 25*(3), pp. 171–183. Quoted in Bessant, J. (2013). Innovation in the Twenty-First Century. In R. Owen, M. Heintz, & J. R. Bessant (Eds.): 4.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- *process* innovation: changes in the ways in which products/services are created;
- *position* innovation: changes in the context in which the products/services are introduced;
- *paradigm* innovation: changes in the underlying mental models behind the activity.

The process of innovation varies according to the nature and the actors, but main steps in producing an innovation are: basic and applied research, development, scale-up or engineering, production and commercialisation, and dissemination and use[13]. From the viewpoint of the value chain, innovation can be identified through four different dimensions: product innovation, process innovation, functional innovation, and chain innovation[14].

In addition to the variety of kinds and strategies of innovation, a great diversity of actors intervenes: the government, state-owned enterprises (SOEs), private firms, individuals, grassroots innovators, universities and non-governmental organisations (NGOs)[15]. The role of public funding across innovation value chain and main actors varies noticeably[16], as across the innovation process the various actors do not have the same weight - governments and private companies are driving innovation efforts, mostly[17]. However, private companies act as the main actor throughout all stages of the chain from research to dissemination and use, the main role of government being funding and performing basic R&D, and in its dissemination and use, while the main role of universities is also in basic research and dissemination of knowledge; other actors such as grassroots innovators are little involved in dissemination; and NGOs can act as important funders of research but are mostly not involved in production[18]. Mostly represented by governments, the public sector is also well represented at certain levels, as in funding research for general or applied knowledge, often with goals pertaining to military purposes or public health, and to some extent for industry competitiveness[19].

Areas of emergent science and technology (e.g. nanotechnology, synthetic biology, etc.) and emerging technologies have raised - apart from oppositions from some stakeholders – also a debate on the ways to control their development, accompanied by reflection on the place of public participation in both setting research agendas and modulating research trajectories towards socially desirable ends[20]. This shifts the debate from the contents to the modes of innovation: in a sense, "the challenge is not whether or not to innovate, but *how*?"[21].

While there are several ways to frame innovation as a concept[22], innovation modes can be outlined as general categories of innovation configurations or modes, according to varying goals. Across its

[13] Dahlman, C., & Kuznetsov, Y. (2014). Innovation for the "base of the pyramid": Developing a framework for policy experimentation. In Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.), *Making Innovation Policy Work: Learning from Experimentation*, Paris: OECD and The World Bank, p. 79.
[14] Kaplinsky, R. (2014): 52.
[15] Dahlman, C., & Kuznetsov, Y. (2014): 79.
[16] This table is taken from: Dahlman, C. & Kuznetsov, Y. (2014): 80.
[17] Dahlman, C., & Kuznetsov, Y. (2014): 81.
[18] This is thoroughly analysed in: Dahlman, C., & Kuznetsov, Y. (2014): 80-81.
[19] Dahlman, C., & Kuznetsov, Y. (2014): 81.
[20] Fisher, E., Mahajan, R. L., Mitcham, C. (2006). Midstream Modulation of Technology: Governance From Within. *Bulletin of Science, Technology & Society*, *26*(6), pp. 485–496. Quoted in Owen, R., Macnaghten, P., Stilgoe, J. (2012). Responsible research and innovation: From science in society to science for society, with society. *Science and Public Policy*, *39*(6), p. 752.
[21] Bessant, J. (2013): 1.
[22] The concept of innovation can be segmented in various approaches, such as the following segmentation: innovation as the development of new products; innovation as problem-solving; innovation along the steering-serendipity axis. See: Khan, S. S., et al. (2016). The framing of innovation among European research funding actors: Assessing the potential for "responsible research and innovation" in the food and health domain. *Food Policy*, 62(C), pp. 78–87.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

various forms, innovation can still be defined as a permanent process of creative destruction, as Schumpeter outlined it in 1912[23], perceiving the unaltered dynamic of "execution of new combinations" throughout its forms, mainly, product-related, procedural or organisational innovations. The prevailing tendency to reduce innovations to technical innovations, since Schumpeter[24], has put forward prevailing patterns of innovation.

Amongst the numerous innovation approaches, the following non-exhaustive selection considers some features for the relevant connection they bear with participation and society. These are also of interest in the context of public funding schemes, which may relate to these innovation approaches considering they embrace significant science-society interactions and participatory practices, at the process or outcome levels.

Frugal innovation

Briefly defined as "more with less for more people", frugal innovation encompasses many different strands and criteria, and could be considered as an overarching notion rather than a sub-area of "bottom-up" innovation[25], bringing promises of economic, social and environmental benefits[26]. It mainly originated in the context of emerging markets[27], and as a broad concept, it embraces various strategies, motivations and outcomes that share some common features on the product dimension, the process dimension and the context dimension[28]:

"Frugal innovation is a multi-dimensional phenomenon that combines aspects of product, process and environment in different, context-specific ways. Consequently, no single threshold for frugality can be defined with a view to one particular criterion. […] successful frugal innovation cannot be 'measured' in generic terms, but only be identified qualitatively in a specific framework […] it provides a concrete framework of reference to identify the overall 'degree of frugality' of specific solutions in defined contexts of application."[29]

Indeed, frugal innovation strategies stand at the intersection of business-driven and social innovation, and are built around three context-related challenges: i) resources constraints (including knowledge and human resources); ii) institutional voids (e.g. services or regulations); iii) specific needs of population[30]. Across its many criteria, the discourse about frugal innovation mostly relates to core categories of cost reduction, functionality, and performance level, which define it, while some further non-definitional characteristics, such as being sustainable or scalable, can be added as well[31]. More narrowly, frugal innovation could be defined as "the stripping of attributes of technologically

[23] Schumpeter, J., (1912). *Theory of economic development*: quoted in Howaldt, J., & Schwarz, M. (2010).
[24] See Howaldt, J., & Schwarz, M. (2010).
[25] Kroll, H., Gabriel, M., Braun, A., Muller, E. & al. (2016). *A conceptual analysis of foundations, trends and relevant potentials in the field of frugal innovation (for Europe)*. Interim report for the project "Study on frugal innovation and reengineering of traditional techniques" commissioned to Fraunhofer ISI and Nesta. Luxembourg: Publications Office of the European Union, pp. 5-6.
[26] Granqvist, K. (2016). *Policy brief: Funding frugal innovation. Lessons on design and implementation of public funding schemes stimulating frugal innovation.* Vienna: Centre for Social Innovation (ZSI), p. 4.
[27] Weyrauch, T., & Herstatt, C. (2016). What is frugal innovation? Three defining criteria. *Journal of Frugal Innovation, 2*(1), p. 1.
[28] See Kroll, H., Gabriel, M., Braun, A., Muller, E. & al. (2016): 5-9.
[29] Kroll, H., Gabriel, M., Braun, A., Muller, E. & al. (2016): 8.
[30] Granqvist, K. (2016): 11-13.
[31] Weyrauch, T., & Herstatt, C. (2016): 6; 10.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

sophisticated products, systems and services to make them cheaper without losing technical functionalities and therewith making them affordable", thus often bearing an "explicit social aim"[32].

Considering the support that the public sector can provide in regards to frugal innovation approaches, it could be considered that it plays a "potential role as a 'customer' for frugal innovation, both from the perspective of procuring frugal solutions from third parties, and of adopting frugal thinking within the design and delivery of services"[33]. Public funding schemes supporting frugal innovation have been notably developed by national governments and international charitable organisations, aiming at stimulating the creation of commercially profitable solutions, which generate social impact, address global development challenges or support innovations at the grassroots, while usually the term "frugal innovation" is not mentioned as such, maybe due to a lack of recognition[34].

Grassroots Innovation

The grassroots innovation approach relies on needs-based user experimentation and often leads to incremental innovations[35]. Quite similar to what has also been labelled as crowd-based innovation or community-based innovation[36], grassroots innovation is often devoted to energy and sustainability, although it is a broad category, encompassing other forms[37]. Grassroots Innovation can be defined as a network of activists and organizations generating novel bottom-up solutions for sustainable development and consumption, bringing solutions that respond to the local situation and the interests and values of the communities involved[38]. This bottom-up approach of innovation plays a pivotal role in sustainable development, and is generated by civil society instead of government or business, as it operates without state or commercial interests. The technological change that is brought about in grassroots innovation involves a social movement component in support of a broad social change[39]. With the rise of digital technology, new kinds of grassroots innovation have emerged, often in connection with social issues and challenges, in a global movement for commons-based, peer-production, such as hackerspaces[40], or fablabs, and makerspaces, around open access, community-based design and fabrication workshops[41].

Grassroots innovations enable social, cultural and specific ethical values that differ from mainstream innovations: their distinctive nature gives rise to a range of potential benefits for sustainability[42]. Indeed, grassroots innovation activities generate knowledge that is particularly relevant to policy for

[32] Granqvist, K. (2016): 4.
[33] Kroll, H., Gabriel, M., Braun, A., Muller, E. & al. (2016): 40.
[34] See the analysis led in Granqvist, K. (2016): 18-19.
[35] OECD (2015). *Innovation Policies for Inclusive Growth*. Paris: OECD Publishing, p. 17.
[36] Crowd-based innovation is an umbrella term that emphasizes the promise of empowering "the crowd", and which could be considered as similar to grassroots innovation in that sense. See Cuppen, E., Klievink, B., & Doorn, N. (2019). Governing crowdbased innovations: an interdisciplinary research agenda. *Journal of Responsible Innovation, 6*(2), pp. 232-239.
[37] Frugal innovation strategies, for instance, may refer to grassroots approach.
[38] Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: towards a new research and policy agenda. *Environmental Politics, 16*(4), p. 585: quoted in M. Hossain (2016). Grassroots Innovation: a systematic review of two decades of research. *Journal of Cleaner Production*, *137,* pp. 973-981.
[39] Hossain, M. (2016): 973-981.
[40] Smith, A., & Seyfang, G. (2013). Constructing grassroots innovations for sustainability. *Global Environmental change*, *23*, p. 829.
[41] See Tracey, P., & Stott, N. (2016). Social innovation: a window on alternative ways of organizing and innovating. *Innovation, 19*(1), p. 52.
[42] Monaghan, A. (2009). Conceptual niche management of grassroots innovation for sustainability: The case of body dispostal practices in the UK. *Technological forecasting & Social Change, 76*, p. 1027.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

sustainable innovation[43], understood as socially just and environmentally sustainable development, after Brundtland[44]. Typical cases of grassroots innovation encompass e.g. community energy projects, agro-ecological farming initiatives, locally-organised housing developments, village and neighbourhood materials recycling and local remanufacture, and community-led water and sanitation projects[45]. The growing interest in sustainable development as part of sociotechnical transitions is a pivotal point where persisting problems cannot be solved using the currently dominant approaches[46]. It is however argued that despite its importance for sustainable development, grassroots innovation has a limited impact in reality[47]: for instance, they seek to internalise more socially just principles without really attending to the wider social structures that are the root cause of injustices[48], with the risk of loss of more radical aspects of grassroots innovation processes, such as public participation or community empowering, because of predominant concerns of marketability over social transformation[49]. Despite these weaknesses that can be identified in grassroots innovation processes, each challenge addressed creates forms of knowledge of considerable social value in debates about innovation policy and create a fruitful interaction between knowledge production and debates[50].

In regards to participatory processes, grassroots innovation offers interesting cases of broadening of participation, creating linkages across sectors and across spaces, as it mainly emerges from citizens' innovations, unorganized lay people or local entrepreneurs, amongst others[51]. Participation in grassroots innovation manifests as a rise of inclusive innovation as a tool for social development[52]: grassroots innovations often arise in contexts and because of situations that are unjust in terms of the distribution not only of resources but also political power[53]. Interesting cases of participatory processes reflecting broadening participation have been documented, in situations where local power relations acted against participation (marginalised populations in regards to technology development, for instance)[54]. Also, bottom-up configurations such as grassroots innovation[55]/crowd-based innovations usually take place in a regulatory vacuum, in the sense that they create an "institutional void" by not fitting or aligning with the institutions in place[56]. This may result in some public values being threatened. This lack of regulation appears to be the key element that makes this type of innovation special.

---

[43] Smith, A., Fressoli, M., & Thomas, H. (2014). Grassroots innovation movements: challenges and contributions. *Journal of Cleaner Production, 63*, p. 115.
[44] World Commission on Environment and Development, 1987.
[45] Smith, A., Fressoli, M., Thomas, H. (2014): 115.
[46] Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy*, *30*, p. 383.
[47] Hossain, M. (2016): 973-981.
[48] Smith, A., Fressoli, M., & Thomas, H. (2014): 120.
[49] Smith, A., Fressoli, M., & Thomas, H. (2014): 121.
[50] Smith, A., Fressoli, M., & Thomas, H. (2014): 121.
[51] Also important during scale up phase, according the transition theory, where the engagement of citizens is essential for transition: Hossain M. (2016): 973-981.
[52] This phenomenon relates both to technologies for social inclusion and contemporary grassroots innovation movements; Smith, A., Fressoli, M., & Thomas, H. (2014): 119.
[53] Smith, A., Fressoli, M., & Thomas, H. (2014): 120.
[54] Smith, A., Fressoli, M., & Thomas, H. (2014): 119.
[55] Also in crowd-based innovations.
[56] Cuppen, E., Klievink, B., & Doorn, N. (2019): 232-239. This publication also explains how crowd-based innovation creates a new situation in which actors may start contesting the fit of the institutional arrangements to this new situation: a process of contestation that acts as an institutional overflow, followed by adapation: backflow to "repair" the mismatch.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Overall, the expansion of innovative approaches, supported by digital technologies, modifies profoundly the science-society relationship, materialised by the emergence of new spaces (fab labs, hackathons, living labs).

Inclusive innovation

In the field of innovation policy, approaches aiming at sustainable growth and shared prosperity can be found in emerging domains such as the base-of-the-pyramid (BOP) / pro-poor growth innovation; innovative entrepreneurship; and green innovation[57]. Addressing the issue of poverty and sustainable development, inclusive innovation focuses on inequalities, in order to consider the nature of growth than economic growth per se, implying the necessity to move from an exclusive to an inclusive growth strategy. Inclusive innovation focuses on the actors who benefit from, participate in and decide on the outcomes of innovation: related policies could be generally defined as a mode that is

> "directed towards ensuring that the benefits and the risks of innovation are more equally shared. These policies will actively consider whose needs are met by innovation and how excluded social groups could be better served, focus on initiatives that promote broad participation in innovation, and take a democratic and participatory approach to priority-setting and the governance of innovation."[58]

Taking innovation in the great variety of its forms and manifestations (sectors, processes, economies), inclusive innovation can relate to either an organisational or technical novelty that is to be broadly diffused and have an impact on welfare and living standards[59] of disadvantaged. Outside of Europe and in developing countries, this innovation strategy may imply a market adaptation (by creating for developing countries market and then exporting to developed countries markets)[60].

The public sector can play an important role in the promotion of inclusive innovation, through the various stages of the innovation process. As far as the public sector is concerned (mostly governments), this mode of innovation does not receive enough support for goods and services production relevant to disadvantaged populations, except for two sectors, general health and military[61].

Open Innovation

Open innovation is a distributed innovation process, that has received increased attention over the past decade[62], combining external and internal ideas to create value into platforms, architectures and systems[63], opening up the innovation process "to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets, fostering a

---

[57] This assumption and the unfolding development follows OECD's publication: Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.) (2014). *Making Innovation Policy Work: Learning from Experimentation*, Paris: OECD and The World Bank.
[58] Stanley, I., Glennie, A., & Gabriel, M. (2018). *How inclusive is innovation policy? Insights from an international comparison* (Working paper). London: Nesta, p. 2
[59] Dahlman, C., & Kuznetsov, Y. (2014): 72.
[60] Dahlman, C., & Kuznetsov, Y. (2014): 76; 78.
[61] Dahlman, C. & Kuznetsov, Y. (2014): 81.
[62] Felin, T., & Zenger, T. R. (2014). Closed or open innovation? Problem solving and the governance choice. *Research Policy*, *43*(5), pp. 914-925.
[63] Bogers, M., Chesbrough, H., & Moedas, C. (2018). Open Innovation: Research, Practices, and Policies, *California Management Review*, *60*(2), p. 6.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

stronger culture of entrepreneurship"[64]. Open innovation is based on the free flow of information and ideas across departments and organisations, therefore a process of harnessing the distributed and collective intelligence of crowds, relying on collaboration, sharing, self-organisation, decentralisation, transparency of process, and plurality of participants[65]. The benefits of open innovation are better adaptation to dynamic market needs, shared resources and risks among partners, and higher commercial returns. The risks are mostly related to a wider consideration on opening up innovation processes: the "paradox of openness", that could be described as the need of disclosure of innovative creations towards potential buyers being followed by the risk they need not pay in order to exploit it[66].

In short, open innovation could be defined as the "use of purposive inflows and outflows of knowledge to accelerate internal innovation"[67], involving all kinds of actors in the innovation process, "from researchers to entrepreneurs, to users, to governments and civil society"[68]. This model assumes that useful knowledge is widely distributed, and that external knowledge sources should be integrated as a core process in innovation. Two different kinds of open innovation can be identified, inbound (outside-in) and outbound (inside-out): the first one involving opening up a company's innovation process to many kinds of external inputs, whereas the second one requires organisations to allow unused and underutilised ideas to go outside the organisation for others to use in their businesses and business models[69].

In a digital world, where innovation increasingly requires feedback on the needs, the strength of open innovation is the ability to create an ecosystem in which people, organisations, and sectors can foster co-creation[70]. Open innovation is likely to play a key role in the developed economies over the next decade, combined with sustainable development goals (SDGs)[71], following the European Commission's policy approach to innovation, which promotes the Three Opens: Open Innovation, Open Science and Open to the World. Set as a priority by the European Commission, Open Innovation responds to the fact that "we live in a time when those without access to the traditional establishment are often the ones doing the most exciting work"[72]. The European Commission identifies "Open Science" as the development of a European Science Cloud and open access to scientific data generated by Horizon 2020 projects[73]. Connected to open innovation, open science is an umbrella

[64] European Commission - Directorate-General for Research and Innovation (2016). *Open Innovation, Open Science, Open to the World*, 2016. Luxembourg: Publications Office of the European Union. This publication also underlines that the concept of Open Innovation is "constantly evolving and is moving from linear, bilateral transactions and collaborations towards dynamic, networked, multi-collaborative innovation ecosystems" (p. 11).
[65] Murray, R., Caulier-Grice, J., & Mulgan, G. (2010). *The Open Book of Social Innovation*. London: The Young Foundation and Nesta, p. 38
[66] Laursen, K., & Salter, A. J. (2014). The paradox of openness: Appropriability, external search and collaboration. *Research Policy, 43*, pp. 867-878.
[67] Chesbrough, H. (2006). Open innovation: a new paradigm for understanding industrial innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), *Open innovation: Researching a New Paradigm*. Oxford University Press. Quoted in European Commission - Directorate-General for Research and Innovation (2016). *Open Innovation, Open Science, Open to the World*, p. 11.
[68] See: Carlos Moedas' speech "A new start for Europe: Opening up to an ERA of Innovation Conference", Brussels, 22 June 2015. In European Commission - Directorate-General for Research and Innovation (2016): 86.
[69] Bogers, M., Chesbrough, H., & Moedas, C. (2018): 7
[70] Bogers, M., Chesbrough, H., & Moedas, C. (2018): 10.
[71] Bogers, M., Chesbrough, H., & Moedas, C. (2018): 11.
[72] Carlos Moedas' speech "Lund Revisited: Next Steps in Tackling Societal Challenges", Lund, 4 December 2015. In European Commission - Directorate-General for Research and Innovation (2016): 97.
[73] Open Science encompasses several dimensions: open access, open data, open reproducible research; and it implies evaluation, guidelines, policies, tools that respond to some criteria such as: open peer review, open metrics and impact. For more information, see: https://www.fosteropenscience.eu/resources (date accessed: 17 May 2020).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

term encompassing multiple meanings: the democratic right to access publicly funded knowledge (open access to publications) as well as a better bridging of the divide between research and society (citizen science)[74].

If Open innovation is "now envisaged as a quadruple helix which brings civil society into the triple helix of government, industry and universities"[75], however, the way research and innovation intersects with the concept of quadruple helix and "its desire to embed civil society as a fourth strand remains little explored"[76]. Nevertheless, participation in Open Innovation processes is a key element:

> "Citizens, users and Civil Society Organisations have a central and transversal role to play in bringing innovation to the market. They create a demand for innovative products and services, they can fund and / or finance projects that are relevant to them, they can be at the source of innovative ideas worth spreading and scaling up and they can have a say in what research is meaningful to them and can impact their lives."[77]

Social Innovation

Social innovation could be generally defined as "novel or more effective practices that prove capable to tackle societal issues and are adopted and successfully utilised by individuals, groups and organisations concerned"[78]: these innovative practices are therefore "motivated by the goal of meeting a social need"[79]. Some authors identify this innovation approach as an intended change in social practices that addresses the most deep-rooted problems of society and contributes to overcoming concrete social problems and/or to satisfying the needs of specific societal actors[80]. This form of innovation allows for new or enhanced social relations in product or service systems, and answers needs and problems in a better way than what is provided by established practices. Focused on a set of issues that matter to a shared future, it could be anchored in the search of new needs, or necessity, or efficiency savings, or to new technologies adaptation, for instance[81]. Across the variety of approaches in social innovation, two different visions compete: on the one hand a "practical/organisational stream" that describes it more as an entrepreneurial process and, on the other hand, a stream describing it more as a process of changing social relations[82].

---

[74] Fecher, B., & Friesike, S. (2013). *Open Science: One Term, Five Schools of Thought*. Vol. 218. German Council for Social and Economic Data (RatSWD). These authors propose to consider five Open Sciences streams, depending on whether we focus on the technological architecutre, the accessibility of knowledge creation, the impact measurement, the (democratic) access to knowledge, or collaborative research.
[75] Owen R., & Pansera, M. (2019). Responsible Innovation and Responsible Research and Innovation. In D. Simon, et al. (Eds.). *Handbook on science and public policy*. Northampton, MA: Edward Elgar Pub, p. 39.
[76] Owen R., & Pansera, M. (2019): 43.
[77] European Commission - Directorate-General for Research and Innovation (2016): 17.
[78] Definition proposed by the Centre for Social Innovation (ZSI) based in Vienna. See: https://www.zsi.at/en/about_zsi/profile##Definition
[79] Mulgan G., Tucker, S., Ali, R., & Sanders, B. (2007). Social Innovation – What It Is, Why It Matters and how It Can be Accelerated. Skoll Centre for Social Entrepreneurship, Said Business School, University of Oxford, London, p. 8.
[80] Howaldt, J., & Schwarz, M. (2010): 31.
[81] Six different triggers of social innovation are identified in: Murray R., Caulier-Grice J., Mulgan G. (2010): 16-17.
[82] See: Moulaert, F., et al. (2017). *Social Innovation as a Trigger for Transformations:The Role of Research*. Luxembourg: Publications Office of the European Union.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Social innovation outcomes have to be socially-accepted and "ultimately institutionalized as new social practice or made routine"[83]. Social innovation differs from technical innovation, in that it is an immaterial intangible structure and innovation intervenes at the level of social practice[84]. It also differs from social change in that it is associated with intentional change, and its ultimate goal[85] is systemic change, involving new frameworks of architectures made up of many smaller innovations. Social innovation is addressed in Innovation Union and other policy initiatives, and has been incorporated into the Structural Funds Regulations to facilitate investment by member States through the European Regional Development Fund and the European Social Fund[86].

Based on social desirability, social innovation relies on participation as a process of mobilisation[87]. As such, it could be generally defined as "a process of collective creation in which the members of a certain collective unit learn, invent and lay out new rules for the social game of collaboration and of conflict or, in a word, a new social practice, and in this process they acquire the necessary cognitive, rational and organizational skills"[88]. The impact of social innovations is quite important both on national and regional economies, as they arise at local (citizen) level[89], while they also require professional innovation management[90].

Social innovation can refer to different types [91]:

- social *entrepreneurship*: the process of creating and growing a venture, either for-profit or non-profit, where the motivation of the entrepreneur is to address social challenges;
- social *intrapreneurship*: the process of addressing social challenges from inside established organisations;
- social *extrapreneurship*: the process of inter-organisational action that facilitates alternative combinations of ideas, people, places and resources to address social challenges.

In a broader sense, grassroots innovation, crowd-based innovation and open innovation could be considered as forms of social innovation, as an over-arching category.

Even though the innovation approaches that have been detailed in this section are only a non-exhaustive selection, they feature relevant science-society interactions. The connection to ethics of participation could be considered indirectly, in the quality and objectives of these interactions[92].

[83] Howaldt, J., Domanski, D., & Kaletka, C. (2016). Social Innovation: Towards a new innovation paradigm. *Revista De Administração Mackenzie*, *17*(6), p. 27.
[84] See Howaldt, J., & Schwarz, M. (2010).
[85] The process of social innovation from inception to impact could be analysed as a 6-step process: prompts, inspirations and diagnoses; proposals and ideas; prototyping and pilots; sustaining; scaling and diffusion; systemic change. See Murray R., Caulier-Grice J., Mulgan G. (2010): 12-13.
[86] European Commission (2013). A Guide to Social Innovation: in Khan, S. S., et al. (2016): 80.
[87] See Howaldt, J., Domanski, D., & Kaletka, C. (2016): 20-44.
[88] Crozier, M., & Friedberg, E. (1993). *Die Zwänge kollektiven Handelns – Über Macht und Organisation*. Frankfurt: Hain, p. 19. Quoted in Howaldt, J., Domanski, D., & Kaletka, C. (2016): 27.
[89] Howaldt, J., & Schwarz, M. (2010): 40.
[90] According to a study realised by Nesta, examining the conditions for the diffusion and dissemination of social innovations: see Mulgan, G., Ali, R., Halkett, R., & Sanders, B. (2007). *In and out of sync. The challenge of growing social innovations. Research report*. Quoted in J. Howaldt, & M. Schwarz (2010): 41.
[91] The following typology and definitions are developed in Tracey, P., & Stott, N. (2016): 53.
[92] The following chapter will provide criteria and ways to analyse these dimensions.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Ethical challenges in R&I governance

The aforementioned forms of innovation bear a number of features, individually, that relate to forms of participation, making each a different connection of science and technology developments with society. Choosing a specific form can only make sense when it relates to an identification of the purpose of the participation[93]. The overall goal that could be considered as a common denominator across all these forms is to enhance the democratic governance of research and innovation processes. Through the various emerging innovation approaches it can be identified that *participation* is primarily taken into account in recent innovation literature, with a growing concern on deliberations and participatory approaches[94].

Both on the side of EU governance of emerging technologies, as well as in the implementation of new innovation modes, there are ethical challenges of different nature. In the case of ethical challenges related to the implementation of new modes, they stem from the the way societal challenges are dealt with, the ways to prioritise these challenges, as well as the ways to address competitive interests. On the side of R&I governance, ethical features raise the challenge of reaching an efficient balance between innovation dynamics and regulatory constraints, while the specific challenges of emerging technologies raise issues regarding the internationalisation and the precautionary principle, which will be hereafter examined.

Concerns about the ethical impact of R&I

Significant public and philosophical concerns on ethical, social and economic impacts of research are arising in many research areas that could be identified as key sectors in terms of ethical/societal challenges (e.g. brain research, Artificial Intelligence, robotics) and emerging technologies (e.g. CRISPR/Cas9, etc.). Addressing these concerns, publicly funded research and innovation (hereinafter R&I) is confronted with the internationalisation of the debate, with regulation discrepancies, ethical divides, and the related intricacies of leverage of publicly funded R&I across countries. This debate raises the question of EU/non EU relations, as the hindrance of regulations may result in the relocation of R&I activities in geographical areas not covered by applicable laws. Beneath this issue lies the already existing over-regulatory spectrum of R&I at EU level: a decade ago, the European Commission Expert Group on Science and Governance had stated

> "there has been a shift towards the legalisation of ethics in the governance of research, which may undermine the processes of ethics in society […] The Expert Group suggests that there has been a shift to non-binding governance or 'soft law' – codes of practice, guidance, and reporting measures"[95].

As ethics processes exceed the legalisation of ethics, the reinforcement of this latter may hinder R&I ethics and the possibility of ethics of participation. In the context of the internationalisation of R&I, the governance of emerging technologies may find efficient tools on the side of ethics, so as to better tackle such issues. Similarly, R&I actors can rely on ethics as they provide adapted guidance on viable pathways, encompassing both legal compliance and public acceptance.

[93] This dimension will be examined in the next chapter.
[94] Participation as such will be examined in detail in the next chapter.
[95] European Commission (2010). *Textbook on ethics in research*, p. 147.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Precautionary principle

As a means to avoid irreversible and/or large scale damage and to ensure security despite high scientific uncertainty, the precautionary principle is applied either in the context of scientific controversy or in the acquisition of new knowledge. The framing of the precautionary principle is a pivotal question in research and innovation ethics, intervening either upon existing regulations and laws or beforehand, where regulations and laws do not exist yet[96]. First embedded in European policy in the 1992 Maastricht Treaty for environmental policy, it has expanded to other fields of policy[97] under EU law, where it intervenes as "provisional risk management measures", that is before adverse effects are obvious. This principle is used in public decision making situations "where following an assessment of the available scientific information, there are reasonable grounds for concern for the possibility of adverse effects on the environment or human health, but scientific uncertainty persists"[98]. The principle can be applied in cases: i) of potential adverse impacts on the environment or human health with serious consequences; ii) when governmental action should be taken in regards to controversies/lack of/insufficient scientific knowledge[99]. This principle applies mainly within EU product authorization procedures, as an incentive to make safe and sustainable products[100]. Abuses of the principle can happen, such as disguised protectionist measures in trade sector can happen, which led the European Commission to set up guidelines for the precautionary principle's application[101].

Sometimes considered as a term for responsibility, the precautionary principle is fundamentally of anticipatory nature and "does not allow uncertainty on the scientific side of assessment to be used as an excuse when serious *presumptions* of significant and/or irreversible damages have been made"[102]. The diversity of cases highlights the importance of an assessment of the state of affairs in science and the type of uncertainties involved, since "uncertainty" can relate to several cases[103]:

- in dealing with hypothetical effects and imaginary risk, which require independent scientific evaluation, both transparent and publicly accessible;
- when facing a defined and quantified risk, which implies that policy makers can respond with a normal risk management approach;
- in situations in which one cannot fully rely on the scientific information system as such when it comes to the estimation of possible adverse effects, which requires a precautionary approach;
- when particular cause-effect relationships cannot be scientifically established, while at the same time a precautionary approach is required for adverse effects that are known.

Being provisional measures, precautionary measures are lifted when scientific knowledge has made progression to the point where former uncertainties (risk and adverse effects) turn into defined consensual levels of harm and damage[104], even though it can sometimes be seen as a hindrance to

[96] Von Schomberg, R. (2012a). The Precautionary Principle: Its Use Within Hard and Soft Law. *European Journal of Risk Regulation*, *3*(2), pp. 147-156.
[97] Von Schomberg, R. (2012a): 147.
[98] Von Schomberg, R. (2012a): 147.
[99] Von Schomberg, R. (2012a): 148.
[100] Von Schomberg, R. (2013): 67.
[101] Von Schomberg, R. (2012a): 149.
[102] Reber, B. (2018). RRI as the inheritor of deliberative democracy and precautionary principle. *Journal of Responsible Innovation: Responsible Innovation and Brain, 5*(1), p. 40.
[103] This analysis can be found in: Von Schomberg, R. (2012a): 151-152.
[104] Von Schomberg, R. (2012a): 156.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

innovation[105]. The risk of too early or too late government reaction to emerging technologies can imply failing to address its nature or missing the opportunity to intervene[106]. Other limitations can be found in prevailing institutional preference, when current practice is taken as the default norm amongst several alternatives[107], which does not encompass proper assessment of future developments. In regards to normative standards, precautionary regulation implies that the standards remain open for discussion, concerning the societal acceptability of R&I outcomes. By doing so, precautionary frameworks facilitate in particular deliberation at the science/policy/society interfaces to which risk management is fully connected[108].

The impossibility of defining fixed standards and operating with open (transformable) standards is an inherently deliberative process and also a positive feature of a regulatory framework in democratic societies: the challenge is to connect these standards with the discussion within scientific committees, the risk management level and society at large[109]. The precautionary principle is deliberative in its nature, and implies deliberation on normative dimensions decided upon when the principle enters public policy[110].

Ethics and responsibility in innovation

Responsibility in innovation

Ethics in R&I could be broadly defined as "common platform for deliberation and discussion of values in society, that is based on perceptions of right and wrong, is influenced by cultural norms, and aims at informing policy-making".[111] Ethical analysis encompasses ethical aspects (ethical questions or moral dilemma at stake); ethical questions *per se* (conformity with ethical standards); ethical issues; and ethical dilemmas when moral principles are conflicting: the evaluation of right or wrong is based on ethical/moral values (ideals), or principles and norms that define standards – identified as "ethical principles" on a general level[112]. Among "ethical principles" are principles concerning individual rights and conditions deserving respect; principles concerning benefits and harms; fairness principles; and virtues (good human character traits)[113].

In the literature, key qualities of ethics in the context of R&I are:

- openness towards stakeholders and the public[114];
- public participation[115] (including information, consultation of, and with public deliberation);

[105] The opposite is the "proactionary principle" promoted by transhumanists, amongst others, and which suggests regulations should lower in favour of innovators. See: Stilgoe, J. (2013). [Foreword] Why Responsible Innovation? In R. Owen, M. Heintz, & J. R. Bessant (Eds.): XIII.
[106] Von Schomberg, R. (2012a): 154.
[107] Von Schomberg, R. (2012a): 154.
[108] Von Schomberg, R. (2012a): 156. See also: Reber, B. (2016). *Precautionary Principle, Pluralism and Deliberation: Science and Ethics*. London/New York: ISTE/Wiley.
[109] See Von Schomberg, R. (2012a): 156.
[110] Von Schomberg, R. (2012a): 147.
[111] Brom, F. W. A., Chaturvedi, S., Ladikas, M., & Zhang, W. (2015). Institutionalizing Ethical Debates in Science, Technology, and Innovation Policy: A Comparison of Europe, India and China. In M. Ladikas, S. Chaturvedi, Y. Zhao, & D. Stemerding (Eds.), *Science and Technology Governance and Ethics* (pp. 9–23). Cham/Heidelberg/New York/Dordrecht/London: Springer.
[112] Shelley-Egan, C., Brey, P., et al. (2015): 21.
[113] Shelley-Egan, C., Brey, P., et al. (2015): 21-22.
[114] This could also be perceived as a participation criterion.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- transparency and accountability of processes;
- thematic openness in terms of which questions can be raised;
- systematic argumentation in terms of a priority of arguing over (political) bargaining (this also includes scholarly integrity).

Considering the complexity and unpredictability of innovation environments, the concept of responsibility could be considered as a key dimension in innovation[116], in that it ensures innovations bring benefits only. Responsible innovation stems from the radical uncertainty about the future[117]: on the policy-making level, responsibility could be considered here as the frontier of existing research and innovation ethics with a pluralistic, evolving and reflexing field of reflection. Given the future-oriented nature of innovation and its transformative power, the notion of responsibility applied to innovation involves the responsibility in the future it creates, although this presents conceptual and practical difficulties[118]. This foresight issue is a problem of knowledge that is linked to the limits of predictability between labs and real-world implementation[119], the unpredictability of interference effects[120], and is also, ultimately, a moral problem of capacity is linked to human finitude[121] :

> "science is often badly suited to understanding the consequences of the actions it enables us to perform, particularly when they introduce novel entities (like nuclear reactors, genetically-modified organisms (GMOs), and so on) to the world, because important aspects of how these function in the world may not be covered by the state of the art."[122].

Responsibility bears an ethical stance that can either refer to the legal, moral or social sphere. Ethics and morals are often considered as interchangeable, and in either case different levels can be identified, leading to the distinction between applied ethics, normative ethics (moral theories), and meta-ethics, despite their permeability[123]. Also, in addition to the pluralism of ethical levels, the pluralism of moral theories entails that although deontologism prevails in our current context, there are several rational paths can be followed through ethical pluralism in regards to ethics assessment (in justification context):

- types of entities assessed from a normative ethics perspective;
- normative factors;
- foundations (foundational normative theories).

Conflicting factors or hybrid forms of reasoning pave the way towards the surpassing of regulations (as in ethics review/assessment) and deontologist ethics towards a inevitable broader scope, pluralistic, implying an enhancement of reflexivity and responsibility[124]. This latter is notably polysemic, and its historical roots are to be found in imputability and accountability[125]: responsibility derives from

---

[115] "Participation" could act as an overarching notion embracing all these ethical dimensions.
[116] Bessant, J. (2013). Innovation in the Twenty-First Century. In R. Owen, M. Heintz, & J. R. Bessant (Eds.): 2.
[117] Grinbaum, A., & Groves, C. (2013). What is "Responsible" about Responsible Innovation? Understanding the Ethical Issues. In R. Owen, M. Heintz, & J. R. Bessant (Eds.): 128.
[118] Grinbaum, A., & Groves, C. (2013): 124.
[119] Grinbaum, A., & Groves, C. (2013): 124.
[120] Interference effects can also be extended in space and time: Grinbaum, A., & Groves, C. (2013): 125-126.
[121] Grinbaum, A., & Groves, C. (2013): 124.
[122] Grinbaum, A., Groves, C. (2013): 124.
[123] Pellé, S., & Reber, B. (2016). *From Ethical Review to Responsible Research and Innovation*. Hoboken: ISTE/ John Wiley & Sons, pp. 30-31.
[124] See the in-depth analysis provided on the law/ethics divide, and the pluralism of ethical theories: in Pellé, S., & Reber, B. (2016): 31 *sqq*.
[125] Grinbaum, A., & Groves, C. (2013): 120.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

the Latin term *respondere* (to respond), which can be identified in ten different situations or understandings, which are: cause; blameworthiness; liability; accountability; task (role); authority; capacity; obligation; responsiveness; virtue (care).

The various meanings of responsibility can be divided between negative and positive interpretations, the first category being notably focused on the individual and causal chains and imputability, whereas the second one has a prospective element, and the future being the horizon which determines morally desirable goals[126]. Among possible meanings of responsibility, the first relevant one appears to be the individualist and consequentialist[127] concept of responsibility that prevails, implying that moral agents anticipate the consequences of their actions[128]: "rather than duties being pre-ordained, it is up to the individual moral subject to take responsibility for deciding what s/he should do, and to prepare to be accountable later for the consequences "[129]. In that sense, "taking responsibility means to exercise foresight and to increase one's knowledge about the world and how one's actions might interact with and alter it [130]". Ignorance at the time of the action does not mean that there is no moral or legal responsibility[131]. Amongst all these interpretations of responsibility, those pertaining to emerging technologies/forms of innovation are interpretations based on a normative appreciation of the good: responsibility as moral obligation, responsibility as responsiveness; responsibility as virtue (as care; as an obligation to be held accountable).

Responsible innovation "starts from an understanding of innovation as a system, a web of myriad actors, rather than a pipe" [132]. This complex web includes users, scientists, entrepreneurs, governments, and others[133], where there is an endorsement of the relevant public values during the innovation process [134]. Responsible innovation "means taking responsibility in ways that are, respectively, quasi-parental and collectively political in nature"[135]. On the opposite side, irresponsible innovation can occur in contexts where the importance of the innovation's societal context has been miscalculated or when unresolved conflicts have taken place during the innovation process, which usually involves several actors[136]. This can result in four types of irresponsible innovations:[137]

- technology push[138];
- neglect of fundamental ethical principles;
- policy pull[139];
- lack of precautionary measures and technology foresight.

[126] Pellé, S., & Reber, B. (2016): 70-72.
[127] The ideal consequentialist moral agent in this context might be Jeremy Bentham's utilitarian subject, who considers if each action serves the aggregate happiness of society: see Grinbaum, A., & Groves, C. (2013): 122.
[128] Grinbaum, A., & Groves, C. (2013): 122.
[129] Grinbaum, A., & Groves, C. (2013): 121.
[130] Grinbaum, A., & Groves, C. (2013): 122.
[131] Grinbaum, A., & Groves, C. (2013): 123.
[132] Stilgoe, J. (2013): XV.
[133] Stilgoe, J. (2013): XV.
[134] Taebi, B., Correljé, A., Cuppen, E., et al. (2014). Responsible innovation as an endorsement of public values: the need for interdisciplinary research. *Journal of Responsible Innovation, 1*(1), p. 118.
[135] Grinbaum, A., Groves, C. (2013): 134.
[136] Von Schomberg, R. (2013): 60.
[137] Von Schomberg, R. (2013): 60-63.
[138] In cases where substantial dissent among major stakeholders does not allow responsible technological development and one company takes the lead with a technology push. See: Von Schomberg, R. (2013): 61.
[139] When policy makers integrate new technologies/innovations beyond their technical feasibility, proper technology assessment and public scrutiny: see Von Schomberg, R. (2013): 62.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

As noted above, responsibility in and of itself has a wide array of approaches. As part of EU-funded projects, ethical research identifies the ethical issues in research projects in interaction with the scientists and can be either within parallel or embedded research, the latter implying a closer cooperation with the researchers and the advantage of having a commitment from both the ethicists to the project and from other project members to the ethical research as part of the project[140]. Even though a moral/ethical expertise is debatable, ethicists provide experience in identifying ethical issues and usually have some formal education in ethics that provides a specialisation useful to guide research: ethicists[141] have access to all relevant material and information and help to broaden the discussion and reflect on the consequences of the choices during decision-making[142].

Besides, the moment when ethics intervene determines the very possibility to have an impact: as ethical guidance could be ineffective once technology has been developed or introduced in society, this urges for anticipation and upstream engagement[143]. Finding the right momentum is a problem known as the Collingridge Dilemma:

> "at the time when we can still make changes to the technology, one lacks the information about effects which only the introduction and use of the technology in society could provide, but at the moment that the technology has been introduced in society and information about its effects and morally salient characteristics starts to become available, it is often very hard to still make changes. We should aim to have results of ethical discussions available at a moment when it can still be used to inform the design, implementation or utilization decisions."[144]

While it seems clear that responsible innovation should be directed at socially desirable and socially acceptable ends although both in concept and practice its definition remains unclear[145].

Ethics and Technology assessment

The field of ethics has seen a significant development in the past century. From a predominantly meta-ethical enterprise in the beginning of the twentieth century, the focus in the sixties gradually shifted to more applied forms of ethics, of which medical ethics is probably the most prominent one. In these early years of applied ethics, the focus was still mainly on the application of ethical theories to practical problems, for instance deontology and utilitarianism[146]. Since the 1990s, ethics of technology has emerged as one of the important branches of applied ethics. Within this field, ethical research is increasingly carried out as so-called "ethical parallel research": the idea behind this type of research is that ethical investigations are carried out parallel to, and in close cooperation with, a

[140] Van Gorp, A., & Van der Molen, S. (2011). Parallel, Embedded or Just Part of the Team: Ethicists Cooperating Within a European Security Research Project. *Science and Engineering Ethics*, *17*(1), p. 42.
[141] Ethicists can be similar to consultants, or researchers who are conducting research within the considered project: Van Gorp, A., & Van der Molen, S. (2011): 41.
[142] Van Gorp, A., & Van der Molen, S. (2011): 40.
[143] Upstream engagement will be examined in the section on new trends in innovation approaches and configurations.
[144] Van den Hoven, J. (2014): Responsible Innovation: A New Look at Technology and Ethics. In M. J. Van den Hoven, N. Doorn, T. Swierstra, B. Koops & H. Romijn (Eds.), *Responsible Innovation 1: Innovative Solutions for Global Issues*. Dordrecht: Springer, pp. 4-7.
[145] Owen, R., Stilgoe, J., Macnaghten P., et al. (2013). A Framework for Responsible Innovation. In R. Owen, M. Heintz, & J. R. Bessant (Eds.): 27.
[146] Manders-Huits, N., & Van den Hoven, M. J. (2009). The moral relevance of technological artifacts. In P. Sollie, & M. Düwell (Eds.), *Evaluating New Technologies.* Dordrecht: Springer.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

specific technological R&D project. The ethicists provided skills that scientists, researchers or innovators did not have: this interaction allowed the ethicists to co-shape new technological developments. Whereas the pre-World War II management was aimed at increasing the pace of technology development and the early TA attempts at inhibiting the pace, the third generation TA attempts are aimed at informing the direction of technology development[147].

With the growing complexity of issues of participation and governance in mid-20th century, science and technology policy evolved towards technology assessment, which emphasized research on the "social, ethical, and environmental impacts" of scientific and technological change[148], in response to the growing societal awareness on undesirable consequences[149] that are bind to technological offerings, thus offering guidance for funding and regulatory activities[150]. TA started with statements about the future performance of technologies, thus assessing their impact on society[151], and during five decades has provided a set of philosophies, practices and approaches. Impact assessment reflected the belief that mapping consequences of future technology on all relevant dimensions was feasible and also useful, as it was supported by probabilistic methods[152].

Thanks to its anticipatory nature, TA served for forecasting and R&D governance by helping decision-making about which technologies should be funded for development or how they might be regulated. TA has put experts at the forefront, as this impact assessment was exclusively expert-led, though TA assumptions have been criticised on the level of predictability (considering non-linear and indeterminate processes of research and innovation) and on the legitimacy of experts' knowledge in decision-making, when several values are at stake[153]. Several forms of TA have been developed, categorised in the literature through distinct features, which are mainly: parliamentary TA; expert TA; participatory TA; constructive TA; discursive TA.

Public concern over the impact of emerging technologies has been traditionally addressed both "downstream" of technological development (e.g. by regulations and market mechanisms), as well as "upstream" (e.g. by research policy and technology assessment)[154]. However, TA methods became progressively more participatory and constructive, following the Dutch Constructive TA (CTA), with a broader array of participants, seeking to influence both upstream decisions and technological design decisions as well[155]. The inclusion of stakeholders in TA addressed the issue of experts' exclusive judgement and decisions in policies, in order to reach a more democratic innovation policy process[156]. Public upstream engagement came along as a new form focusing on more interactive approaches to science-technology-society relations, through dialogue and other engagement practices. It aims at creating a communication loop, from the public to policy makers, scientists and engineers[157]: an

[147] Van de Poel, I. R. (2008). How should we do nanoethics? A network approach for discerning ethical issues in nanotechnology. *NanoEthics*, *2*(1), pp. 29-30; quoted in Doorn, N., & Nihlén Fahlquist, J.A (2010). Responsibility in engineering: Towards a new role for engineering ethicists. *Bulletin of Science, Technology & Society*, *30*, p. 225.
[148] Shrader-Frechette, K. (1995). Technology assessment. In W. Reich (Ed.), *Encyclopedia of bioethics,* (2nd rev. ed.), *5*, pp. 2484-2490. New York: Macmillan. Quoted in Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 487.
[149] Van Lente, H., et al. (2017). Responsible innovation as a critique of technology assessment. *Journal of Responsible Innovation, 4*(2), p. 256.
[150] Shader-Frechette, K. S. (1995): 487.
[151] Van Lente, H., et al. (2017): 254.
[152] Risk calculations and decision theory are part of them; see Van Lente, H., et al. (2017): 254.
[153] Van Lente, H., et al. (2017): 254.
[154] Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 485-496.
[155] Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 487.
[156] Van Lente, H., et al. (2017): 254-255.
[157] Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 488.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

information loop between science (and policy making) and the public, such as public participation model promoted by the Danish Board of Technology and its consensus conferences[158]. Public engagement methods imply the participation of scientists and engineers as citizens and a distinction could be made between upstream engagement techniques aimed at policy-making processes, from midstream engagement techniques aimed more explicitly at influencing the self-governance of R&D processes[159].

A number of science and technology projects (e.g. in information technology and nanotechnology) have engaged ethical, legal, and social aspects/implications (ELSA/ELSI) in their work in order to help ensure that the production of knowledge and technology develops in accordance with social concerns and values. Similar to TA and ELSI programmes, upstream approaches emphasise the early consideration of sociotechnical implication[160] that can intervene from the outset, as real-time technology assessment, as an observation mechanism.

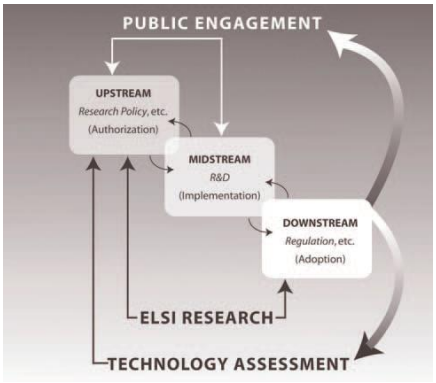

Figure 1: Science and Technology Governance Stages[161] [Retrieved from: Fisher, E., et al. (2006)]

Further to TA and ELSI, methodologies for real-time TA have been developed, bringing elements lacking from technology assessment, in order to lead to an inherently reflexive R&D enterprise, where the social science activities are fully integrated with the core science agenda[162]. This can be achieved through[163]:

- studying past examples of transformational innovations to anticipate future interactions between society and new technologies;
- mapping the resources and capabilities of the relevant innovation enterprise to identify key R&D trends, major participants and their roles, and organisational structures and relations;
- eliciting and monitoring changing knowledge, perceptions, and attitudes among stakeholders;
- engaging in analytical and participatory assessment of potential societal impacts, for informed societal response to innovation (from scientists to the general public).[164]

In addition to the evolution from hard impacts towards soft ones[165], the journey from TA to CTA and then RRI[166] has led to an internal evolution of the focus and goal of ethical assessment, and its resources and legitimacy: the former TA focused on impact, and was drawing from experts' knowledge, while its political legitimation was anchored in science mobilisation. CTA's focus on inclusion and design is rooted on publics/citizens knowledge (or TA-agents), and its political

[158] Practised since the 1980s. See Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 488.
[159] Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 490-494.
[160] Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 489.
[161] Figure from Fisher, E., Mahajan, R. L., Mitcham, C. (2006): 491.
[162] Guston, D. H., & Sarewitz, D. (2002): 93-109.
[163] These TA approaches have been identified as such in: Guston, D. H., & Sarewitz, D. (2002): 100 *sqq*.
[164] The last two approaches have some higher degree of participation.
[165] Van Lente, H., et al. (2017): 257.
[166] Responsible Research and Innovation (RRI) will be examined in the next section.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

legitimation lies in serving democracy, and improving technology for societal reasons. However, all three forms - TA, CTA and RRI - have each been criticised for their possible biases[167]: TA in the marginalisation of relevant aspects; CTA for the intricacies of stakeholders' interests; while the next feature, RRI, is not immune to naive instrumentalisation[168].

RRI and its roots in ethics of technology

Another strand of the ethics and technology linkage[169] is the one that has been developed through Responsible Research and Innovation (RRI) programmes. Rooted in ethics of technology, responsible innovation has been promoted by the EU, referring primarily to the intention of making innovation consistent to important public and moral values by including these values at all stages of innovation: as a collective duty of care, on both the desired outcomes of innovation and also the way to make its pathways responsive in a context of uncertainty[170]. Connected to RRI, Responsible Innovation (RI) is a parallel discourse[171], as both of them

> "at times variously intersect with, reinforce or challenge existing de facto narratives and norms of responsibility as these relate to scientific research, development and innovation (e.g. those relating to academic conduct and research integrity)"[172].

Both RRI and RI are interpretively flexible and politically malleable[173]. As a policy discourse that emerged from the European Commission, RRI is rooted in the European Commission's Science in Society programme, and shares much with the discourse of RI, which has in contrast emerged largely from academic roots[174] and which remains mostly an ideal, a guiding principle, unresolved in terms of its political, institutional and normative practices[175]. As an open question, RI "asks how we can and should meaningfully engage as a society with the futures innovation seeks to create, futures that are being created unintentionally or by design."[176].

RRI could be generally defined as:

> "a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable

[167] These are identified as "perversities" by some authors: see Van Lente, H., et al. (2017): 255.
[168] This analysis can be found in: Van Lente, H., et al. (2017): 255-256.
[169] Further to the aforementioned forms in this chapter, and apart from RRI programmes, participatory technological assessment is also a major feature, which will be examined in the second part of this deliverable, due to its main connection to participatory approaches in innovation.
[170] Owen, R., Macnaghten, P., Stilgoe, J. (2012). Responsible research and innovation: From science in society to science for society, with society. *Science and Public Policy*, *39*(6), pp. 757-758.
[171] It could be argued that RRI offers a breakdown of responsibility in several (external) dimensions, and as such does not fully cover the notion of responsibility in and of itself: see Reber, B. (2019). Taking moral responsibility seriously to foster Responsible Research and Innovation. In Gianni, R., Pearson, J., & Reber, B. (Eds.), *Responsible Research and Innovation: from concepts to practices* (pp. 50-73). Oxford: Routledge.
[172] Owen R., & Pansera, M. (2019): 26.
[173] Owen R., & Pansera, M. (2019): 28.
[174] Owen R., & Pansera, M. (2019): 26.
[175] Owen R., & Pansera, M. (2019): 27.
[176] Owen R., & Pansera, M. (2019): 28.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

> products (in order to allow a proper embedding of scientific and technological advances in our society)."[177]

RRI aims at research and innovation processes that are more responsive and adaptive to societal grand challenges and requires broader foresight and impact assessments[178], without having an innovation strategy driven on its normative side by market demand[179]. As such, it can be considered as a strategy of stakeholders to better anticipate research and innovation outcomes aimed at the "grand challenges" of our time, for which they share responsibility[180]. RRI's focus on outcomes is nurtured by ethics, and aims at aligning to aspirational notions, which seals its legitimacy. It aims at normative anchor points such as, notably:[181] ethical acceptance (compliance with fundamental values); sustainability; social desirability.

The roots of RRI approach go back to research in applied ethics and ethics of technology, more particularly. The intersection of ethics with technological innovations and applied science and engineering aimed at finding practical innovative solutions for important social and global problems that could shift public policy and decision making[182]. In applied ethics of technology research programmes, participation (by stakeholders[183]) was considered as key element: input from civil society, consumer organisations, NGOs, decision makers and politicians, professionals and market parties, would ensure the connection with real world matters[184]. Feedback loops provided by "valorization panels" for instance would be sought after during research programmes, confirming the position that:

> "In order to be relevant to thinking about innovation and allow interested and affected parties take part in discussion about technology, 'technology' should be construed in a broad sense, in terms of 'systems of socio-technical systems' and it should be acknowledged that the social context of technology, the regulatory frameworks, incentive structures, institutional arrangements and governance are of equal importance to understanding technology as the engineering aspects."[185]

With Horizon 2020 research strategy, the concept of RRI found its most clear policy expression, one that considers ethical, legal and policy issues early in the innovation chain, aligning research and innovation goals of the European Commission with broader societal needs through Horizon 2020 Societal Challenges themes[186] :

> "Responsible Research and Innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and

[177] Von Schomberg, R. (2013): 63. However, the notion of transparency in this definition is arguably limited, as in case of of collaboration with private enterprises that can protect some of their knowledge in view of investment and future developments as it is explained in: Pellé, S., & Reber, B. (2016): 44.
[178] Von Schomberg, R. (2013): 51.
[179] See René von Schomberg's analysis, who describes that "the normative dimension of what counts as an 'improvement' is decided by market mechanisms" and that "posive impacts of innovations under public research and innovation policy schemes are solely justified in purely economic terms": Von Schomberg, R. (2013): 54.
[180] Von Schomberg, R. (2013): 51.
[181] Von Schomberg, R. (2013): 64.
[182] Van den Hoven, J. (2014): 4-7.
[183] Representatives from the innovation and technology sector.
[184] Van den Hoven, J. (2014): 4-7.
[185] Van den Hoven, J. (2014): 4-7.
[186] European Commission (2013). *The EU Framework Programme for Research and Innovation*: quoted in Khan, S. S., et al. (2016): 80.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

> innovation, with the aim to foster the design of inclusive and sustainable research and innovation. It implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society."[187]

In its current framing in Horizon 2020, RRI includes six policy keys, one of which explicitly concerns ethics, another one public engagement[188]. The intrinsic value of ethics seems to contrast with their identification as a "key" of RRI: limitations have been reported on these keys, such as the fact they are isolated themes, and do not substantively engage with innovation systems[189].

As a concept, RRI has had so far a substantial path throughout national and European policy, with a main focus on societal directions that appear to be desirable, "stressing the ethical aspect of new technologies: they do not merely produce new risks and benefits, they alter the symbolic or moral order as well", which leads to "the idea that reflection on research and innovation should incorporate normative ideals"[190], as it embraces a broader set of values and focuses on morally ambiguous situations and moral controversies[191]. Early engagement of stakeholders in research and innovation has been progressively acknowledged in the area of policy making. The idea behind RRI is that societal actors and innovators become mutually responsive to each other[192], thereby co-creating solutions for which they share responsibility. The notion of responsibility plays a crucial role in RRI as it establishes the link between participatory technological assessment and ethical assessment, two domains from which RRI inherits[193].

The various dimensions of RRI reflect distinctive perspectives - and discourses - for[194]:

- Policy Makers: this perspective mentions "Address grand societal challenges", "Increase public trust" and "Build a responsible future";
- Researchers: this perspective mentions "Incorporate other views", "Evaluate the impact", "Anticipate, reflect, engage, act", "Share the process, make it worthy" and "Share your responsibility";

[187] See European Commission [online]: https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation (date accessed: 17 May 2020).
[188] The six policy keys of RRI as set by the European Commission are: ethics, gender equality, governance, open access, public engagement, science education.
[189] Owen, R., & Pansera, M. (2019): 27.
[190] Van Lente, H., et al. (2017): 255.
[191] At the same time, RRI takes stock of soft impacts, which pertain to private sphere and individual choice matters. Van Lente, H., et al. (2017): 256; 257.
[192] Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society). See: Von Schomberg, R. (2012b). Prospects for technology assessment in a framework of responsible research and innovation. In M. Dusseldorp, & R. Beecroft (Eds.), *Technikfolgen Abschätzen Lehren*. Wiesbaden: VS Verlag fur Sozialwissenschaften, p. 50.
[193] Reber, B. (2018): 38-64.
[194] According to the perspectives outlined in the SwafS-programme is the RRI Tools community project for research, technological development and demonstration (rri-tools.eu), funded by the European Union's Seventh Framework Programme. In this projects, six different perspectives on RRI are identified, each stressing different aspects of RRI.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- Business and Industry: this perspective mentions “Invite all relevant actors”, “Boost socially acceptable innovation”, “Find new business opportunities”, “Reinforce your customers’ trust”, “Add value, secure your future”;
- Education Community: this perspective mentions “Responsibility is a learnt behaviour”, “Stimulate curiosity”, “Contextualize science“ and “Empower future generations”;
- Civil Society Organisations and RRI for citizens: Both deal with “Your voice and ideas are important”, “Co-create the future”, “Be informed, be critical” and “the media are key actors”.

RRI is usually associated with discourses on democratic governance, responsiveness (reflection and deliberation), responsibility[195]. The second one refers to the integration and institutionalisation of established mechanisms of reflection, anticipation, and inclusive deliberation in and around the processes of research and innovation: this answers to the need of inclusive deliberation processes of dialogue, engagement and debate, inviting and listening to wider perspectives from publics and diverse stakeholders[196]. The main specificity of RRI in regards with other governance concepts lies in its emphasis on deliberation about the purposes and motivations, not only products, of innovation and on responsiveness. Participation seems key in this RRI approach, as it aims at involving all stakeholders in research and innovation processes from an early stage on. While RRI could be considered as an improvement of TA, by giving weight to ethical deliberation, and taking stock of the ambiguous consultation of stakeholders, RRI still has room for improvement if we consider some criticisms that have been addressed.

Innovation governance goes beyond risk governance and in the field of responsible innovation, it implies that processes and outcomes are taken into account[197]. Amongst regulatory frameworks, Codes of Conduct have the advantage of flexibility, which can prove useful when the ground for legislative action is still uncertain, while they also help identify knowledge gaps and target societal objectives that can be useful for research funds[198].

Policies and Regulations on ethics of innovation

Main regulations on research ethics & research integrity

EU regulations further the ethical issues taken into consideration in EU funding procedures, and policy, and complete a list of former international regulations on research ethics and research integrity. Regulations intervene in the aforementioned areas of concerns:

> “Applying established ethical principles and legislation to research involving children, patients, vulnerable populations; use of human embryonic stem cells; privacy and data protection issues; research on animals and non-human primates. Also includes established principles of research integrity (data fabrication, falsification, plagiarism or other research misconduct).”[199]

[195] Although this can be called into question - see: Reber, B. (2018): 38-64.
[196] Owen, R., Macnaghten, P., Stilgoe, J. (2012): 755.
[197] Von Schomberg, R. (2013): 67.
[198] Von Schomberg, R. (2013): 68.
[199] Owen R., & Pansera, M. (2019): 38.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 872441.

The two founding legal texts on research ethics address the issue – and set the basis - of the protection of research subjects:

- The Nuremberg Code, formulated in 1947 in Nuremberg, Germany, by the American judges of the Nuremberg Tribunal, in the aftermath of World War II. Rooted in the shocking revelations of German and Japanese medical experimentation on human subjects, the Nuremberg Code was designed on the notion of free and informed consent for all human participants in biomedical research and sets ten fundamental principles, on consent, proportionality, necessity and the right to withdraw;
- The Helsinki Declaration of 1964[200] on research ethics, that sets ethical principles for the conduct of medical research on human subjects (protection of research subjects: the well-being of the individual research subject must take precedence over all other interests).

These two texts are followed by other international normative instruments - mostly on research ethics - mainly the following ones:

- The Convention on Human Rights and Biomedicine or the Oviedo Convention, adopted by the Ministers of the Council of Europe in 1996, which sets standards[201] for all members of the Council of Europe on ethical issues raised by research within the framework of the protection of human rights;
- UNESCO's Universal Declaration on Bioethics and Human Rights;
- Council for International Organizations of Medical Sciences' (CIOMS) International Ethical Guidelines for Biomedical Research Involving Human Subjects;
- European Charter of Fundamental Rights (articles referring to research integrity and to data protection).

Many ethical issues are covered by legal instruments in the EU, however research ethics go beyond legal frameworks and require independent evaluation at all stages to reach responsible research and innovation. Part of this goal is ensured by Ethics Review procedure organised by the European Commission. Also, there is a strong connection between research ethics and human rights, with reciprocity and overlaps: within the European regulatory framework, research ethics are based on the commitment to human rights, a compliance which is relevant for all policy domains.

Current legal literature on ethics of research and innovation is both international codes of conduct and voluntary codes, at international or EU level, which could be classified by geographical scope[202] or thematically, some of them being general or covering specific topics in ethics of research and innovation.

Research integrity (general)

A number of integrity codes in research have been issued at EU level: they cover the general principles on research integrity and are furthered by voluntary codes (legally non-binding) issued by several European universities. The *European Code of Conduct for Research Integrity*[203], compiled by All

[200] Revised in 1975.
[201] Including standards for the use of the human genome and research on human embryos.
[202] This is for instance the presentation mode of the ENERI project, a EU-funded database for all codes, guidelines and recommendations, both national and international, covering all topics of research ethics and research integrity: http://eneri.eu/codes-of-conduct/
[203] All European Academies (ALLEA) (2017). *The European Code of Conduct for Research Integrity* (revised edition). Berlin: ALLEA. This code of conduct was published in 2011, with a revised edition in 2017 (considered here)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

European Academies (ALLEA) in 2011, sets the general principles on research integrity, informing national research policies in Europe and applying to research in all scientific and scholarly fields, and both in publicly funded and private research, as a framework for self-regulation[204]. Main principles (reliability, honesty, respect and accountability) are followed by good research practices, failing to which being perceived as "violations of research integrity". These principles also serve to justify research funding as such becomes a criterion for the project's compliance with the agreed framework. However, ethical principles come with a set of intricacies: as for accountability for instance - an upstream problem, prior to the research activity -, which lies in the grounds that serve to prioritise funding, and that responds either to scientific policies or even politics (societal challenges)[205]. Downstream of the research process, developments can bring about unexpected collateral effects or controversies[206]. Following these guidelines, several national non-binding codes of conduct have emerged, either with a sectoral focus or a cross-cutting perspective, following the self-regulation principle of the *European Code of Conduct for Research Integrity*[207].

Covering the needs of information society, data protection is covered by general legal texts on research integrity[208] and specifically by the EU's Regulation 2016/679 -*General Data Protection Regulation* (GDPR). Considered by the European Commission as both a central issue for research ethics in Europe and a fundamental right, data protection is linked to autonomy and human dignity[209]. This main legal source regarding data protection is grounded on founding texts of the European Union – the EU Charter of Fundamental Rights and the Treaty on the Functioning of the European Union. First legislation on the topic arose out of the concern in Europe that the law in force did not provide sufficient protection of the rights of citizens and more general on the topic of privacy. With the growing use of digital data, the connection of data with risk regulation has grown to a major concern, which the GDPR tackles by strengthening the individual rights vis-à-vis data controllers - either public or private entities: data processing operations become the pivotal element of a "shift towards a model of 'enforced self-regulation' in the management of technological uncertainty[210]. Data protection is also connected to data ethics, as ethical considerations attempt to tackle the epistemic change that Big Data has brought in knowledge availability and dissemination, and more generally in the governance of public and private space[211].

encompassing emerging challenges emanating from technological developments, such as open science, citizen science and social media. This Code of Conduct has been set as a "living document", to be revised every five years at the most, in order to take account of evolving concerns.

[204] As stated in its Preamble.

[205] Pellé, S., & Reber, B. (2016): 5.

[206] Especially in sectors such as biomedical research, genetically modified organisms or nanotechnology. See: Pellé, S., & Reber, B. (2016): chapter 1.

[207] Such as the sectoral focus of the *Code of Ethics for Estonian Scientists*; or the (more general) *Netherlands Code of Conduct for Research Integrity*.

[208] The European Code of Conduct for Research Integrity includes some guidelines on "data practices and management", already included in the 2011 version (see in particular sections 1.4; 2.2.4; 2.2.5; 2.3) and further developed in the 2017 version.

[209] European Commission (2018, November 14). *Ethics and data protection*. Retrieved from: https://ec.europa.eu/info/sites/info/files/5._h2020_ethics_and_data_protection_0.pdf

[210] Spina, A. (2017). A Regulatory Mariage de Figaro: Risk Regulation, Data Protection, and Data Ethics. *European Journal of Risk Regulation, 8*(1), p. 89.

[211] Spina, A. (2017): 92.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Research ethics: the protection of research subjects

Science and society issues diverge from scientific integrity issues: the first relate to problems depending on the socio-ethical context of research, whereas the second category focuses on standards that are relevant when conducting research[212].

Even though research ethics are most developed in medical research, the general principles apply to all fields of research[213], bringing principles such as informed consent, or confidentiality, that are cross-sectoral. Already addressed by several international legal frameworks (see above) since the Code of Nuremberg, the issue of the protection of research subjects – research ethics - is mainly covered by the Belmont Report, issued in 1978 by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, and which sets *Ethical Principles and Guidelines for the Protection of Human Subjects of Research*.

The objective of the Belmont Report is to provide an analytical framework serving to guide the resolution of ethical problems arising from research involving human subjects, through general prescriptive judgements – "basic ethical principles"[214] on: i) respect; ii) beneficience (avoid harm); iii) justice. These three main ethical principles are completed by a set of requirements in their application, which are: i) informed consent (information, comprehension, voluntariness); ii) assessment of risks and benefits (nature and scope, systematic assessment); iii) selection of subjects.

As a common denominator of these regulatory frameworks, risk regulation tackles scientific and technological uncertainty: while risk assessment, risk management and risk communication are all intertwined in the same precautionary position:

> "risk regulation has been traditionally associated with the uncertain negative outcomes connected with the products of industrialized manufacturing, such as food, pharmaceuticals, chemicals, or with sources of energy, safety of transport, or general environmental issues."[215]

Overall, current regulations on ethics of R&I cover ethics of participation only to the extent they relate to the involvement of research subjects, but not specifically on ethics of participation in innovation governance and innovation processes themselves. Further to regulations, such issues can be tackled by ethical processes, already operative through formalised procedures in public R&I funding.

Ethics assessment in EU-funded R&I

Further to international and European regulatory frameworks, ethics are also playing a key role in the stream of EU R&I policies and the projects that are supported. Ethics assessment provides moral

[212] This publication also mentions that "there is, of course, no perfect watershed between the two categories". See the first edition of the aforementioned code of conduct: European Science Foundation, & ALLEA (2011). *The European Code of Conduct for Research Integrity*. Strasbourg: Ireg, p. 10.
[213] This section is mainly based on the following publication: European Commission - Directorate-General for Research and Innovation (2013). *Ethics for Researchers: Facilitating Research Excellence in FP7.* Luxembourg: Publications Office of the European Union.
[214] The Belmont Report identifies them as such: see part B of the Belmont Report. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (1979). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research.* Retrieved from: https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html
[215] Spina, A. (2017): 88.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

judgement on R&I practices, projects, developments, ensuring their conformity with moral values, principles and norms: these assessments can be project/practice-oriented; policy-oriented; or related to professional conduct[216].

Within EU funding schemes in R&I, this takes shape through ethical compliance processes, which is a main pillar yet under-represented in RRI literature[217]. Programmes supported by the European Commission respond to the research proposal evaluation procedure – Ethics Reviews – whose purpose is to ensure the compliance of funded research activities with fundamental ethical principles. The various Framework Programmes of the European Commission represent a great proportion of public funding and their compliance with ethical principles is a key element in their selection. The legislation that sets the standards for each programme underlines the fundamental principles that have to be considered, as well as some precautionary principles on specific fields of research[218]. Evaluation is a useful feedback for decision making, providing systematic assessment of the implementation or merit of a programme, by drawing conclusions based on empirical analysis of data (direct or indirect)[219]. The two main sensitive ethical issues are arguably research involving humans and the protection of personal data.

[216] Shelley-Egan, C., Brey, P., et al. (2015): 23-24.
[217] This assertion has been brought forward and thoroughly studied in: Pellé, S., & Reber, B. (2016).
[218] Certain fields of research cannot receive funding (e.g. human cloning), or for other fields may be financed if they demonstrate compliance with licensing and control procedures (e.g. research on human embryonic stem cells).
[219] Oldsman E., & Nexus Associates (2014). Making evaluations count: Toward more informed policy. In Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.), *Making Innovation Policy Work: Learning from Experimentation*, Paris: OECD and The World Bank, p. 230.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

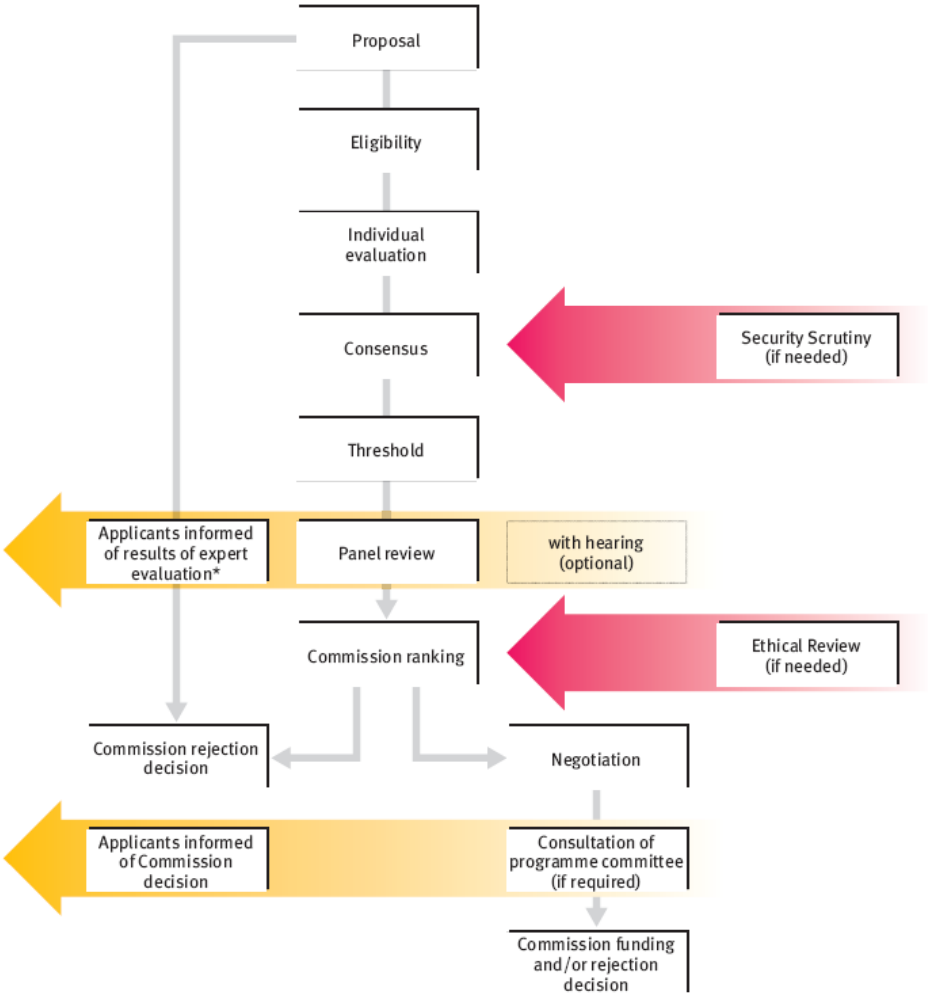

Figure 2: The European Commission's ethics review procedure[220]

The current Ethics Review procedure has been established in 2011[221] and applies to proposals submitted to the European Commission that have been retained with a view to funding but identified as raising ethical issues. Indeed, research proposals are evaluated both on their scientific merit and on its ethical and social impact, meeting ethics requirements. At the European Commission, Ethics Reviews are performed by a panel of experts, in two phases[222]: i) Ethics Screening; ii) (full) Ethics Review (ethics assessment). The ethics review procedure intervenes in a wider time scale of project development, from its submission to its implementation, which are: submission, with ethical self-

[220] This figure is taken from: European Commission - Directorate-General for Research and Innovation (2013).
[221] Ethics Reviews procedure has been established in 2011, by the *Commission Decision of 28 February 2011 amending Decision C(2008) 4617 related to the rules for proposals submission, evaluation, selection and award procedures for indirect actions such as the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013) and under the Seventh Framework Programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities (2007-2011)*.
[222] These two phases have the purpose to identify projects in need of a follow-up or audit to assist the beneficiaries to deal with the ethical issues raised by their work, eventually ending in preventive and/or corrective measures.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

assessment; assessment to determine the scientific value of the project and establish a ranking; ethical review; preparation for allocation; project implementation[223].

Ethics Review occurs in the intermediary step of the 3-step ethics appraisal process:

- *ethics self-assessment* by the applicant;
- *ethics review* by the ethics experts, before the finalisation;
- *ethics checks* by ethics experts, and officers[224], for selected projects, after the signature of the grant agreement.

Early on in the development of a research project, a list of ethical issues outlined by the European Commission has to be taken into account, as ethics panels could be globally qualified as risk averse[225]. These 11 ethics issues in Ethics Reviews are (the ethics issues "checklist")[226]:

1. Human embryo / foetuses
2. Human beings
3. Human cells / tissues
4. Personal data
5. Animals
6. Non-EU countries
7. Environment, health & safety
8. Dual use
9. Exclusive focus on civil applications
10. Misuse
11. Other ethics issues

Beyond ethics compliance and their primary use as a recommendation to researchers to think about ethics while designing research protocols, the ethics reviews procedure acts as a powerful tool for reflexivity in the R&I process, in general. Extending it to innovation actors too, the set of ethical issues considered in ethics reviews are significant items whose use could be exceedingly wider than its context of use. Across the ethical issues listed in the ethical reviews, some of them are of prevailing importance:

Data protection and Privacy

Aiming at strengthening the rights of the individuals, data protection and privacy issues related to the principles set in the *Charter of Fundamental Rights*[227], the *Treaty on the Functioning of the European Union*[228], and the General Data Protection Regulation (GDPR)[229]. These principles aim to guarantee our right to privacy and refer to the technical framework and security measures designed to guarantee that all personal data are safe from unforeseen, unintended or malevolent use.

---

[223] Pellé, S., & Reber, B. (2016): 8.
[224] Officers from the European Commission (initially) and now especially from the Europan research area (ERA).
[225] Karatzas, I. *The Ethics Appraisal Scheme in Horizon 2020.* Retrieved from: https://bestprac.eu/fileadmin/mediapool-bestprac/documents/Outputs/Learning_materials/Ethics_H2020_Appraisal_2017_Karatzas.pdf
[226] See European Commission, Directorate-General for Research & Innovation (2019). *Horizon 2020 Programme: Guidance – How to complete your ethics self-assessment*.
[227] Official Journal of the European Union (2010a). *Charter of Fundamental Rights of the European Union*, (30.3.2010), N° C 83/393, articles 7-8.
[228] Official Journal of the European Union (2010b). *Consolidated Version of the Treaty on the Functioning of the European Union,* (30.3.2010), N° 83/55, article 16.
[229] See *infra* in this chapter.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Informed consent

Participation of research subjects requires their informed consent, which is information prior to their participation. This is a core principle in research ethics that is covered by many international conventions and guidelines, and which is required when the research involves the participation of human beings, when the research uses human genetic material or biological samples and when the research involves personal data collection. It implies that prior to consenting to participation, participants should be clearly informed of the research goals, possible adverse events, possibilities to refuse participation or withdraw from the research, at any time, and without consequences.

Research on human embryos and foetuses

Embryonic stem cells research (hESC) raises quite important ethical questions on sensitive issues related to human life, that receives a variety of answers in Europe according to specificities of national regulations on that topic. As a consequence to this, the European Commission accepts only research projects that are allowed in all European Member States[230]. This issue is completed at international level by the UNESCO Universal Declaration on the Human Genome and the Human Rights.

Dual Use

This term refers to technology that can be used both for peaceful and military aims. In the context of research, the possible dual use of new technologies implies potential misuse, in the event that research activities either involve or generate materials, methods or knowledge that can misused. Cases of dual use are in research that can be anticipated to provide knowledge which could be misused for criminal/terrorist purposes; research involving materials that when misused could cause severe harm to humans, animals or the environment; research which uses either classified / dangerous / restricted information, materials or techniques.

Animal research

Conducting research on animals (animal testing / research) should be compliant with three principles:

- *reduction*: methods that can reduce the number of animals
- *replacement*: prioritize methods that do not involve animals
- *refinement*: all methods should alleviate / minimize the potential pain for animals and enhance animal welfare for animal used.

Research involving developing countries

When research is conducting in or in collaboration with non-EU countries, the activities must comply with the general objectives of the Union's external action and also be compliant with all European standards. In the case of developing countries or emerging economies, special measures have to be taken to ensure that the rights and interests of all participants are adequately protected and that the benefits of the research are equally shared.

Taking stock of current challenges and approaches in innovation, the ethical landscape and the regulatory schemes applying to research and innovation, this chapter has highlighted the importance

[230] In case the research to be funded would be forbidden in one Member State, the research is not accepted.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

of anchoring future developments on ethical (prescriptive) strands that surpass existing legal schemes and normative/regulatory approaches. Normative anchor points[231] lead us to the issue of participation that widens ethical considerations with new intricacies. The risk of over-regulation and the weight of normative features loom as research and innovation often shows the need of independency. Participation as entangled with ethics shows another way forward.

[231] Further to those considered in this chapter, they could be seen elsewhere, as in the European Treaty on the EU. See: Von Schomberg, R. (2013): 57.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

II - PARTICIPATORY PRACTICES

In the governance of science and technology, expert analysis is increasingly making space for new frameworks that foster engagement with stakeholders and/or citizens and/or the public, in order to reach more inclusive, discursive, deliberative, pluralistic, reflexive, participatory approaches[232]. However, while policy making embraces more "participation", there is not a single perspective on participation, and the multiplicity of its understandings shows that in and of itself "participation" is an umbrella term, which has to respond to normative grounds and precise criteria, in order to blend in concrete innovative frameworks. The wide spectrum of participatory practices will be firstly analysed through the complexity of its meanings and related practices, in order to define who the participants are, the new ways to include citizens and stakeholders in research and innovation, and what these publics can bring to innovation processes.

Defining "participation"

A diversity of types and timelines of participation

Taken broadly, participation[233] is a category that does not indicate the actors, the nature of the process chosen and the outcomes. Should it integrate the general public or stakeholders - and who in this latter category? Does it intervene before, during or after research and innovation and how? What are the expected outcomes and how are they being taken care of? Such questions need to be answered in light with innovation modes and current challenges in research and innovation. Even though the legitimacy of participation in research and innovation tends to be self-evident, a lack of definition of the proper process may lead to poor forms of participatory practices.

The first questions arising with participation in research and innovation processes are with what purpose, how, and consequently, when is participation occurring? As a generic term, participation could be circumscribed to technology assessment (TA), which is still a wide category, while it can also refer to other dimensions. This complexity is also reflected across the related terms defining participation such as "dialogue" or "engagement", "involvement", "consultation", indicating public talk as a flexible construction[234]. Depending on their type, participatory processes can fulfill several roles, both in identification of policies/programmes, identification of undesired consequences, improvement of quality/transparency (thanks to assessment), knowledge sharing, and leverage on the impact, amongst others.

Stemming from a context of loss of public trust – a democratic deficit particularly salient in the current science-society relationship, participation springs up as a remedy. Through the multiple features of participatory approaches, the prevailing need to address transparency and openness are common drives aiming at convincing the public to trust decision-making, thus restoring legitimacy[235]. Parliamentary TA introduced a participative turn of TA, bringing public participation to the forefront,

[232] Stirling, A. (2005). "Opening Up" and "Closing Down": Power, Participation and Pluralism in the Social Appraisal of Technology. *Science, Technology & Human Values, 33*(2), p. 263.
[233] In this chapter, R&I and R&D&I (research, development and innovation) are used interchangeably to refer to all research and innovation processes, at all stages, and throughout the diversity of possible configurations.
[234] In the sense that these terms are "open to variable interpretations": see Irwin, A. (2006). The Politics of Talk: Coming to Terms with the "New" Scientific Governance. *Social Studies of Science, 36*(2), p. 314.
[235] Irwin, A. (2006): 306.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

following the lead of, notably, Denmark and its consensus conferences[236], borrowing from the medical consensus conferences[237], which offer a public mediation between scientific expertise and public policies[238]. While the Danish model focused on public debate, the Netherlands[239] developed another model based on co-production, where deliberative forums spurred interactions between mini-publics, through a hybrid deliberation[240]. Regardless of their differences, these various models convey the same set of issues around the broad notion of participation.

Widely understood as involvement, "participation" is a wide category, that can refer to various forms, contexts, types of participants, requirements and aims: the related mechanisms that can be leveraged to reach effective involvement are also diverse[241]. As a general categorisation attempt, some dimensions of participation could be outlined as follows:

- **R&D&I programme design**

  Participation in project/programme design; topic identification; exploration of links between knowledge production and beneficiaries[242].

- **Knowledge sharing**

  Often referred to as "public information" in the literature on public participation, this is arguably the most minimal form of involvement of citizens and stakeholders, since the flow of the information journey is one-way.

- **Consultation on policies**

  This form goes further than public information as it implies a feedback loop on the information that is shared, and discussed before taking further actions. The level of integration of the results and the aggregation of public opinion can vary, depending on the ways it is conducted.

- **Evaluation**

  Participation in assessment of science and technology has been developed for more than thirty years through technology assessment[243]. It serves to agree on substantial investments and technical options; to better respond to social needs; agenda-setting; mapping of scientific controversies; more interactive surveys[244]. The benefits of participation in evaluation processes are mainly that by expanding the viewpoint of experts with perspectives of other epistemic communities, it can help reaching a more comprehensive view of a technological innovation and its impacts on society[245]. Assessment can refer to distinct processes, depending on the stages of innovation processes: *ex-ante* evaluation[246],

[236] Invented by the Danish Board of Technology (DBT).
[237] Reber, B. (2006). Technology assessment as policy analysis: from expert advice to participatory approaches. In Fischer, F., Miller, G., & Sidney, M. (Eds.), *Handbook of Public Policy Analysis. Theory, Politics, and Methods* (pp. 493-512). Public Administration and Public Policy Series. New York: Rutgers University/CRC Press.
[238] Van Lente, H., et al. (2017): 259.
[239] The Netherlands Office of Technology Assessment (later renamed Rathenau Institute).
[240] Van Lente, H., et al. (2017): 259.
[241] Rowe, G., & Frewer, L. J. (2005). A Typology of Public Engagement Mechanisms. *Science, Technology, & Human Values, 30*(2), p. 252.
[242] Such activities may involve wider participation in terms of test-users, end-users, co-creators.
[243] See the related section in the previous chapter.
[244] See Pellé, S., & Reber, B. (2016): chapter 5.
[245] See Pellé, S., & Reber, B. (2016): chapter 5.
[246] Verification of adequacy of objectives with the needs, issues, challenges.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

interim evaluation[247], final, and *ex-post*[248] evaluation. Each stage has a different array of implications, while evaluation can be also considered throughout the whole timeline, as *in itenere* assessment (during all phases).

If the "assessment" category presents more precise variables, this is due to the varying nature of its characteristics according to the project's timeline. However, the level of precision reached in assessment processes could be taken as a general criterion pertaining to all participatory processes: in order to ensure innovation addresses societal needs, a number of ethical problems have to be anticipated through the involvement of stakeholders, along with scientists and engineers, at the earliest possible stage[249]. Considering the flow of information path as the overarching variable, the general categorisation that has been outlined could be summarised differently, with participation mechanisms split up across three types of mechanisms: communication, consultation and participation *per se*[250], along with variables related to each structure.

Other categorisations can be found in the literature, as for instance a tripartite distinction based on the objectives of the policy process, that can either be: transmitting information (unidirectional); consultation (bi-directional); active participation (where all parties involved contribute to the issue to a certain extent)[251]. Although the latter seems to better reflect the idea of "participation", all forms are considered as part of participatory approaches, the common denominator being the involvement of "the public"[252]. According to this categorisation, participatory approaches take place in three distinctive areas: evaluation, planning, and implementation.

Widely defined, public participation is "the practice of involving members of the public in the agenda-setting, decision-making, and policy-forming activities of organizations/ institutions responsible for policy development"[253]. With varying levels and ways of participation, the broad category of public participation could be opposed to nonparticipation situations related to traditional models of governance, where along with nominated experts, elected policy-makers set policy without reaching out to the public[254]. According to the level of involvement and the goals, certain forms may not be considered as participatory[255]. As opposed to representation, participation raises the issue of the involvement of new audiences in innovation processes, although the level of activity and the nature of these external audiences are yet to be defined.

The increased attention on the involvement of the public in the affairs and decisions of policy-setting bodies has emerged as an international trend, commonly identified as "public participation", rephrased as "public engagement"[256]. At the same time, the number of processes, techniques, mechanisms to enact involvement has also grown[257].

[247] Occurring during research and innovation, half-way of the programme/project.
[248] Either mid-term or long-term impact measurement after the closing of the programme.
[249] Taebi, B., Correljé, A., Cuppen, E., et al. (2014): 118.
[250] Rowe, G., & Frewer, L. J. (2005): 254.
[251] Slocum, N. (2003). *Participatory Methods Toolkit: A Practitioner's Guide.* Maastricht: United Nations University, p. 9.
[252] Slocum, N. (2003): 9.
[253] Rowe, G., & Frewer, L. J. (2005): 253.
[254] Rowe, G., & Frewer, L. J. (2005): 254.
[255] This important view will be further analysed in the course of this chapter.
[256] Rowe, G., & Frewer, L. J. (2005): 284.
[257] Rowe, G., & Frewer, L. J. (2005): 251.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

A diversity of "participants"

Commonly identified as an "inclusion" mechanism, participation can embrace various kinds of participants[258], among which stakeholders, citizens, the general public (lay people), and civil society - often as composite publics. Participation actors are another blurred area in the definition of participation, usually identified as "citizens" or "stakeholders", which are not overlapping terms, nor covering the whole array of potential participants. If participatory processes in innovation involve mainly citizens, with the aim to bridge science and society, other actors can be identified under the category of "stakeholders". As the variables in participation are multiple, so are the models, according to who participates, what is the underlying intention, who conducts the procedure, what is the distribution of (technical) expertise, and if there really is a choice addressed to participants[259].

Participants are seen either as internal or external actors, involved in activities happening either before, during or after research and innovation processes. According to the field - e.g. funding agencies, participants are perceived as different entities and can embrace a scope that can either be specific or wide. Generally seen at the intersection of science and society, participants are usually referring to multi-actor approaches, involving societal engagement, stakeholder engagement, citizens dialogue, and any interaction that brings guarantees that social impact of new technologies and innovations can be taken into account in research and innovation activities. Participation also relates to the wide category of participatory democracy, which is fundamentally a means to achieve the very ideal of self-government[260]. Throughout the various participatory approaches, the common denominator is the involvement of "the public", which "can be average citizens, the stakeholders of a particular project or policy, experts and even members of government and private industry"[261]. On the contrary, a restrictive approach limited to participatory processes in funding schemes refers precisely to evaluation processes and ethical appraisals.

Some general divides could be outlined[262]:

- **Participation orchestrated by funding / non-funding entities**

In ethical review (appraisal) schemes, experts and researchers are participants taking part in review processes, ensuring the proper ethical/scientific evaluation of activities according to ethical requirements. Also, some beneficiaries in funded R&D&I projects could be considered as "citizens participants" or "participants in novel modes of interaction", considering their role is to implement the funded proposals. The compliance with ethical requests is a current feature in participatory processes orchestrated by public funding entities.

- **Participants as citizens / stakeholders**

Community organising and creative methods to involve citizens differ from stakeholders involvement specifically focused on categories of citizens that may have an interest in research and innovation activities. As a category, "citizens" is broader than "stakeholders" and can ultimately embrace all types of participants in their belonging to a given society. "Citizens" can also be seen as a category opposed

[258] In addition to usual participants (experts, scientists).
[259] See Rowe, G., & Frewer, L. J. (2005): 251-290.
[260] Fung, A. (2003). Associations and Democracy: Between Theories, Hopes, and Realities. *Annual Review of Sociology, 291*(1), p. 533.
[261] Slocum, N. (2003): 9.
[262] The following distinctions concern different dimensions: these are not disjunct and can be combined.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

to "stakeholders" as it implies an action towards the common good, raising ultimately the question of the societal purpose or implication of an R&I activity.

- **Participation in creation or implementation (operational working processes) / in evaluation (assessment)**

Participants involved in the operational working process of R&D&I activities differ from those involved in evaluation processes. Contributing to programmes design or implementation involves a different engagement than participation in evaluation, where the contribution focuses on compliance with ethical frameworks, regulations and procedures.

Participants could be also categorised according to their main role as funding beneficiaries, evaluators/experts, and partners. A more detailed categorisation would allow to make a distinction of roles according to the type of participation: citizens, research subjects, researchers, experts/evaluators, innovators/social entrepreneurs, NGOs, firms, funders, public/semi-public bodies, end-users/consumers. Some categories can overlap, according to the nature of participation, as it is the case for "citizens", who may be for instance directly involved as research subjects. In assessment (evaluation), several types of experts/evaluators can be identified, depending on the proximity with the project: self-assessment; internal; external (neutral); evaluation by beneficiaries (or users)[263]. Regarding knowledge sharing, both researchers and citizens can be involved, while both of them are also involved in other categories, since researchers participate in R&D&I activities and citizens in consultations on policies. Firms and public bodies are mainly represented in the implementation of projects, while citizens can also be represented through civil society organisations and not necessarily through individual direct involvement.

Participants in research and innovation could generally be outlined through the two main categories of citizens and stakeholders: the first one addresses the concern of public engagement, whereas the second one ensures all concerned parties are involved in assessment and decision-making, resulting in either policies or research and innovation products. Both citizens – as general public – or stakeholders can contribute in fostering responsible innovation, helping to incorporate relevant ethical and societal aspects into innovation practices and to achieve desirable goals, by discussing, assessing directions and consequences, and setting priorities[264].

Stakeholders can be defined as individuals, groups or organisations who can affect or be affected by an organization's activities, although a distinction can be made "between economic stakeholders like employees and suppliers, and non-economic stakeholders like NGOs and research institutes"[265]. Stakeholders represent shared interests, while they also respond to the notion of inclusion and sustainability. As an accountability mechanism, stakeholder engagement targets a purpose to achieve agreed outcomes[266]. On the level of inclusivity, participation of stakeholders aims at achieving accountable and strategic response to sustainability[267]. Stakeholder engagement contributes to

[263] Towards participation in the design & implementation of follow-up / monitoring.
[264] See: Blok, V., Hoffmans, L., & Wubben, E. F. M. (2015). Stakeholder engagement for responsible innovation in the private sector: critical issues and management practices. *Journal on Chain and Network Science, 15*(2), pp. 147-164.
[265] Blok, V., Hoffmans, L., & Wubben, E. F. M. (2015): 149.
[266] AccountAbility (2015). *AA1000 Stakeholder engagement standard (AA1000SES).* London: AccountAbility, p. 5. The AA1000SES (2015) is a generally applicable framework for the assessment, design, implementation and communication of quality stakeholder engagement.
[267] AccountAbility (2015): 4.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

responsible innovation by bringing transparency, interaction, responsiveness, and co-responsibility[268]. On a wider scale, stakeholders are also complexifying controversies and debates in innovation processes, as they operate on the level of the representation of interests.

Throughout the categories of participants, the most meaningful variable might be the level of responsibility that is assigned to them, according to the type and mechanism of participation. Identifying new ways to include citizens and stakeholders in research and innovation requires specifying the context and the scope.

The value of participation

Participation is a challenging element in RRI, bringing a new set of implications, in comparison with ethical reviews. Beyond ethics, the concept of Responsible Research and Innovation has emerged as an extension of the science in society discourse[269] about co-production of solutions to global challenges and purposeful science[270], upstream engagement[271], and reflexive responsibility of scientists and innovators[272]. Within RRI, participation plays an important role as one of the pillars/keys, of procedural nature[273]: although it is not an over-arching one, its contribution to governance and ethics is as fundamental as its connection with open science. Seen as the cornerstone of a democratic approach of research and innovation, the meaning of participation evolves according to the specific focus that is considered, e.g. citizen participation or stakeholder participation, each having distinctive scope. Beyond the inclusion of lay participants through consultation, participation is sought for values that are fostering the democratic construct of our societies. Contributing to responsibility in science and technology, participation is commonly seen as the corollary of democracy, ensuring core democratic values are integrated throughout time and frameworks. At the core of science-society relationship, participatory processes play a vital role in supporting democracy, even though democracy is not always mentioned in technology assessment or RRI, for instance[274]. It is however acknowledged that complex public problems can be tackled efficiently by opening channels of participation inviting citizens and stakeholders in public decision-making[275], especially considering these voices can be at odds with expert and scientific positions[276]. Depending on the conditions and the nature of participation, the value of this latter varies significantly: participation practices may lead to unfair concentration of power in the hands of a privileged, educated elite and would undermine interests of disadvantaged groups who have not been able to engage in participation.

Two cornerstones of participatory approaches are its pragmatic and democratic value:

---

[268] See: Blok, V., Hoffmans, L., & Wubben, E. F. M. (2015): 147-164.
[269] See Khan, S. S., et al. (2016): 78.
[270] Jasanoff, S. (2005). *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton: Princeton University Press.
[271] Wilsdon, J., Willis, R. (2004). *See-through Science: Why Public Engagement Needs to Move Upstream*. London: Demos.
[272] Owen, R., Macnaghten, P., Stilgoe, J. (2012): 751-760.
[273] It could be argued that participation, governance and openness are rather of procedural nature, focusing on cooperation, whereas gender equality, scientific education and ethics are more of substantial nature. See Pellé, S., & Reber, B. (2016): chapter 2.
[274] Pellé, S., & Reber, B. (2016): chapter 2.
[275] Fung, A. (2008). Democratizing the Policy Process. In R. E. Goodin, et al. (Eds), *The Oxford Handbook of Public Policy*, Oxford: Oxford University Press, pp. 681-682.
[276] Sykes, K., & Macnaghten, P. (2013). Responsible Innovation – Opening Up Dialogue and Debate. In R. Owen, M. Heintz, & J. R. Bessant (Eds.): 93.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

> "Demands for increased public participation in policy-making have been founded upon both pragmatic and normative lines of argumentation. From a pragmatic perspective, participation is considered to improve the quality of decisions, while from a normative point of view participation is necessary to render the decision-making process more democratic"[277].

Value in participation lies also in the capacity to introduce dialogue and debate in an arena that fifty years ago was rather undisputable. Acknowledging science and technology can have unforeseen effects and that it is no longer solely positive, neither for humans nor the environment, appeals to more dialogue. Participation can help to tackle this issue:

> "[Science] is also part of the contemporary social and economic order, and closely tied to processes of industrialism and consumerism. Scientists have taken different sides in these debates, and sometimes felt uncomfortably stuck in the middle." [278]

The question of the ethical grounds and the legitimacy of participatory processes is also that of defining what is the contribution of citizens and stakeholders to R&I. Participatory processes have several benefits, in decision-making, in R&D&I processes themselves, and in priorities setting. These benefits could be summarised as following:

- impact measurement: insight on undesired consequences and also in bringing R&D&I policy aligned with societal needs, through the involvement of e.g. end-users and co-creators;
- transparency and accountability of R&D&I thanks to evaluation processes;
- allocation of funding: participation can help in priorities identification and the justified allocation of resources through competitive funding;
- science-society dialogue: participation as part of consultation or dissemination process to share knowledge and merge the gap between citizens and scientific processes.

These processes inform and help decision-making, by providing leverage on the impact (bringing R&D&I policy aligned with societal needs), avoiding undesired consequences, setting priorities (and fostering competitive funding), enhancing transparency, quality and accountability of R&D&I. A thoughtful participation can also avoid conflicts of interests (which can occur from both internal or external stakeholders), by anticipating them, reasoning in terms of common good, or finding compromises.

Could there be an ethical position advocating non-participation in research and innovation? Traditionally left in the hands of experts and scientists, technical issues cannot always be embedded in participatory processes[279]. The traditional divide between experts and lay public derives from the belief that decisions regarding technical issues should be handled by experts and scientists alone: the extended view of participatory processes is counter-intuitive in the context of the traditional approach of science and technology governance. Without participation, there can be a minimal representative policy process[280], where representation of citizens is seen in the translation of citizens' interests into policies by politicians, and where the accountability intervenes in the outcomes only through the voting process.

[277] Slocum, N. (2003): 10.
[278] Sykes, K., & Macnaghten, P. (2013): 86-87.
[279] Rowe, G., & Frewer, L. J. (2000). Public Participation Methods: A Framework for Evaluation. *Science, Technology, & Human Values, 25*(1), pp. 3-29.
[280] See Fung, A. (2008): 671.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

While fostering dialogue could be considered as the key benefit of participation, debate can be either direct, through deliberation, or indirect, by allowing an inclusive approach on certain matters. The tendency towards professionalisation of public engagement has shaped dialogue differently over the past decade, increasing the divide between academic social scientists and dialogue practitioners, leading some to criticism over "public engagement industry whose commercial interests can compromise democratic ideals of participation"[281]. This issue can be tackled by increasing the process of dialogue, in deliberative processes for instance, or more generally by ensuring participation takes place at all stages of innovation[282], with enough transparency and feedback from lay people, whose viewpoint should gain legitimacy. Reinvesting participation this way aims at a process where publics and issues emerge, in a pluralist, inclusive and interdisciplinary way[283], bringing several criteria: of intensity; openness; quality; and responsiveness.

Main benefits of participatory science and innovation spread out in two directions: knowledge added-value (cost benefits, speed of delivery, diversity of skills mobilised, diversified observations) and in societal or social added-value (in education; in fostering the science-society relationship; in citizen empowerment; in problem solving and skills building)[284].

Varying approaches to participation and public engagement

Public participation

Formalised procedures of public participation mostly relate to technology assessement and deliberation on research and innovation. Although there are also participatory processes in new innovation modes (e.g. social and open innovation), which assume a much wider range of participants than traditional innovation processes, however, in these processes, the mode of participation – not exclusive to public participation – is not a formalised participatory process and not addressed as such in the reviewed literature. For the purpose of these new modes which extend formalised participatory procedures, the previously outlined distinctions of participation modes and participants can serve to delineate the way participation is dealt with.

From information and consultation to more acute participatory forms, the expansion of assessment towards public participation in science/technology developments is multifold. Often used interchangeably with public participation, public engagement is more known since it was adopted by the European Commission[285]. Public engagement could prove challenging in data collection given the discrepancy that can occur between real socially desirable answers (reported public opinion) and true public opinion, in surveys for instance[286]. This is verified in several experiments, through sectoral cases, where it seems that participatory (deliberative) processes stimulate efforts to enhance desirable impacts and mitigate undesirable ones in the decision-making process set up by

[281] See Chilvers, J. (2010), *Sustainable Participation? Mapping Out and Reflecting on the Field of Public Dialogue on Science and Technology*. Summary Report. London: Sciencewise-ERC and the University of East Anglia, London. Quoted in Sykes, K., Macnaghten, P. (2013): 100.
[282] Sykes, K., & Macnaghten, P. (2013): 101.
[283] Sykes, K., & Macnaghten, P. (2013): 101.
[284] See: Houllier, F., & Merilhou-Goudard, J.-B. (2016). *Les sciences participatives en France. État des lieux, bonnes pratiques et recommandations* Rapport élaboré à la demande des ministres en charge de l'Éducation nationale, de l'Enseignement supérieur et de la Recherche. [Retrieved from: www.sciences-participatives.com/rapport].
[285] Rask, M., et al. (2018). *Public Participation, Science and Society: Tools for Dynamic and Responsible Governance of Research and Innovation*. New York: Routledge, p. 4.
[286] Van Gorp, A., & Van der Molen, S. (2011): 36 *sqq*.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

researchers, e.g. about research priorities and directions[287]. Public participation can operate in decision-making on science and technology policy, either at limited or enhanced levels, when public views are actively solicited - in strategy, programme design and evaluation. Participation could refer to the involvement of stakeholders, of citizens (general public), also of under-represented categories that could be fostered through participatory processes, as well as end-users throughout their diversity, at all stages of R&D&I and consultation on policies. Also, citizens as a wide category can refer either to individuals or to civil society actors - citizens organised in associations too - as the potential of these latter in the revitalising participatory impulses and ideals has been acknowledge[288].

Main formalised public participation methods are: referenda, public hearings/inquiries, public opinion/surveys, negotiated rule making, consensus conference, citizen jury/panel, citizen/public advisory committee, and focus groups. They can be grouped into five categories, regardless of the variability of the inner characteristics pertaining to each category:

- **Public hearings:** broad category which refers to several mechanisms, tending to be loosely structured as open forums, with the appearance of individual and community involvement[289];
- **Initiative:** considered as the prototype of democratic process, they enable citizens to place issues on the ballot for voter approval[290];
- **Public surveys:** can complement participation through hearings or written comments by providing a more representative portrait of public opinion, by offsetting the biases and seeking opinions more broadly, also from the uninterested but affected public;[291]
- **Negotiated rule making:** "participants generally consider the products of a negotiation to be more informed, pragmatic, and workable than products of a conventional rule making. Parties have access to information as it is needed and the opportunity to educate others and persuade them of the reasons behind their positions"[292];
- **Citizens review panels:** "conditions, representatives of the lay public can acquire the information and understanding to enable them to apply their judgment to technical policy problems. Participants can influence the agenda, question experts, evaluate evidence, balance competing considerations, and debate issues, possibly with authoritative decision makers". However, this model reaches only a portion of the affected public[293].

A more granular comparative approach that takes stock of all contemporary forms of participatory approaches can lead to the identification of several other methods, with different objectives, topics, categories of participants and degree of involvement:

> "citizen juries, consensus conferences, deliberative conferences, the Delphi and Charette methods, focus groups, planning committees, scenario workshops, 'visions of the future' consumer workshops, global cafés, opinion polls (with or without deliberation), questionnaires, citizen advisory committees, vote conferences,

[287] Guston, D. H., & Sarewitz, D. (2002): 106.
[288] On this topic, see Fung, A. (2003): 515-539.
[289] Fiorino, D. J. (1990). Citizen Participation and Environmental Risk: A Survey of Institutional Mechanisms. *Science, Technology, & Human Values, 15*(2), p. 230
[290] Fiorino, D. J. (1990): 231.
[291] Fiorino, D. J. (1990): 233.
[292] Fiorino, D. J. (1990): 234.
[293] Fiorino, D. J. (1990): 235.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

interactive TA, constructivist consumer TA, ad hoc committees relating to the rules of negotiation, interdisciplinary work groups and political role play"[294].

The extent of the selection of main participatory methods varies across literature, as some authors consider fewer methods or additional ones such as planning cells for instance[295].

Across scientific and grey literature, participatory methods considered to facilitate higher levels of involvement are: Charrette Method; Delphi Process; citizens' juries; citizens' panels; consensus conference; deliberative polling; round table method; scenario workshop; search conference; study circles; and methods of sustainable community development[296]. Also, some attempts to classify methods can be found, through an analysis grid that takes stock of the objectives, the topic, the participants and the time length of the process[297].

However, amongst the various models, no one prevails, as contextual factors determine the effectiveness of each[298]. Judging on participation criteria, these models have diverse internal characteristics, in allowing direct participation of amateurs (all except negotiated rule making); exercising full decision authority (in initiatives and negotiated rule making); allowing discussion (in negotiated rule making and citizen review panels). Also, all models do not offer the same basis of equality in terms of influence over the definition of issues: this is mostly occurring in negotiated rule making, where the public's consent is a pre-requisite for the conclusion of the process[299]. In addition to the limitations inherent to lower forms of citizen participation, the risk of distortion of participation is also limitating the efficiency of participation in terms of actual outcomes.

Participatory processes are not obvious and public talk can either be "derided as unsubstantiated words and empty rhetoric", or even can occasionally be perceived as an impediment to science-led progress[300]. In addition to this vulnerable construct, tensions can put legitimacy at risk and undermine the ethical grounds of participatory processes:

- biases can potentially occur at any level/type of participation; with external or internal stakeholders[301];
- scientific and ethics evaluation can diverge;
- public consultation can occur without link to decision-making;
- lack of dialogue or knowledge sharing with lay citizens;
- lack of dialogue on future orientations/targeted impacts.

To reach equity and fairness and avoid biases, there is also the need to address concerns for ethical issues taking into account their impact on society, especially for emerging technologies in fields such as medical research, nanotechnologies: new science and technology and their political economy can considerably impact upon vulnerable groups – including the unborn and those unable to defend

[294] The length of this list varies across the literature. This substantial list goes further than Slocum's ten-entries classification. See: Reber, B. (2005). Technologies et débat démocratique en Europe: de la participation à l'évaluation pluraliste. *Revue française de science politique*, *55*(5), pp. 812-813.
[295] See: Slocum, N. (2003): 15.
[296] Shelley-Egan, C., Wright, D., et al. (2014). *Report (handbook) of participatory practices*. SATORI Deliverable D2.1, pp. 21-23.
[297] See: Slocum, N. (2003): 25.
[298] See Rowe, G., & Frewer, L. J. (2000): 3-29.
[299] Fiorino, D. J. (1990): 237.
[300] Irwin, A. (2006): 318.
[301] External stakeholders in assessment processes can represent interests as well.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

themselves[302]. Empowering wider social agency in innovation through participation is all the more justified in contexts where social choices are issued from a narrow set of incumbent interests[303]. These latter can intervene in appraisal by framing it in a way that closes down the range of social choices: thus, a stylised participation could be opposed to an "opening up" participatory appraisal[304].

Contradicting the tendency in science study to resolve issues of governance through legal treatment[305], participation shows another way in open science-public relations that can bring along significant legitimacy to R&I processes. While on some topics participation is perceived through the perspective of enhancing public trust, a naive focus on engagement in and of itself cannot rebuild trust and be taken as an antidote for public scepticism over technical change and innovations[306], when there is such divide between science and society. In line with a democratic perspective, it could be argued that participation should be driven by ethical grounds targeting a greater degree of deliberation and inclusion, so as to allow a constant space for inclusive dialogue.

Participation addresses general concerns of the general public on innovations' purposes and motivations: questions such as "in whose interests is the science being developed? Are particular innovations necessary? Are there alternatives?"[307]. The importance of social agency in science and technology choices is of matter in policy-making, where public dialogue is often claimed to increase the legitimacy of decisions. In other spheres, participation's legitimacy lies in that it helps to "explore the grey areas of public opinion, away from polarized discussion and media sensation, enabling more nuanced and in-depth thinking about an issue"[308]. Legitimacy of participatory processes depends as well on the time and the way they are conducted: addressing ethical dilemmas in upstream participation where science/innovation are at an early stage, is for instance a determining factor in ensuring ethical grounds of innovation processes.

Participation in technology assessment

Moving from a loosely defined "participation" to methods, one stumbles upon questions such as "what participation mechanism is most effective in enabling public participation, in what circumstances," and to be able to test it, one must possess definitions of such important concepts as participation mechanism, effective, and circumstances"[309].

Evaluation is probably the most institutionalised and long-standing field of participatory practices, notably renowned through participatory technology assessment. Participation in technology assessment does not cover the whole array of participatory practices in innovation, but has an extensive importance in ensuring the legitimacy and efficiency of funded projects. However, the

[302] Sykes, K., & Macnaghten, P. (2013): 103.
[303] Stirling, A. (2005): 264.
[304] Motivations underlying appraisal correspond to three types of imperatives that shape the role of intentionality: normative (the right thing to do), instrumental (aims to secure particular ends) and substantive (aiming at generally better ends). See Stirling, A. (2005): 264.
[305] Irwin, A. (2006): 317.
[306] Irwin, A. (2006): 315.
[307] Sykes, K., & Macnaghten, P. (2013): 102.
[308] Sykes, K., & Macnaghten, P. (2013): 97.
[309] Rowe, G., & Frewer, L. J. (2005): 252.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

distinction between *ex-ante* assessment and *ex-post* assessment[310] is not always specified in the scientific literature on the topic[311], blurring the lines of criteria and implications.

In the evolution of public engagement, the development of technology assessment organisations, in Europe and in the United States from the 1970s, played a key role as a stakeholder model: they provided a warning of future technological mishaps, and raised awareness on the lack of democratic input in technological governance, the answer to this issue being the presence of elected representatives at an early stage[312]. The Danish Board of Technology led this a step further, through a more inclusive approach to assessment: not only through informing Parliament but creating a space for dialogue with public debates and the related model of public deliberation, broadly understood, through consensus conferences[313]. In addition to this development, the Netherlands fostered deliberative fora, through diverse technological domains, bringing a substantial contribution to institutional innovation on public deliberation, mainly thanks to the Rathenau Institute (formerly known as Netherlands Organization for Technology Assessment – NOTA)[314]. These developments were impulsed by intense public debate in the media and in civil society organisations on critical issues (e.g. on genetic modification of plants and animals), which required broad societal debates[315]. The growing concern over scientific controversies kept raising attention on the lack of public's confidence in science and the need to embed dialogue with the public in policy-making in science, which notably spurred in the UK, around 2000. Further to this, upstream dialogue projects between scientists and the public have taken place in the following years across Europe, mainly with the support of the European Commission[316].

Despite thirty years of participatory technology assessment in Europe, issues such as "why", "how" to participate and in order to reach "what quality" are not yet solved[317], which arguably weakens the legitimacy of participation:

> "Why not to ask these questions directly to citizens in case of public technological controversies? Yes, but how many citizens can we meet? Must they be demographically or legally representative? These two adverbs indicate two problems. The first will require a great number that can quickly become counter-productive in debates. How to participate in such a large number? The second one immediately shows that these citizens are not more legitimate than others, let alone the elected. Without ever directly answering these questions, nearly 30 years were dedicated to 'risky' socio-political experiences in the evaluation of controversial technologies."[318]

Four main criteria could be identified in participatory TA[319]: public acceptance (encompassing criteria such as representativeness, independence, early engagement, impact and transparency); deliberative democracy requirements; reflection of procedural justice and fairness; ethics of discourse. The combination of all these criteria can vary significantly, according to the importance attached to each in

[310] See *supra*: first chapter.
[311] See Reber, B. (2005): 814.
[312] Sykes, K., & Macnaghten, P. (2013): 87.
[313] Sykes, K., & Macnaghten, P. (2013): 87-88.
[314] Sykes, K., & Macnaghten, P. (2013): 88.
[315] Sykes, K., & Macnaghten, P. (2013): 88.
[316] Important projects for innovation and ethical implications have been supported by Framework 6 and 7 of the European Commission: see Sykes, K., & Macnaghten, P. (2013): 90.
[317] See Pellé, S., & Reber, B. (2016): chapter 2.
[318] See Pellé, S., & Reber, B. (2016): chapter 2.
[319] See: Reber, B. (2005): 811-833.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

decision-making and in normative choices. Amongst other forms of TA, participatory TA systematizes the involvement of diverse social actors, stakeholders and citizens, along with technical scientists and experts, covering a variety of methods such as consensus conferences, focus groups, scenario workshops. With a varying focus on stakeholders or public, participatory technology assessment relies essentially on inclusion, its diversity and coherence in the process up to decision-making. Participatory Technology Assessment has emerged as socio-political experimentations on emerging science/technology features and controversies, based on moral justifications intervening in the course of a public evaluation, with a varying degree of normativity[320]. Considering risks are being tackled more effectively through a widened participation, participatory TA defends the diversity of views and aims at defending all affected persons[321]. Furthermore, the complexity of decision-making in a widened participatory context implies to deal with pluralism of values and disagreement:

> "In general, the handling of inter-personal problems has to balance between respecting the individual person - even if he/she acts in a problematic way - and the need of the majority. This may be done by using the management's' right to set certain rules (for example to impose facilitation upon the group) or, quite opposite, to expel from setting specific rules by pushing the participants to take action themselves. Both sides of the balance may be seen as actions that respect the discourse ethical claims for the process, as long as they are exerted with openness and transparency."[322]

This entails the difficulty to have a clear view on the way to address the moral dimension and how to tackle disagreements in assessments through a pluralist position. While participatory TA aims at expanding to norms and values and reason-giving, the difficulty to address the moral dimension remains as a methodological pitfall[323]. Therefore, it is of utmost importance that justifications and decision-making reach the same transparency as that of scientific evidence and their public restitution[324]. Furthermore, the literature focuses also on two weaknesses, which are common to participatory technology assessment: on a pragmatic level, improving the quality of decisions requires to have a widened spectrum of knowledge, experience and expertise, which is challenged by the unequal distribution among society members and hence, their limited influence, which entails the need of enhanced access[325]. On a normative level, there is uncertainty on the way to render the decision-making process more democratic, as issues confront social norms that are either conflicting or absent, while the plurality of norms and interests complexifies the process of equal representation[326].

Deliberation in Research and Innovation

Expanding the idea of public participation through iterative processes and fair representation concerns, leads to deliberative models. Participation and deliberation are distinct notions, and do not overlap, although it could be argued that the latter is a form of participation, where dialogue, engagement, and justifications are developed to respond to essential democratic requisites, reflecting

[320] Reber, B. (2005): 812.
[321] However, the concern to widen the access to affected publics tends to outweigh the technical part of participatory TA. See: Reber, B. (2005): 812; 825.
[322] Klüver, L., Bellucci, S., Bütschi, D., van Eijndhoven, et al. (2000). *EUROpTA:* European Participatory Technology Assessment (EUROPTA) - Participatory Methods in Technology Assessment and Technology Decision-Making. Copenhagen, Denmark: Danish Board of Technology.
[323] Reber, B. (2005): 830.
[324] Reber, B. (2005): 832.
[325] Slocum, N. (2003): 10.
[326] Slocum, N. (2003): 10.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

the theory of deliberative democracy. This is furthered by inter-institutional deliberation models, where institutions are responsible and in charge of such processes: public participation in policy-making is designed as a way to perform a dialogue on science and technology in the public sphere, in order to elicit public will[327]. As opposed to the election-centered model, the deliberative model is talk-centered and wants ordinary citizens, to deliberate issues on a regular basis[328]. Drawing from the knowledge of the public, dialogue sheds light on the stakes of the issue - on politics, economy, ethics, and ontology - and widens the assumptions of scientists and policy-makers[329]. In addition to its impact on governance processes, dialogue can also help funders to explore how to increase the social benefit of their research and innovation processes.

Further to deliberation, which is conduct of debate and discussion in order to produce "reasonable, well-informed opinions in which participants are willing to revise preferences in light of discussions, new information, and claims made by fellow participants"[330], *public deliberation* is "a form of government in which free and equal citizens (and their representatives), justify decisions in a process in which they give one another reasons that are mutually acceptable and generally accessible"[331]. In deliberative democracy, the systematic involvement of public deliberation in the process of decision-making, defends a high level of participation, as opposed to the traditional democratic theory, where the voting process is a sufficient source of legitimacy. Through consensus decision-making and majority rule, deliberative democracy defends public deliberation as a core element that strengthens the fabric of democracy[332], by correcting democratic deficits in policy making[333] and aiming at providing "the most justifiable conception for dealing with moral disagreement in politics"[334], disagreement being both a condition and challenge[335] in deliberation. A number of successful practices in the field of deliberation have been underlined, such as good dialogic practices, the importance of hybrid forums[336], and pitfalls to avoid when conducting dialogue[337]. Deliberation can bring several positive effects such as: citizens' views change through discussion, knowledge sharing, deepened civic engagement, participation in public life, and contribution to policy implementation. The moral values sustaining deliberative democracy strengthen the democratic fabric of our societies as greater participation contributes to foster citizenship[338].

While deliberation could arguably be considered as a key dimension in responsible research and innovation, the very nature of its process and its mode remains sometimes undefined. The two fundamental questions that arise are "what" and "who": what form of public opinion is being assessed

[327] Van Lente, H., et al. (2017): 259.
[328] Steiner, J. (2012). *The Foundations of Deliberative Democracy: Empirical Research and Normative Implications.* Cambridge: Cambridge University Press, pp. 37-38.
[329] Sykes, K., & Macnaghten, P. (2013): 97-98.
[330] Chambers, S. (2003). Deliberative Democratic Theory. *Annual Review of Political Science, 6*, p. 309). Quoted in Fagotto, E., & Fung, A. (2014). Embedding Public Deliberation in Community Governance. In J. Girouard, & C. Sirianni (Eds), *Varieties of civic innovation: Deliberative, collaborative, network, and narrative approaches*. Nashville: Vanderbilt University Press, p. 9.
[331] Gutman, A., & Thompson, D. (2004). *Why Deliberative Democracy?* Princeton: Princeton University Press, p. 7.
[332] Fagotto, E., & Fung, A. (2014):10.
[333] Fung, A. (2008): 669–685.
[334] Gutman, A., & Thompson, D. (2004): 10.
[335] Esterling, K. M., Fung, A., & Lee, T. (2015). How Much Disagreement is Good for Democratic Deliberation? *Political Communication, 32*(4), pp. 529-551.
[336] In order to avoid the separation between lay values and science.
[337] See Sykes, K., & Macnaghten, P. (2013): 100-101.
[338] Gutman, A., & Thompson, D. (2004): 30.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

and whose opinion it is that is being assessed[339], generating a set of variables whose combination results in several methods of public consultation. Thus, before engaging in a deliberative process, some questions have to be clarified, as which participants should be included or excluded, the nature of the decision-making method (e.g. majority, unanimity, veto right) and the way final conclusions are dealt with[340].

The form of public opinion that is targeted can also vary (raw public opinion / deliberative public opinion)[341]. Addressing the issue of representation and the impossible ideal of direct democracy both for practical (large number of citizens) and ethical reasons (incapacity to reach the best laws/justifications), deliberative democracy can be anchored on random sampling[342], or on democratically elected representatives of citizens; several methods of selection can occur: self-selection; nonrandom sample; random sample; everyone[343]. Deliberation *per se* is arguably difficult to obtain from ordinary citizens, which entails the need of adapted approaches to increase the level of deliberation.

The problems and limitations of deliberative democracy derive from some specific issues[344] such as representativeness, with polarization seen as a possible negative antecedent for deliberation[345] if the deliberation is not properly conducted[346]. Indeed, critics of deliberation have raised concerns over the possible domination of privileged members' views during deliberation processes[347]. Also, the concern of the public openness in deliberation arises as some theorists consider that deliberation is facilitated when it does not take place in the public eye[348], although the importance of public openness varies according to the phase of decision process[349]. Another issue is the guarantee of a fair and equal representation, as ordinary citizens are involved but their number is debatable[350].

The resulting decision-making has to respond to the reason-giving criterion, by providing reasons that are accepted by free and equal persons: this moral basis implies all individuals are treated as autonomous agents taking part in the governance process, either directly, or indirectly[351]. Further to the reason-giving requirement[352], deliberative democracy also relies on: the accessibility of the reasons given; the binding nature of the decision produced for some period of time; and on a dynamic process (the dialogue remains open and evolving)[353]. A variety of procedures and rules ensure the effectiveness of deliberative processes, such as the transparent and responsive relationship between citizens and their representatives, both being expected to justify the reasons and decisions[354]. Also, deliberation has to take place in public, and deliberative justifications must be understandable and

[339] Fishkin, J. (2009). *When the people speak: deliberative democracy and public consultation*. Oxford: Oxford University Press, p. 21.
[340] See Pellé, S., & Reber, B. (2016): chapter 5.
[341] Fishkin, J. (2009): 21.
[342] Fishkin, J. (2009): 11
[343] Fishkin, J. (2009): 21.
[344] Irwin, A. (2006): 315.
[345] Steiner, J. (2012): 223.
[346] Polarisation could be considered as a consequence of improper deliberation. See: Steiner, J. (2012): 224.
[347] Fishkin, J. (2009): 100.
[348] Steiner, J. (2012): 125 *sqq*.
[349] Steiner, J. (2012): 125-138.
[350] Steiner, J. (2012): 32.
[351] Gutman, A., & Thompson, D. (2004): 3.
[352] Usually opposed to aggregative social choice procedures and their voting processes, deliberation relies on reason giving, which is its most important characteristic: see Fagotto, E., & Fung, A. (2014): 9.
[353] Gutman, A., & Thompson, D. (2004): 3-6.
[354] Gutman, A., & Thompson, D. (2004): 3.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

clear to those to whom it is addressed[355]. When citizens rely on experts, which frequently occurs, the access to the reasons or the bases of the reasons should still be accessible.

Although the outcomes of deliberation aim at reaching common good, there is disagreement over consensual or pluralist results[356]. Advocates of pluralism argue that it might be "more charitable and more realistic than the pursuit of the comprehensive common good that consensus democrats favor"[357]. However, deliberative democracy does not in itself indicate a unique method for bringing deliberation to a justified conclusion[358], and, furthermore, can "rely on other procedures, most notably voting, which in themselves are not deliberative"[359]. Also, deliberative democracy can contradict the idea that what the majority decides is right, if for instance a minority is deprived of a basic liberty[360]: as opposed to purely procedural forms of deliberative democracy, it can be argued that "the proper conception of deliberative democracy goes beyond process" and even sometimes justice should be prioritised over deliberation[361]. If public deliberation instances are usually born from the initiative and energies of civic organisations and entrepreneurs, their existence through time requires institutional support by politicians and decision makers. With the support of local capacities[362], public deliberation can acquire a social or political embeddedness, which is the regular habit of deliberation in the community's political institutions and social practices, on an iterative basis.

Soft law on Participatory approaches

The blind spot of participation modes

In the absence of regulations on participatory practices in R&I, the literature on the subject reveals the compartmentalisation of the different mechanisms and, at the same time, the complexity of a global distinction of participation modes. Across the scientific literature on the subject, categorisations reveal various viewpoints and criteria in terms of process or objectives.

Value-based categorisation in view of empowerment

One of the classic texts on participation is Arnstein's so-called "ladder of participation", where the bottom represents low active involvement (considered as non-participation) and the top represents high engagement, through 8 ascending rungs: "manipulation", "therapy", "informing", "consultation", "placation", "partnership", "delegated power", and at the upper level "citizen control".

The two lower ranks, termed "manipulation" and "therapy" are identified as "non-participation", as these forms do not enable citizens in planning or conducting programs, but enable powerholders to

[355] Gutman, A., & Thompson, D. (2004): 4.
[356] It should be noted that philosophers in the footsteps of Mouffe and Young have criticised the aim of consensus, arguing it is both unrealistic and undesirable as an outcome, and thus, the aim of deliberation could be to map the divergence of opinions. See Mouffe, C. (1999). Deliberative democracy or agonistic pluralism? *Social Research, 66*(3), pp. 745–758; Young, I. M. (1990). *Justice and the politics of difference.* New Jersey: Princeton University Press.
[357] Gutman, A., & Thompson, D. (2004): 29.
[358] Gutman, A., & Thompson, D. (2004): 19.
[359] Gutman, A., & Thompson, D. (2004): 18.
[360] See Gutman, A., & Thompson, D. (2004): 135.
[361] Gutman, A., & Thompson, D. (2004): 40-41.
[362] Embeddedness requires a public deliberation that is iterative and that is anchored in community-based or governmental organisations: see Fagotto, E., & Fung, A. (2014): 13-14; 19.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

"educate" or "cure" the participants. Going up in this ladder, next degrees are ranked as degrees of "tokenism" as they allow the have-nots to hear and to have a voice. While "informing" and "consultation" levels allow citizens to be informed and have a voice, at the same time their views are not transferred to higher levels: "when participation is restricted to these levels, there is no follow through, no 'muscle', hence no assurance of changing the status quo"[363]. Also in the same category of "tokenism", the mechanism of "placation", allows citizens to advise, although the separation from powerholders is still present.

Upper levels are grouped as "degrees of citizen power", as they are considered to bring the empowerment of citizens, either through "partnerships" with traditional powerholders; or higher, "delegated power"; while at the highest level of empowerment is "citizen control". In the two topmost rungs, "have-not citizens obtain the majority of decision-making seats, or full managerial power". Criticism over this ladder-model of participation has raised the issue of the underlying judgement on what type of participation is best, in an ascendant path[364].

Contextual models of participation

As an alternative to the ladder, the wheel of participation[365], states that four categories of participation (inform, consult, participate and empower) each different in intensity, can be equally appropriate, depending on the context. In this model, the term "participation" can refer both to the overall wheel and to one of the single categories within the wheel. When participation refers to the overall wheel in a comprehensive use of the term, participation indicates all the means by which affected publics take part in policy formulation or implementation[366].

Another model of participation that distinguishes contexts of use is the one rooted in the distinction of activities. Rowe & Frewer[367] propose to rephrase the "disparate area of public participation as public engagement", in which they distinguish three significantly different activities: public communication, public consultation, and public participation[368]. The three concepts have been differentiated according to the nature and flow of information between the exercise sponsors and public participants:

- **Public communication:** information is conveyed from the sponsors of the initiative to the public. In this dimension, information flow is one-way, as there is no involvement of the public in the sense that public feedback is not required or specifically sought. When the public attempts to provide information, there are no mechanisms specified a priori to deal with this at any level beyond, perhaps, simply recording the information. Effectiveness is conceived in terms of "maximizing the relevant information from the sponsor and efficiently transferring it (with minimal information loss) to the maximum number of the relevant

[363] Arnstein, S. R. (1969). A Ladder Of Citizen Participation. *Journal of the American Planning Association, 35*(4), p. 217.
[364] See in particular: i) Davidson, S. (1998). Spinning the wheel of empowerment. *Planning*, 1262, pp. 14–15; ii) Reed, M. (2008). Stakeholder participation for environmental management: a literature review. *Biological Conservation*, *141*(10), pp. 2417–2431; iii) Rowe, G., & Frewer, L. J. (2005): 251; iv) Rowe, Gene and Lynn J. Frewer (2000): 251-90.
[365] Model developed by Davidson, S. (1998): 14–15.
[366] This view is also consistent with Richardson's definition of participation: Richardson, A. (1983). *Participation*. London: Routledge.
[367] Rowe, Gene and Lynn J. Frewer (2000): 251-90; Rowe Gene and Lynn J. Frewer (2005): 251.
[368] Rowe Gene and Lynn J. Frewer (2005): 284.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

population, with the efficient processing of that information by the receivers (the public/participants)"[369].

- **Public consultation:** information is conveyed from members of the public to the sponsors of the initiative, following a process initiated by the sponsor. Significantly, no formal dialogue exists between individual members of the public and the sponsors. The information elicited from the public is believed to represent currently held opinions on the topic in question. Effectiveness is conceived in terms of "maximizing the relevant information from the maximum number of the relevant population and efficiently transferring it (with minimal information loss) to the sponsor, with the efficient processing of that information by the receivers (the sponsors)"[370].
- **Public participation:** information is exchanged between members of the public and the sponsors. That is, there is some degree of dialogue in the process that takes place (usually in a group setting), which may involve representatives of both parties in different proportions (depending on the mechanism concerned) or, indeed, only representatives of the public who receive additional information from the sponsors prior to responding. Rather than simple, raw opinions being conveyed to the sponsors, the act of dialogue and negotiation serves to transform opinions in the members of both parties (sponsors and public participants). Effectiveness is conceived in terms of "maximizing the relevant information from the maximum number of all relevant sources and transferring it (with minimal information loss) to the other parties, with the efficient processing of that information by the receivers (the sponsors and participants) and the combining of it into an accurate composite"[371].

This three-tier classification has been further detailed into a typology revealing four classes of communication mechanisms, six of consultation mechanisms, and four of participation mechanisms[372].

A last interesting approach in this classification of participatory mechanisms is the one that instead of relying on the type of activities, focuses on the variability of characteristics of responsible stakeholder engagement, in regards with the different phases of innovation. Following this approach, some key characteristics allow categorisations: Transparency, Responsiveness, Interaction, and Co-responsibility[373].

Value-based categorisations in view of empowerment and contextual categorisations of participation show the extent of discrepancies between the various mechanisms termed as "participation" although they have little in common in terms of publics, outcomes, timeline, outcomes and relationship with responsible innovation goals.

Soft law's contribution to shaping participatory approaches

A normative instrument

On the side of existing regulations, the main reference on participation is the 1998 Aarhus *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in*

[369] Rowe Gene and Lynn J. Frewer (2005): 263.
[370] Rowe Gene and Lynn J. Frewer (2005): 263.
[371] Rowe Gene and Lynn J. Frewer (2005): 263.
[372] Rowe Gene and Lynn J. Frewer (2005): 285.
[373] This approach is developed in the following publication: Blok, V., Hoffmans, L., & Wubben, E. F. M. (2015): 147–164.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Environmental Matters[374], which establishes the rights of the public with regard to the environment. Despite the focus on environmental matters in this Convention, the general principles may serve our general considerations on regulatory frameworks pertaining to participation. The sixth article of this Convention could be considered as pivotal as it specifies the various kinds of public participation in decision-making, through the following distribution:

- public information[375];
- public involvement procedures[376];
- integration of public participation outcomes[377].

These aspects are complemented by some specificities further to public involvement procedures, notably in the process of programme and policy preparation[378], and preparation of legally binding normative instruments[379].

The Aarhus Convention might be the only normative instrument of its kind addressing the issue of participation directly, which, albeit the specific sectoral focus on environmental concerns, is outlined through a clear breakdown of its characteristics and implications. Yet, given the operationality of this instrument and the distinction of participatory processes, its relevance for wider contexts in science-society relationship is arguably acute. The uptake of such recommendations on participation can rely on the tripartite distinction of participation as: information, consultation, and participation in decision-making. This process of methodical partition between participation processes can be taken as a reference and extended to innovation processes across all sectors.

Policies and soft law

On the level of policies, citizen science frameworks range beyond the scope of normative instruments, and yet can be valuable in defining governance tendencies in participatory practices as a well-defined area. The reign of "do-it-yourself scientists"[380] doing science outside conventional spaces, could be included in groundbreaking features shaping future participatory modes, based on bottom-up approaches and co-creation, through citizen empowerment and inclusion[381]. This reflects the wider tendency of the science-society relationship, which has shifted from top-down traditional approaches (experts governance) towards bottom-up models of public engagement, anchored in dialogue, co-construction of research and innovation agendas, bringing new institutional models and a democratic turn thanks to the new role of the public. Citizen science seems to contribute to this tendency, although we consider that it mostly represents institutionally led (top-down) initiatives[382].

The current great interest in participatory mechanisms engaging citizens in science and technology raise questions on the ways to have meaningful engagement from the top-down and ways to build

[374] The United Nations Economic Commission for Europe (UNECE) (1998, 25 June). *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters*. Aarhus (Denmark). Retrieved from: https://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf
[375] See Article 6 §1; §2; §9.
[376] Article 6 §3 to 7.
[377] Article 6 §8.
[378] Article 7.
[379] Article 8.
[380] Nascimento, S., et al. (2018). Citizen science for policy formulation and implementation. In S. Hecker, et al. (Eds.), *Citizen Science – Innovation in Open Science, Society and Policy*. London: UCL Press, p. 236.
[381] Nascimento, S. et al. (2018): 236.
[382] Nascimento, S., et al. (2018): 234.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

independent, yet effective citizen engagement capacities. While a number of initiatives have sprung over the last decade, existing engagement models suffer from limitations, the majority of them being unable to efficiently provide lay citizens with the skills and capacities to engage and have an impact in scientific and technological developments[383]. Depending on the goal, citizen engagement can be meaningful – e.g. to reach public acceptance, or to reach policy impact – but is not a goal as such *per se*[384]: following this, bottom-up active citizen engagement may not be desirable or meaningful, considering, for instance power differentials between lay citizens and scientists[385]. The engagement of lay citizens finds two cases of justification: i) they should have a say in scientific and technological development that will affect their lives and the broader society in significant ways; ii) they bring valuable knowledge and perspective into decisions and this diversity makes decisions more robust[386].

The institutionalisation of citizen science has led up to the conception of the "Ten Principles of Citizen Science", a framework developed in 2015 by ECSA (European Citizen Science Association), an international community of citizen science practitioners and researchers to set out characteristics of high-quality citizen science, highlighting good practice[387], in order to both support and challenge the citizen science community, and to improve practice. The core principles promoted are based on openness, accessibility, meaningful participation and recognition for contributions[388]. In regards to participation, the involvement of citizens can occur in multiple stages of the scientific process: incorporating local knowledge and expertise can benefit the research, although the impacts of co-created citizen science have not been assessed enough[389].

Citizen science acts as a bridge between citizens and policy-makers, it is renowned as a useful source of information for governments, and is proven effective in fostering open science, thus contributing to policy design and implementation. Yet, the mechanisms are still lacking for citizens to impact evidence-based processes for policy-making[390]. On a general level, several questions arise on the topic of citizen science, as to the different approaches (contributory, collaborative, co-created), and the implementation of such projects at large scale while maintaining interaction with participants throughout the scientific process[391].

Potential citizen science contributions to policy are, mainly:

- meeting the data collection targets of programmes that need to monitor large geographical areas with high frequency;
- providing evidence for assessments through supporting regulatory compliance;
- community empowerment and awareness raising. [392]

[383] Powell, M., & Colin, M. (2009). Participatory Paradoxes. Facilitating Citizen Engagement in Science and Technology From the Top-Down? *Bulletin of Science, Technology & Society*, *29*(4), p. 326.
[384] Powell, M., & Colin, M. (2009): 327.
[385] According to Maria Powell and Mathilde Colin investigation with a Citizens' Coalition on Nanotechnology, citizen engagement can be initiated from the top-down it however requires a significant top-down guidance which is challenging and time consuming. See: Powell, M., & Colin, M. (2009): 327; 331.
[386] Powell, M., & Colin, M. (2009): 327.
[387] Robinson, L. D., et al. (2018). Ten Principles of Citizen Science. In S. Hecker, et al. (Eds.), *Citizen Science: Innovation in Open Science, Society and Policy* (pp. 27–40). London: UCL Press, p. 33.
[388] See: Robinson, L. D., et al. (2018).
[389] Robinson, L. D., et al. (2018): 35.
[390] Nascimento, S., et al. (2018): 230.
[391] Robinson, L. D., et al. (2018): 36.
[392] See: Nascimento, S., et al. (2018).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

These benefits are contributing to general consideration on citizen science as a timely, cost-effective source of information to support evidence-based policy implementation and monitoring, complementing official sources[393]. Indeed, the growing interest in citizen science and its proven economic value thanks to the in-kind contributions, are favouring its further development within policies. Furthermore, it is recognised as instrumental in fostering novel science in research and innovation strategies, policies and initiatives, and ensures research and innovation agendas are guided towards issues of concern to citizens[394].

Negative aspects of citizen science are that it does not necessarily entail more participation of citizens, and does not ensure the participation of local communities. Nevertheless, it acts as a powerful citizen mobilisation and can bring a change in attitudes, since the involvement of public and civil society stakeholders in co-creation fosters public acceptance[395].

At the crossroads of ethics and participation, new pathways for responsible innovation can emerge, drawing from soft law, scientific literature recommendations, and attempts to reach indicators in these multi-dimensional approaches. The following chapter will also build on EU-funded projects' conclusions on the matter, policy recommendations, and analysis of existing gaps in the institutionalisation process and existing frameworks from regulatory bodies.

[393] Nascimento, S., et al. (2018): 221.
[394] See: Nascimento, S., et al. (2018): 226.
[395] Nascimento, S., et al. (2018): 226-228.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

III – ETHICS AND PARTICIPATION ADDRESSING NEW CHALLENGES IN R&I

Merging ethics and participation in PRO-Ethics brings the novelty of two fields which are not combined in the literature to the extent of the full potential of their interactions. Even though the focus on ethics of participation is predominantly addressed by PRO-Ethics' scope, in this theoretical framework the merge of ethics with participatory practices addresses also the specificities of both as they appear in the existing scientific and grey literature. In this section indicators will be reviewed and outlined, while current regulatory frameworks at European level will be examined in order to determine in what way ethics of participation are covered. The challenges and limits, both of theoretical and practical nature, will be outlined in order to determine the way forward, in the next steps of PRO-Ethics.

Institutionalisation and indicators

Variabilities in the institutionalisation of Ethics and Participation

At the intersection of ethics and participation in R&I, the process of institutionalisation has led to useful categorisations that separate fields in ethics and in participatory practices. At the same time, grey literature on the matter indicates discrepancies across EU Member States[396].

Ethics

In the European R&I governance, the engagement with ethics appears in several dimensions: from ethical compliance procedures in European funding schemes, to – more broadly - RRI frameworks. The institutionalisation of ethics varies according to the level of formalisation: formal engagement occurs in institutions dealing with the compliance of research integrity, or ethics in agenda-setting in science, technology and innovation; on the other side, informal engagement with ethics takes place in ad-hoc activities, such as research projects[397]. Although the degree of formalisation varies, this is a disputable distinction as literature on the subject has pointed out the high degree both of precision and of development of ethical thinking in the so-called Ethics Reviews procedure, as part of a quite formalised and thorough procedure of ethical compliance in European funding schemes.

Main observations conducted by MoRRI[398] on ethics[399] across institutionalisation processes underline the importance of ethics committees among EU Member States (half of the higher education institutions having a committee[400]); the lower influence of research integrity offices[401]; and the common practice of ethics assessments by funding organisations in a number of countries[402].

[396] This section builds on conclusions from past EU-funded projects.
[397] Griessler, E., Lang, A., & Wuketich, M. (2015). *Analytical report on the dimension of research and innovation ethics*. MoRRI, Deliverable D2.4.2, p. 10.
[398] The MoRRI ("Monitoring the Evolution and Benefits of Responsible Research and Innovation") project (2014-2018) conceptualised and implemented the first RRI monitoring system in Europe. See: http://morri-project.eu
[399] The following statements are based on the conclusions on ethics in the following publication: Peter, V., Maier, F., Spaini, C., et al. (2018). *Monitoring the evolution and benefits of responsible research and innovation in Europe. The evolution of Responsible Research and Innovation – the Indicators Report.* Luxembourg: Publications Office of the European Union.
[400] Except for Bulgaria.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Perhaps a significant delineation of institutionalisation levels of ethics could be considered in the types of ethical engagements, leading to a threefold distinction[403]:

- *Ethical governance:* "institutionalisation of compliance" through ethics debate in terms of the implementation of standards in research ethics in science, technology and innovation policies (research ethics committees in research performing organisations or RFOs, institutions governing academic integrity);
- *Ethical deliberation:* advisory systems; institutionalisation of ethics debates that raise issues in technological developments in science, and in technology and innovation policies (e.g. ethics advisory committees);
- *Ethical reflection:* academic and societal discussion of ethical issues; institutionalisation of ethics debate that support critical reflection and engagement in debates on research standards, emerging technology issues and social justice in science, technology and innovation policies (informal deliberative activities, academic units dedicated to ethics).

This tripartite distinction helps to dissociate the actors and the cases that have been theoretically outlined through types of institutionalisation that differ in their scope.

Connecting the various ethical approaches to innovation impacts and stakeholder involvement, several directions can be outlined in ethical analysis and approaches. In the SIENNA project[404], some features for ethical analysis of emerging fields and technologies have been outlined, and two methods are presented as most promising[405]:

- Ethical Impact Assessment: a 14-step process beginning with determining the needs of an EIA assessment, and which encompasses principles of privacy and data protection, autonomy, nonmaleficence, beneficence and justice.
- Anticipatory Technology Ethics: with its 3 levels of ethical analysis (technology, artefact, application level), it is geared towards emerging technologies, through forecasting and future studies for impacts anticipation.

The degree and level of connection to participatory methods is however unclear in both methods, although their merits on an ethical level are clearly identified.

This institutionalisation of ethics goes along with a wide array of actors that, perform, fund, monitor and regulate R&I with an increasing integration of ethical considerations through ethical assessment or ethical guidance of R&I[406]. These are mainly: national ethics committees, research ethics committees, associations and networks of research ethics committees, universities and research institutes, science academies and associations of science academies, research funding organisations, academic and professional organisations in science and engineering, standardisation organisations accreditation and certification organisations, governmental organisations and councils, companies,

[401] They are less common in the EU, with the exception of Germany, Belgium, the UK, and to a smaller proportion in Estonia, Greece, Malta, Portugal, and Slovenia.
[402] However, this is not a common practice in countries such as Cyprus, France, Hungary, Portugal, Spain and the UK.
[403] See: Griessler, E., Lang, A., & Wuketich, M. (2015): 6-7; 10; 12.
[404] For the following descripion, see: Rodrigues R., Broadhead S., & Trilateral Research Ltd. (2018). *The consortium's methodological handbook*. SIENNA, D1.1, pp. 14-18.
[405] SIENNA follows here the SATORI project's conclusions.
[406] Shelley-Egan, C., Brey, P., et al. (2015). *Ethical assessment in research and innovation: A comparative analysis of practices and institutions in selected other countries*. SATORI Deliverable D1.1, p. 19.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

business and industry associations, academic and professional organisations in R&I, civil society organisations[407].

Participation

At a minimal stage, public engagement could be defined as a societal commitment to provide tools to empower citizens to participate in R&I debates and processes; at a deeper level of engagement, citizens can become peers in the knowledge production or assessment and government processes[408]. The separation between *stakeholder engagement* and *public participation* (engagement) allows to distinguish the representation of specific interests (individual, or collective) from the involvement of the general public in R&I activities and decision-making.

Grey literature on the subject draws the separation between these two forms that share the same aim, with different positions. The increase of public dialogue about new developments in science and technology has mainly focused on stakeholder engagement and less on public participation, the first one allowing a more granular participatory design across categories, such as end users, citizens and representatives of interests groups. In most cases, the two categories overlap to a significant degree and are used interchangeably, even in literature that takes stock of the differences[409]. Both stakeholder engagement and public participation are "expected to more ethical R&I because a greater number of viewpoints and interests will be represented in them, or that ethical issues will be considered carefully"[410]. This causal link is however questionable, as a diversity of views does not necessarily always entail more ethical results and discussion, nor a representation of diverse views in a more efficient way than it could be on specialists' side.

On EU scale, public engagement is institutionalised to a varying degree across funding structures, with inequalities in infrastructures supporting engagement of citizens across countries, despite an increasing involvement of citizens in R&I processes, also in higher education institutions[411]. Evaluation of public engagement is considered to be absent from evaluation mechanisms in several countries, which indicates some limitations in its institutionalisation[412].

Also pointing in this direction are the variabilities of public involvement in science and technology decision-making across Europe in terms of formalisation of participatory mechanisms[413]. This indicator of institutionalisation intersects two dimensions: the identification of formal structures and mechanisms for citizen involvement in view of decisions about science and technology; and a second dimension identifying the degree to which citizens are effectively involved in making decisions. While some countries have formalisation of participatory mechanisms and high levels of citizen

[407] Shelley-Egan, C., Brey, P., et al. (2015): 19.
[408] Strand, R., Spaapen, J., et al. (2015). *Indicators for promoting and monitoring Responsible Research and Innovation. Report from the Expert Group on Policy Indicators for Responsible Research and Innovation*. Luxembourg: Publications Office of the European Union, p. 21. This report reflects the work of an expert group that was appointed early 2014 by the European Commission "to identify and propose indicators and other effective means to monitor and assess the impacts of Responsible Research and Innovation (RRI) initiatives, and evaluate their performance in relation to general and specific RRI objectives".
[409] For instance, among grey literature, the SATORI project either identifies the separation of both categories, or combines them without specifying: see Shelley-Egan, C., Wright, D., et al. (2014): 16.
[410] Shelley-Egan, C., Brey, P., et al. (2015): 32.
[411] Peter, V., Maier, F., Spaini, C., et al. (2018): 54.
[412] Peter, V., Maier, F., Spaini, C., et al. (2018): 54.
[413] Peter, V., Maier, F., Spaini, C., et al. (2018): 42.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

participation, others have less formalised or non-formalised structures. This also points out that higher degree of formalisation entails higher involvement of citizens[414].

The MoRRI project analyses "citizen engagement and participation of societal actors in research and innovation" (abbreviated to "public engagement"), which is conceptually defined through activities where there is a distinct role for citizens and/or societal actors in research and innovation processes. Public engagement is separated into five categories: public communication, public activism, public consultation, public deliberation, and public participation[415]. The start of participation in research and innovation can be located in the 1960 and 70s, when public concern with developments in science and technology rose, when concerns about

> "environmental depletion, consumerism, nuclear power, the dominance of multinational corporations, the risk of war etc. challenged the prevailing positive understanding of science and technology, and emphasized a need to discuss science and technology not only as instruments for solving military, economic, and social problems, but also as a source of social and environmental problems" [416].

This led to a reconceptualization of modern science and technology "as a social activity with significant societal implications"[417]. In parallel, the 1980s and 90s

> "saw early, and scattered, policy responses to public concerns and scientific risks. Systematic technology assessment procedures and the establishment of dedicated organisations, ethical committees, as well as increased science communication efforts were introduced heterogeneously across countries, and in some cases, specific institutional arrangements were developed to facilitate public and stakeholder involvement in issues related to science and technology".

Correspondingly, the literature on participation has become rich and diversified. Yet, some general trends can be discerned:

- the field of public engagement and participation can be characterized by "a general turn from one-way and top-down models of communication towards increased focus on 'new' dialogue-based approaches"[418].
- a second characteristic[419], is that the appropriate form of participation is very context specific: where early literature on participation presented more intensive forms of participation as more desirable, literature from the late 1990s presents a more nuanced view on participation, as inherently situational[420] and that therefore no single best participation approach for RRI exists.

Further to categorisations proposed in the scientific literature on the subject, some recommendations for categorisations can be found on the side of the institutionalisation and governance of participation. The International Association of Public Participation (IAP2) establishes a distinction of participatory

[414] Peter, V., Maier, F., Spaini, C., et al. (2018): 42.
[415] See Mejlgaard, N., & Ravn, T. (2015). *Monitoring the Evolution and Benefits of Responsible Research and Innovation. Analytical report on the dimension of citizen engagement and participation of societal actors in research and innovation*. MoRRI Deliverable D2.1, p. 2.
[416] Mejlgaard, N., & Ravn, T. (2015): 10-11.
[417] Mejlgaard, N., & Ravn, T. (2015): 11.
[418] As described in: Mejlgaard, N., & Ravn, T. (2015): 10.
[419] Less highlighted in the MoRRI project, though.
[420] See: Rowe, Gene and Lynn J. Frewer (2000): 3-29.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

practices according to their main outcomes: "inform", "consult", "involve", "collaborate", and "empower"[421]:

- *Inform* refers to governmental organisations that provide the public with balanced and objective information[422].
- *Consultation* refers to obtaining feedback from stakeholders on analysis, alternatives or decisions, e.g. through surveys or a local citizens meeting where citizens are invited to share their concerns about a certain policy.
- *Involvement* means working directly with the public, to ensure that the concerns and ideas of the public are considered.
- *Collaboration* means that all parties collaborate as partners.
- *Empowerment* refers to the process of handing over control to stakeholders by delegating decision-making power to communities[423].

In addition to these recommendations for distinction within participation governance, the AA1000 Stakeholder Engagement Standard (SES)[424], aims to establish the benchmark for good-quality engagement, being a "generally applicable framework for the assessment, design, implementation and communication of quality stakeholder engagement". Claiming that its own design has been "developed using a broad-based, consultative, multi-stakeholder process", this framework is however a less useful tool for categories identification, although it may be particularly informative for assessing the quality of participation.

Indicators for Ethical engagement

Further to the previously examined categorisations, the efficiency of ethical engagement and public engagement can be reached through indicators, which help reinforce the science-society relationship thanks to enhanced dialogue between scientists and the public. This is commonly reflected in endeavours aiming at enhanced democratic values: "including activities not only pursuing a dialogue (among researchers, citizens and other stakeholders), but also searching for a democratic participation of citizenship in decision-making process" [425]. In ethics engagement, as the institutionalisation has led to categorisation and distinction of fields of action for ethical engagement, the concern for impact indicators is part of the same process. Such indicators have been outlined in the context of RRI[426] monitoring, as key areas, among which, ethics, have to prove their efficiency. Paradoxically enough, while "there is no clear consensus about what RRI exactly entails, nor about how to measure its impact"[427], there is a shift of the governance process towards indicators and best practices identification for its key areas. The following analysis will present past conclusions of the MoRRI project and recommendations by the European Commission for new indicators.

---

[421] International Association for Public Participation (IAP2) (2018). IAP2's Spectrum of Public Participation. See online: https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf

[422] In many categorisations, this will not be considered as "participation".

[423] See: Davidson, S. (1998):14–15.

[424] See: AccountAbility (2015).

[425] Strand, R., Spaapen, J., et al. (2015): 49.

[426] In this context RRI is broadly understood as "process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products": Von Schomberg, R. (2012b). Quoted in Strand, R., Spaapen, J., et al. (2015): 5.

[427] Strand, R., Spaapen, J., et al. (2015): 5.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

MoRRI conclusions on Ethics

Current indicators on ethics among EU Member States in the context of research and innovation, have allowed a significant overview from the perspective of an institutional approach to ethics, describing it primarily in terms of how the institutions in place "secure" ethics and not so much in terms of specific ethical challenges. It is operationalised in terms of the degree to which ethics or research integrity committees are in place, and the strength and breadth of their influence on research activities. Strong ethics committees can be characterised where the submission of applications to the committee is obligatory, all disciplines are covered and where decisions are binding. The associated indicators are measured at the national level and apply to both public research organisations and funding organisations:

- Ethics at the level of research performing institutions consists of two measures[428]:

i) a measure of the share of higher education institutions and public research organisations with a research ethics committee or a research integrity office;

ii) an index measure designed to provide information on the level of mechanisms that should safeguard the observance of ethical standards in research ethics and research integrity implemented within higher education institutions at the country level;

- National Ethics Committees index is a composite measure of the existence, output, impact and quality of national ethics committees across EU-28 Member States[429];
- Research-funding organisations' ethics index covers mechanisms dealing with ethics and societal implications in public and private RFOs.

This analysis does not look at substantive ethics issues (like for example, privacy, sustainability, well-being)[430], but considers primarily the procedural level (i.e., institutionalisation of ethics). There is a wide variation in the prevalence of research ethics committees across Member States, as they are very commonplace among universities in some countries, such as the United Kingdom, Malta and Portugal, and only exist at a minority of universities in others, such as Sweden, Austria, Estonia and Bulgaria. The availability of research integrity offices also varies greatly.

Recommendations from the European Commission for indicators

Another approach can rely on the report from the Expert Group on Policy Indicators for Responsible Research and Innovation (DG Research and Innovation)[431] that integrates the results from several RRI projects funded by the EU and proposes a new approach towards indicators, distinguishing three different aspects of ethics. Ethics have been divided into: research integrity and good research practice; research ethics for the protection of the objects/human subjects of research; societal relevance and ethical acceptability of R&I outcomes[432]. Across these three main subfields of ethics, the European Commission has identified in 2015 some gaps in current indicators for ethics, as they

[428] Listed as indicator "E1": See Griessler, E., Lang, A., & Wuketich, M. (2015).
[429] As the PRO-Ethics project started before the official withdrawn of the United Kingdom from the EU (31 January 2020), and due to the composition of the project's consortium - involving a member from UK - the project systematically considers 28 Member States (27 current official, and UK as a former Member).
[430] Discussion of substantive issues can, for example be found in Van den Hoven et al. (2014), which includes several concrete technologies that are explicitly developed or analysed within a responsible innovation framework.
[431] See: Strand, R., Spaapen, J., et al. (2015): 5.
[432] Strand, R., Spaapen, J., et al. (2015): 7.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

used to be mostly quantitative. The European Commission has identified[433] these limits and made some recommendations for new indicators for ethics in RRI, proposing an evolution from quantitative data to the inclusion of qualitative indicators - varying according to the concerned subfield in ethics:

- Research integrity (and good research practice);
- Research ethics for the protection of the objects of research (human beings, animals and other objects of research);
- Societal relevance and ethical acceptability of R&I outcomes.

The European Commission's recommendations for future indicators in each category can be summarised as follows[434] (see figure, next page):

[433] Strand, R., Spaapen, J., et al. (2015): 34.
[434] The following table is a summary of the recommendations for indicators listed by the European Commission for Ethics. See: Strand, R., Spaapen, J., et al. (2015): 34 *sqq*.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

	Research integrity (and good research practice)	Research ethics for the protection of the objects of research	Societal relevance and ethical acceptability of R&I outcomes
Field of action	Monitoring the level of awareness and ability to adequately handle the tensions and discrepancies between official norms, values and actual practices.	Ensuring the protection of human beings, animals and other objects of research.	The expansion of this field brings it close to broader RRI issues and to the general policy of RRI, with topics such as, e.g.: sustainable development, social justice and inclusions.
Type of indicators needed	Process and perception indicators (rather than outcome indicators).	Qualitative indicators that will involve the exercise of judgement on behalf of the data provider or analyst.	Qualitative indicators, to provide a substrate and a template for meaningful deliberation and interaction between actors within the networks.
Key indicator(s)	Process & perception indicators: - Documentation of institutional attention to normative tensions related to research integrity policies and actions.	Outcome indicator: - Percentage of research proposals for which the ethics review / internal review board (IRB) clearance process requires substantive changes in grant application or second ethics assessment. Process indicator: - The formal and actual scope of the ethics review/IRB clearance.	Process indicators: - Documented change in R&I priorities (research or research funding) attributable to multi-stakeholder and/or trandisciplinary processes of appraisal of societal relevance and ethical acceptability; - presence of mechanisms for multi-stakeholder and/or trandisciplinary processes of appraisal of societal relevance and ethical acceptability; - ELSI/ELSA[435] and/or transdisciplinary component in research projects, that addresses societal relevance and ethical acceptability; *Perception indicator:* - Public awareness and evaluation of mechanisms for multi-stakeholder and/or trandisciplinary processes of appraisal of societal relevance and ethical acceptability.

[435] ELSI/ELSA are the acronyms for "Ethical, Legal and Social/societal Implications/issues/Aspects" that can be found in a specific field or research or innovation.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Like the MoRRI project, this interpretation of ethics does not focus on specific values. In the document itself, some values are included as specific dimensions of RRI (gender equality, sustainability, social justice/inclusion). Though not focusing on innovation *per se*, the literature on research and scientific integrity may also be partly relevant for PRO-Ethics framework. Some of the most recent literature on scientific integrity also covers the incentives that are conducive to irresponsible research behaviour[436]. Complementary to the institutionalised aspects of research integrity, some authors[437] have developed a set of recommended principles and best practices that can be used broadly across scientific disciplines as a mechanism for consensus on scientific integrity standards and to better equip scientists to operate in a rapidly changing research environment. These are intended to foster a culture of scientific integrity.

As part of the institutionalisation of ethics, the presence of indicators for ethics serves to measure and identify some criteria of ethical issues, ethical awareness or activity[438]. Given the high level of complexity to assess qualitative indicators, these recommendations would, however, face major barriers in their implementation, taking into account, also, that indicators are "highly contextual"[439].

Indicators for Participation

Through their institutionalisation, participatory practices in innovation can be outlined through current indicators or through recommendations for new approaches. The graduated approach of public engagement offers "different degrees of agency" and a broader view of participation indicators, which are disputable. Due to the differences across countries in terms of definition and implementation of public engagement, the measurement of participation faces difficulties in reaching precision beyond general motivational estimates[440].

The MoRRI project distinguishes between engagement of other actors in science, in order to inform and/or educate citizens, to inform decision makers and create awareness in order to influence decision-making processes, to facilitate interaction and dialogue, and to involve citizens in decision-making. There are thus a number of aspects of public engagement concerning participation, facilitation and actions to promote engagement. Public engagement indicators developed in the MoRRI project include:[441]

- PE1: Models of public involvement in science and technology decision-making;
- PE2: Policy-oriented engagement with science;
- PE3: Citizen preferences for active participation in science and technology decision making;

[436] Edwards, M. A., & Siddhartha, R. (2017). Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition. *Environmental Engineering Science*, *34*(1), pp. 51-61.
[437] Kretser, A., Murphy, D., Bertuzzi, S., et al. (2019). Scientific Integrity Principles and Best Practices: Recommendations from a Scientific Integrity Consortium. *Science and Engineering Ethics*, *25*(2), pp. 327–355.
[438] See Strand, R., Spaapen, J., et al. (2015): 34.
[439] Strand, R., Spaapen, J., et al. (2015): 5. Further to this, and in addition to empirical barriers, other difficulties arise on the level of meta-ethics, at the intersection of moral realism and contextualism (throughout its various features).
[440] Measures of public interest over the past decade relate mostly to general estimates of changes in interest in R&I issues, trust in science, degrees of optimism, through Eurobarometer surveys. See: Strand, R., Spaapen, J., et al. (2015): 22.
[441] These indicators can be found in the following MoRRI report: Peter, V., Maier, F., Mejlgaard, N., et al. (2018). *Monitoring the evolution and benefits of responsible research and innovation in Europe – Summarising insights from the MoRRI project*. Luxembourg: Publications Office of the European Union, p. 14.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- PE4: Active information search about controversial technologies;
- PE5: Public engagement performance mechanisms at the level of research performing organisations;
- PE7[442]: Embedment of public engagement activities in the funding structure of key public research-funding agencies[443];
- PE8: Public engagement elements as evaluative criteria in research proposal evaluations;
- PE9: Research and innovation democratization index;
- PE10: National infrastructure for involvement of citizens and societal actors in research and innovation.

EU recommendations for future indicators

Similar to the approach on ethical engagement, the efficiency of participatory processes can be assessed either by performance indicators (process indicators / outcome indicators) or by perception indicators. This distinction is part of a global appreciation framework for RRI, applicable to all RRI keys and can be found in the Report from the Expert Group on Policy Indicators for Responsible Research and Innovation[444]. The integration of participatory approaches in R&I governance builds on the "deficit model of science communication", seeing a correlation between information and acceptance (lower rejection rates), although the opposite correlation is also happening, leading to a contextual model of interpretation of the science-society relationship[445]. The application of performance and perception indicators to public engagement (PE) can be delineated into three dimensions, and summarised as follows[446]:

[442] There is no public engagement indicator PE06 in this list, as the originally planned PE06 has been removed from the MoRRI project.
[443] Indicating "whether a country's largest and most prominent funding organisations allocate competitive funding to explicit public engagement activities". See Peter, V., Maier, F., Mejlgaard, N., et al. (2018): 47.
[444] Strand, R., Spaapen, J., et al. (2015). *Indicators for promoting and monitoring Responsible Research and Innovation. Report from the Expert Group on Policy Indicators for Responsible Research and Innovation.* Brussels: European Commission - Directorate-General for Research and Innovation, p. 22 sqq.
[445] See Strand, R., Spaapen, J., et al. (2015): 49.
[446] Elements of this table can be found in: Strand, R., Spaapen, J., et al. (2015): 25.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

	PE dimension of policies, regulation & frameworks	PE dimension of event and initiative making / attention creation	PE dimension of competence building
Performance indicators (R&I processes and their outcomes)	Process indicator: Formal commitment (mission statements) of key actors or in research projects	Process indicator: Science events/initiatives and public attention raising (by scientists or outsourced): e.g. science events, public debates (all kinds of participatory formats). Also citizen science initiatives; and crowdfunded science and technology development.	Process indicator: Measurement of the penetration and development of the training (especially at university level) of communicators and science mediators; and of science event/initiative makers.
	Outcome: PE funding as percentage of R&I expenditure (ratio of 5% allocated to PE-related activities considered as best practice); evidence of the involvement of citizens.	Outcome: Public mobilisation indicators (e.g. mass media coverage; social media references); civil society activism.	Outcome: Level and type of staffing of the communication function of research projects/ research institutes and universities (and degree to which it is performed in-house or outsourced).
Perception indicators (how processes and outcomes are perceived)	Measurement (surveys) of public expectations of involvement in public consultations.	Individuals' reports about taking part in such events/activities: (including involvement in civil society organisations)	Classical indicators of the public understanding of science: e.g. knowledge beliefs; trust and confidence; attitudes (utilitarian expectations, fundamental orientations)

The three public engagement categories have the same set of key actors: States, regions, cities, universities (and university departments), research centres, research projects, sections of the public, civil society organisations. Although not all indicators mentioned are currently implemented or developed to the same degree, the general approach sets a "toolbox" which allows national and regional actors, universities and research institutes, civil society organisations, funding agencies and others to adapt and set up useful indicators according to the context of use[447].

[447] Strand, R., Spaapen, J., et al. (2015): 41.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Challenges in existing regulatory frameworks

Current landscape of regulatory bodies dealing with ethics & participation

On a practical side, the current European landscape of regulatory bodies can reveal gaps and difficulties in the merging of ethical practices with participatory practices in research and innovation. A critical review of literature and documents published in the course of the last decade provides an insight on the way different regulatory bodies and ethics bodies are dealing with participation. For this purpose, the following institutions have been examined[448]:

- Research Ethics Committees (RECs)
- Research Integrity bodies (RIOs)
- Ethics Councils and Ethics Advisory Bodies
- European Parliament and the European Council
- Council of Europe
- Professional Organisations
- NGOs and Citizen Organisations

The methodological search for links to "participation" (broadly understood) has allowed the identification of an overall lack of precise definition of the participatory approach and of the objectives to which it is connected. Similarly, the vague connection to ethics does not allow the identification of ethical tensions, nor of legitimacy of participation, or of the degree of formalisation of participatory processes. Indeed, the mention of "participation" in a normative or regulatory text does not necessarily provide information on the form of participation. Moreover, across literature a recurrent feature is the absence of clear identification of who the exact addressees of the concern of participation are. However, it can be seen that the more application-oriented a recommendation or regulatory text is, the clearer the picture of the addressees becomes, for example in the case of patient representatives. But, even this usually leaves the field open to which methodology the authors of the texts imagine for successful participation. At a general level, the literature examined indicates two broad categories of participation:

- engagement of citizens and the public in general;
- engagement of specific interest / stakeholder groups (e.g. patients or caretakers in the health context, NGOs or social entrepreneurs in other fields).

Participatory practices in Research Ethics Committees (RECs)

Among the few examples that can be found, the resources claim the involvement of laypersons, patients or patient organisations to reach diversity in viewpoints during research project reviews. Although participation remains undefined as a process, some categories emerge: laypersons; patients; patient organisations; the general public. As participatory approaches are not a component which is developed enough across these resources, the link between ethics and participation, as well as potential tensions remain a blind spot of these resources; participation is identified as a general process of involvement that is needed to guarantee an ethically sound review process.

[448] This analysis has been conducted by EUREC for the purpose of this deliverable of the PRO-Ethics project.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

The most relevant document raising this is the EU regulation on clinical trials on medicinal products for human use[449], which indicates that in the decision-making for clinical trials "at least one layperson shall participate in the assessment [of applications]"[450].

Another resource pointing in the same direction is the Guide for Research Ethics Committee Members[451], which underlines that:

> "The appointment mechanism should ensure that potential REC members provide an appropriate balance of scientific expertise, philosophical, legal or ethical backgrounds, and lay views. All REC members, whether professional or lay members, should have an equal standing."[452]

Participatory practices in the field of research integrity

Several research integrity bodies and representative institutions of this field have been analysed: ENRIO; World Conferences on research integrity (WCRI)[453]; the European Network for Academic Integrity (ENAI)[454]; the European Network for Ombuds in Higher Education (ENOHE)[455]; the UK Research Integrity Office (UKRIO)[456]; the Austrian Agency for Research Integrity (OeAWI)[457]; the Czech Academy of Sciences[458]._None of the resources comprised any relevant mention of participation, although all these resources (codes, notably) underline the importance of ethical principles (fairness, transparency, gender, privacy, sustainability), which are the basis for citizens' engagement.

Participatory practices in statements from Ethics advisory bodies

The most relevant statement on participatory practices is the one published by the European Group on Ethics in Science and New Technologies (EGE) on "The ethical implications of new health technologies and citizen participation"[459]. This publication focuses on citizen science perceived as an "active participation" form, and recognises and encompasses several individual or organised actors: "stakeholders, lay persons, patients and consumers but also and in counterpoint, organised interest groups, lobbies and corporate bodies"[460]. Other resources have shown variations in the identification of participation and participants, depending on the relevant field of application: while the health sector targets patients and citizens, the sector of big data, for instance, usually refers to the involvement of the general public.

---

[449] European Parliament and European Council (2014, 16 April). Regulation (EU), N° 536/2014 on clinical trials on medicinal products for human use, and repealing Directive 2001/20/EC. *Official Journal of the European Union, L 158,* 27.5.2014, pp. 1–76. Retrieved from: https://ec.europa.eu/health/sites/health/files/files/eudralex/vol-1/reg_2014_536/reg_2014_536_en.pdf

[450] European Parliament and European Council (2014, 16 April): Article 9, §3

[451] Council of Europe (2012, April). *Guide for Research Ethics Committee Members. Steering Committee on Bioethics. Strasbourg: Council of Europe. Retrieved from:* https://www.coe.int/en/web/bioethics/guide-for-research-ethics-committees-members

[452] Council of Europe (2012, April): 19.

[453] See online: https://wcrif.org

[454] See online: https://www.academicintegrity.eu/wp/

[455] See online: http://www.enohe.net

[456] See online: https://ukrio.org

[457] See online: https://oeawi.at/en/

[458] See online: https://www.avcr.cz/en/

[459] European Group on Ethics in Science and New Technologies (EGE) – European Commission (2015). *The ethical implications of new health technologies and citizen participation*. Luxembourg: Publications Office of the European Union.

[460] European Group on Ethics in Science and New Technologies (EGE) – European Commission (2015): 24.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Participatory practices in codes/guidelines on emerging technologies

A sectoral analysis in the field of AI and Robotics (codes and guidelines) shows a general approach of participation, encompassing the relevant public authorities and stakeholders; society as a whole; and local communities. In these two emerging technology sectors, participation is mostly perceived through the spectrum of future impacts on society: the people (or groups) who might be affected by developments of AI and Robotics technologies. Three main documents are supporting these assumptions. The IEEE Code of Ethics[461] mentions the need to provide adequate public information so as individuals and society may understand the potential impacts of emerging technologies[462]. Also emphasising public information, the Montreal Declaration for a Responsible Development of Artificial Intelligence[463] identifies key principles, among which a "democratic participation principle" mentioning that artificial intelligence systems "must be subjected to democratic scrutiny, debate and control"[464]. Another statement on the importance of community engagement can be found in the Humanitarian UAV Code of Conduct[465], which bridges emerging technologies and humanitarian applications: this resource mentions trust building with local communities as a pillar, also allowing communities to be active participants[466].

Overall, the study of resources across ethics regulatory bodies shows that the connection between ethical practices and participation is not yet developed enough, as the connection is often unspecified, maintained at the level of a general appreciation of potential benefits to keep a transparent relationship with society across R&D&I processes. As there are no precisions on the participatory practices themselves, public involvement is generally mentioned as public information, without further elaboration. Also, participants themselves are rarely distinguished, being globally identified as "citizens", "lay people", or "patients" in the health sector. Two exceptions to this are the mention of citizen science which refers to a specific form of public involvement (whose connection with decision-making has to be clarified, in each case); and the mention of research subjects which also refers to a specific form of participation where citizens are also themselves part of the R&D&I process. In addition to this, the sectoral specificities of the health sector and of emerging technologies (AI and robotics) evolve in the direction of public information for potential/future impacts of R&D&I processes and products on society (here too the connection with decision-making varies), proving the advancement of these fields in the inclusion of participatory practices as a pre-requisite in most cases.

[461] The Institute of Electrical and Electronics Engineers (IEEE) (2006). *IEEE Policies: Code of Ethics*, Section 7. Retrieved from: https://www.ieee.org/about/corporate/governance/p7-8.html

[462] The Institute of Electrical and Electronics Engineers (IEEE) (2006): point 5: "to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems".

[463] University of Montreal (2017). *The Montreal Declaration for a Responsible Development of Artificial Intelligence.* Retrieved from: https://www.montrealdeclaration-responsibleai.com

[464] See: University of Montreal (2017): Principle 5: "In accordance with the transparency requirement for public decisions, the code for decision-making algorithms used by public authorities must be accessible to all, with the exception of algorithms that present a high risk of serious danger if misused."

[465] Humanitarian UAV Network, (2015). *Humanitarian UAV Code of Conduct.* This code of conduct informs the responsible use of civilian drones or unmanned aerial vehicles (UAVs) in humanitarian settings. Retrieved from: https://uavcode.org

[466] This Code of conduct mentions: "building trust with local communities allows them to be active partners, decision makers and enablers, thus enhancing the mission and humanitarian/development impact"; "developing trust and engaging local communities encourages active partnership, builds local capacities and leadership and enhances the impact of your mission".

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

The limits of ethics of participation in R&I

On the side of policy-making, the main limits of ethics of participation are to be found in the operationality of ethical frameworks, in regards with participation broadly understood. Participatory governance ensures stakeholders are able to participate to ethical issues that shape the future of our societies, as a whole, as public engagement fosters social commitments and strong social outcomes. If categorisations of participation are a useful tool that can help sharpen the efficiency of policy-making in this field, however, "a further step involves understanding and defining, perhaps via a second typology, the different types of *context* in which engagement takes place"[467]. The categorisation entails that the selection of a participation mechanism has to be defined according to the context, and of the anticipated effects: contextual criteria have to be measured in the final visible effects of a decision-making process[468].

Considering norms and paradigms for ethical governance of R&I, two sources of limits can be seen in the connection of ethics and participation: on the one side, ethical governance problems underline the gap between the ethical and technical expertise confronted with ethical problems in research and innovation developments[469]. On the other side, public engagement governance is confronted with multifaceted approaches and contextual preferences that do not allow a comprehensive view. Also, the reduction of ethics to consensus or to regulatory framings is another obstacle as moral values are often "compromised for the sake of consensus in reaching an ethical norm"[470]. The predominant views of technical experts in governance may hinder the development of ethical issues in a participatory way.

Another limitation can be seen in the reduction of stakeholders' involvement to poorer forms of participation, as EGAIS' conclusions underline this:

> "Involving stakeholders into ethical governance of projects does not go beyond using stakeholders as feedback mechanisms to inform the design process, rather than addressing and solving the ethical issues, which would mean adjusting the technology or in extreme cases abandoning it."[471]

Seeking for a wider participation that goes beyond unspecified recommendations by regulatory bodies or the Ethics Reviews formalised scheme – limited to publicly funded EU research and innovation, the path forward seems to be dependent on the level of clarity of context and categories at stake. Yet, even well-advanced mechanisms such as Ethics Reviews are confronted with a number of challenges reported by Research ethics committees (RECs) and RFOs[472]:

- lack of clear procedures (standards, protocols, guidelines, tolls) for ethics assessment;
- heterogeneity in approaches and guideline implementation;
- overloaded ethics committees, lack of fruitful discussion, human factors, inconsistence reviews;

[467] Rowe, G., & Frewer, L. J. (2005): 286.
[468] Shelley-Egan, C., Wright, D., et al. (2014): 5.
[469] Kurt, A., Duquenoy, P., Lavelle, S. (2010). *Ethical Governance Models, Paradigm Recognition and Interpretation*. EGAIS Deliverable D3.1, p. 45.
[470] Kurt, A., Duquenoy, P., Lavelle, S. (2010): 45-46.
[471] Kurt, A., Duquenoy, P., Lavelle, S. (2010): 46.
[472] It might be important to note here that in research funding organisations, ethics assessment of research proposals is not always formalised.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- lack of resources (financial, human, time, knowledge).[473]

An additional limitation in policy-making is the timeframe of development of R&D&I projects. They are intrinsically confronted with the timing gap with legal and ethical compliance, as the second does not necessarily anticipate all developments:

> "we need to do more to create a regulatory environment for innovation to flourish. How do we make sure that legislative processes that take several years can adapt to technologies that evolve every month? How do we make sure that regulation is based on an innovation principle as well as a precautionary principle?"

Grey literature resources also focus on good practices in participatory processes as part of ethics-related projects in order to anticipate some difficulties. According to SATORI[474], a number of criteria should be taken into account, in the preparation, the design, the implementation and the follow-up of participatory processes. The preparation entails the clear identification of the goals and wise selection of stakeholders and targets groups, as well as the participatory approach, so as to reach a process that aims towards co-construction in strategy-setting and decision-making[475]. On the design level, a bottom-up and flexible approach allows to engage with stakeholders on the process and the results as to reach representativeness and generate added-value[476]. During implementation, having a good facilitator is an essential element that, however, should not undermine the contribution of lay people, as the main issue is to have a balanced and open process. The follow-up phase after the participatory process should provide an analysis of the outcomes of the process and get further feedback. This process and the further recommendations raised by SATORI project provide detailed recommendations at the participatory process level and a number of technical difficulties are raised, such as the "difficult[y] to detect the direct influence of participatory activities on the policy-making process"[477]. From this analysis, the gaps point out the differentiation of clear levels of ethical engagement, as well as the lack of a comprehensive approach of participatory mechanisms across R&I processes, which differ in nature and timing (before, during or after R&I processes).

Although the legitimacy of public participation and the variety of its objectives make it a positive element, motivations can vary. Considering the normative justification angle, citizens who might be affected by upcoming decisions have the right to participate in these decisions; from an instrumental viewpoint, the motivation might be the need to defuse conflict, and ensure public trust towards the development of new innovations. Substantive justifications, in turn, "reflect the assumption that such participation from people who will use and/or be affected by a technology will raise questions about the real life functioning of development when they leave the laboratory, perhaps leading to innovations that perform better in complex real-world conditions, or that may be more socially, economically and environmentally viable"[478]. EU policies are supported by strong normative assumptions: in R&I, policies rely on weak normative assumptions, and with the ongoing tensions with ethics, often seen as a

[473] The full list and comparative approach can be found in the study conducted in the SATORI project: Shelley-Egan, C., Brey, P., et al. (2015): 80-82.
[474] The SATORI ("Stakeholders Acting Together On the ethical impact assessment of Research and Innovation") project (2014-2017) aimed to develop a common European framework for the ethical assessment of R&I. See online: https://satoriproject.eu
[475] See: Shelley-Egan, C., Wright, D., et al. (2014): 6
[476] See: Shelley-Egan, C., Wright, D., et al. (2014): 7.
[477] Shelley-Egan, C., Wright, D., et al. (2014): 8.
[478] Marris, C., Rose, N. (2010). Open Engagement: Exploring Public Participation in the Biosciences. *PLoS Biology, 8*(11); quoted in Shelley-Egan, C., Wright, D., et al. (2014): 13.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

constraint, the way towards unified EU policies with strong normative assumptions encompassing innovation is still a worksite.

Towards a comprehensive framework for ethical participation in R&I

Criteria for active ethical participation

Amongst the great variety and number of public engagement mechanisms[479], the identification of best practices is not easy as there is uncertainty on "as to how one should *best* enact involvement"[480]. Only a theory of the contingent effectiveness of engagement mechanisms can be developed, in light of the inherent variability, as one mechanism is unlikely to be the most appropriate/effective in all situations.[481] The effectiveness of public engagement depends on the mechanism and the way it is applied, along with the presence of active, as opposed to passive participants (those who do not speak e.g.), as well as the aggregation process and its efficiency, as the equity in input is not guaranteed in group-based output where according to the procedure, polarization and influence can occur diversely[482].

Through formalised forms of public engagement, feedback on effective experiences with metrics of efficiency allow concrete evidence for policy-making or what could be referred to as "soft governance". In the absence of precise indicators, such metrics can rely on criteria which help to determine the pros and cons of main current participatory processes of public engagement. Seeking democratic choice and consent, public participation should be framed through precise criteria that can ensure both its legitimacy and efficiency. Regarding the issue of acceptance, the following criteria could be considered[483]:

- Representativeness: participants should comprise a broadly representative sample of the population of the affected public and represent the relative distribution of views;
- Early involvement: the public should be involved as early as possible in the process as soon as value judgments become salient;
- Influence: the output of the procedure should have a genuine impact on policy;
- Transparency: the process should be transparent so that the public can see what is going on and how decisions are being made.

In terms of process, efficient public participation could align on the following criteria[484]:

- Accessibility: public participants should have access to the appropriate resources to enable them to successfully fulfill their brief;
- Task definition: the nature and scope of the participatory task should be clearly defined at the outset, so that there is as little confusion and dispute as possible regarding the scope of a participation exercise, its expected output, and the mechanisms of the procedure;
- Structured decision-making: the participation exercise should use/provide appropriate mechanisms and tools for structuring and displaying the decision-making process;

[479] Views diverge on the number/categories of techniques. See: Rowe, G., & Frewer, L. J. (2005): 251-290.
[480] Rowe, G., & Frewer, L. J. (2005): 252.
[481] Rowe, G., & Frewer, L. J. (2005): 285.
[482] Rowe, G., & Frewer, L. J. (2005): 273.
[483] See: Rowe, G., & Frewer, L. J. (2000): 12-15.
[484] Rowe, G., & Frewer, L. J. (2000): 15-17.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- Cost-effectiveness: the concern of cost in participation methods should be addressed, so that the procedure might be cost-effective.

Formalised participation models respond differently to these different criteria, and while some of them have low rates in terms of acceptance and process criteria such as the public hearing model, other respond well to one category: referenda, public opinion surveys and focus groups respond well to acceptance criteria but not to process criteria. On the contrary, other participatory approaches such as consensus conferences, citizens' jury/panel and citizen advisory committees are meeting both process and acceptance criteria[485].

In order to expand the dialogue with the public - from an optional add-on to an integral part of the process of policy-making - requires to re-design the democratic process in a more balanced way, where constituents are also active participants[486]. At government level, participation takes the form of "public engagement" and has gained great interest over the years, through various methods aiming at a culture of openness to ideas, through various forms: large scale government-led exercises, platforms for engaging citizens, methods for participation, idea generation and deliberation, processes for involving children, "wiki government", participatory planning, parliamentary structures to develop citizen ideas, citizen petitions, citizen juries, citizen's panels, legislative theatre[487].

The distinction of the various participatory approaches and the time scale of intervention, and the objective, whether it concerns evaluation, planning or implementation, can help dissociate active forms of participation from other indirect forms and thus reach a concrete framing of the process. The choice of the participatory method can rely on a set of criteria relating to objectives, topic, participants, time and budget, which entails to consider: i) the reasons for involvement and expected outcomes; ii) the nature and scope of the issue; iii) who is affected, interested, or can contribute to solutions; iv) the amount of available time; vi) the availability of resources[488].

Reaching clarity in the definition of the objectives is also a key element in the efficiency of participatory processes, ensuring their adequacy with the expected outcomes. On a general level, a wide categorisation could be the following one[489]:

- 'Aspiration' level: towards either i) democratisation (enabling participants with information allowing an active contribution by finding solutions relevant for decision-making); or ii) advising (revealing stakeholders' knowledge and positions relevant to the process of decision-making).
- 'Output' level: aiming at either i) diversity (generating a wide and explicit spectrum of options); or ii) reaching consensus (enabling a group to reach a decision on an issue).

Distinction of participants is also essential in the selection of the participatory process as categories have to be clearly distinguished[490]:

- citizens (as individuals);
- stakeholders (citizens represented by organisations, such as: NGOs ; private industry; interest groups);

[485] Rowe, G., & Frewer, L. J. (2000): 22.
[486] Fung, A. (2008): 676.
[487] See: Murray R., Caulier-Grice J., & Mulgan G. (2010): 40-44.
[488] Slocum, N. (2003): 11.
[489] See: Slocum, N. (2003): 12-13.
[490] Slocum, N. (2003): 13.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- experts (according to the issue considered);
- politicians (for the uptake of the outcomes);
- policy-makers: this category is particularly relevant for processes that are likely to influence policy.

On the timeframe level, and similarly to the distinction of time scale in technology assessment, in policy issues too participation differs significantly in terms of impact according to the moment it takes place. In "active" forms of participation, looking for feedback loops from end-users and citizens can help better address societal impacts, from the stage of initial design and planning[491]. While achieving consensus can be seen as a pitfall in trying to exert an inclusive and active participation, early engagement can allow equal sharing of perspectives, values and reasoning [492].

An additional criterion helping in reaching adequacy between the issue and the way it is addressed is defining the need for a participatory approach, which relates to the following cases:

- themes that require ethical, social or cultural study and may call for a choice between fundamental values and principles;
- policy issues that call for a combination of public awareness, learning, a search for solutions and emotional or moral acceptance of the eventual decision;
- public policy choices that will rely on the precautionary principle or the weight of evidence;
- underlying values and principles that must be clarified before detailed proposals or risk management options are brought forward;
- a clearly defined set of options or proposals that support the search for consensus or innovative solutions.[493]

While ethical participation in innovation policy-making/governance is the main feature across literature, ethics of participation in innovation processes are also an important field in need of criteria, which will be addressed in the course of PRO-Ethics development.

Good practices in participatory processes applied to innovation ethics

If "ethics should not be perceived as a constraint to research and innovation, but rather as a way of ensuring high quality results"[494], the participatory turn can help sustain such views, as public participation entails that "upon everyone's shoulders rests a particular moral obligation to engage in the collective debate that shapes the context for collective decision-making"[495]. Even though this assumption enshrines the ethical outcomes of participatory processes, it faces challenges on the empirical level, so as to how engage citizens with appropriate incentives that would secure such mobilisation.

Governance and funding maintain a strong leverage in shaping innovation practices towards an ethical and participatory turn that takes stock of context specificities to define adequate approaches. A

[491] Slocum, N. (2003): 10.
[492] Slocum, N. (2003): 10.
[493] Slocum, N. (2003): 11.
[494] Strand, R., Spaapen, J., et al. (2015): 33.
[495] Von Schomberg, R. (2007). *From the ethics of technology towards an ethics of knowledge policy & knowledge assessment.* Luxembourg: Publications Office, p. 12.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

responsible innovation strategy should intervene at all stages of R&D&I and encompass all ethical issues, as well as a

> "continuous inclusion of stakeholders' values in the process of technological design. The relevant public values can be extracted from the always-rich public debate, and the potential value conflicts need to be identified. The insights of this interdisciplinary research should then inform technological design, the associated institutions and the decision-making process."[496]

An upstream connection of science and society in the course of R&I processes allows a connection of ethical issues with participatory approaches. Ethics of collective co-responsibility, "expressed at the level of free (international) public debate in which all should participate"[497], can take place in such early engagement configurations. Early engagement can be taken a step further by including both people with a different (social science or humanities) background in the innovation process and also lay people/civil society.

Following the democratic-inclusive paradigm, which combines democratic participation of a community of citizens and the inclusion of society in the determination of social options[498], the democratic governance model entails - further to consultation - a co-construction of rules and options that matter for society[499]. Related to the democratic paradigm, the co-construction model of governance involves stakeholders and policy-makers in the construction of policies, while the role of experts is extended to more participants in a participative approach to innovation[500].

The way forward requires a combination of an ethical framework addressing "both the aspect of unintentional side consequences (rather than intentional actions) and the aspect of collective decisions (rather than individual decisions) with regard to complex societal systems"; the lack of such theoretical guidance inclining to "shift our attention to an ethics of knowledge assessment in the framework of deliberative procedures instead"[501]. Essential components of responsible innovation frameworks are the result of a strong combination of ethical concerns and active use of participatory challenges:

- interdisciplinary research;
- public values: ex ante assessment of stakeholder values and the specification of values during development and implementation[502];
- challenges to give weight to varying opinions;
- facilitation of trade-offs (timely and proactive identification of potentially conflicting values).[503]

---

[496] Taebi, B., Correljé, A., Cuppen, E., et al. (2014): 120. However, the implementation of such a process faces difficulties stemming from moral pluralism implications.
[497] Von Schomberg, R. (2007): 11.
[498] Kurt, A., Duquenoy, P., Lavelle, S. (2010): 27 *sqq*.
[499] Although such approaches can be confronted to difficulties in bridging the knowledge gap between experts and lay persons, on technical topics.
[500] On the topic of the "co-construction model" of governance, see: Kurt, A., Duquenoy, P., Lavelle, S. (2010): 40.
[501] Von Schomberg, R. (2007): 5.
[502] According to these authors, others approaches such as particpatory technology assessment are not equipped to deal with the values that emerge during technology development and implementation: Taebi, B., Correljé, A., Cuppen, E., et al. (2014): 121.
[503] Taebi, B., Correljé, A., Cuppen, E., et al. (2014): 120-122.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Another guidance tool can be found in the potential of social innovation and governance structures that foster sustainability[504] and aim to "finding better and alternative ways to meet existing needs and to more effectively work through unintentional repercussions and side effects of industrial development in society"[505]. RRI provides a substantial basis to build on: by integrating its principles into policy, participation can be leveraged, with a focus on the dimension of responsiveness.

Deliberation opens up the degree of uncertainty and reveals the risk-taking dimension of participatory approaches. As future developments and their outcomes are both scientifically uncertain, they become increasingly indeterminate with participation, "as they are shaped reflexively through an open horizon of contingent choice and political debate"[506]. Also, the difficulty of establishing balanced ethical frameworks has already been underlined in the literature, as the difficulty to choose between strong and weak definitions of participation or "between anthropocentric and ecocentric moral frameworks for pathway evaluation"[507].

On the side of funding bodies and governments, the notable improvements in the "opening up" of their governance processes is often still constrained by the fact that:

> "dialogues still tend to be seen as an add-on to established structures, rather than the start of a new sort of relationship with the public. There is, therefore, a need to move beyond thinking of public engagement in isolation, to talk about governance in the public interest."[508]

Contradicting the tendency in science study to resolve issues of governance through normative treatment[509], participation shows another way in open science-public relations that can bring along significant legitimacy to R&I processes.

The shift from R&I processes from the people to R&I processes by the people has marked a new participatory paradigm that goes beyond mere consultation or information mechanisms towards collaborative and transformative mechanisms where the public takes part in decision-making and is an active part of the process. In RRI, the focus on inclusive deliberation pledges to involve a diverse range of engaged stakeholders and publics, so as to increase legitimate decision-making in regards to "socially robust knowledge"[510]. The related goals and outcomes bring about, amongst others, the opportunity of participation in agenda-setting and defining societal challenges; equitable decision making; and a better capacity and basis for robust and legitimate decision-making[511]. Through the prism of a shared co-responsible approach of innovation, deliberative systems are facing the constraint to serve a wide array of values, as they could

> "be judged according to how well they serve the epistemic, ethical, and democratic functions of deliberation. Epistemically, they should produce preferences, opinions, and decisions that are appropriately informed by facts and logic and that derive from

[504] Howaldt, J., & Schwarz, M. (2010): 47.
[505] Howaldt, J., & Schwarz, M. (2010): 45.
[506] Demeritt, D. (2011). Pathways to sustainability: perspectives and provocations, *Environment and Planning*, *43*, p. 1227.
[507] Demeritt, D. (2011): 1227.
[508] Sykes, K., Macnaghten, P. (2013): 104.
[509] Irwin, A. (2006): 317.
[510] Owen R., & Pansera, M. (2019): 31-32.
[511] Owen R., & Pansera, M. (2019): 31-32.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

> the meaningful consideration of relevant reasons. Ethically, deliberative systems should produce mutual respect among citizens. Democratically, deliberative systems should give voice to multiple and plural perspectives, interests, concerns, and claims on the basis of feasible equality and equal opportunity. From all three perspectives, a healthy deliberative system is one in which relevant considerations are brought forth from all corners, aired, discussed, and appropriately weighed."[512]

A comprehensive deliberative form would require a complex setup in the coordination and framing, in order to ensure a diversified landscape with a fair distribution in the visibility of perspectives and views. If we may consider it as an ideal configuration, its implementation and operationality would also entail the reinforcement of information sharing amongst participants as well as the expansion of space for a debate of such extent in views, in sharing capacities, and with an agreed common respect of ethical principles, norms and values. Despite the technical difficulties of this ideal, it however provides some sound basis of directions that could be considered as general orientations.

At the same time, new perspectives emerge with the expansion of digital technologies, which have propelled online platforms that use participatory approaches to offer new costless solutions enhancing the relationship between citizens and governance, allowing for citizen science collaborations, crowdsourcing, or online surveys (citizens as subjects of research and innovation processes)[513]. Although the so-called "civic tech" have emerged as a promising new field for participatory practices, the variabilities of civic tech movements in terms of technology used, degree of change, publics engaged, social processes and functions, do not allow a unique definition[514]. The growing and diverse field of civic tech has emerged at the nexus of technology, civic innovation, open government and resident engagement[515]. The great variety of initiatives termed "civic tech" hinders the direct connection with responsible research and innovation practices, although the two main forms of open government and community action[516] do bear in themselves the main features of participatory practices. If we consider the specific case of R&I, the first feature, which is reflected through citizens consultations and data transparency on behalf of governments reinforce the democratic governance of innovation. The contribution of citizen-led initiatives on the other hand can improve considerably the conditions for citizen empowerment and collective decision-making. Civic tech innovation can be identified through eleven main forms[517], across the two dimensions.

On the side of open government:

- 1) **data access and transparency:** promotion of government data availability, transparency and accountability;

[512] Mansbridge, J. (2014). A Systemic Approach to Civic Action. In J. Girouard, & C. Sirianni (Eds), *Varieties of civic innovation: Deliberative, collaborative, network, and narrative approaches*. Nashville: Vanderbilt University Press, p. 240. It could be argued that a threefold compliance of deliberative mechanisms with epistemic, ethical and democratic values could be considered either this way or perhaps more appropriately as a whole, since all dimensions overlap: as ethics, which also embrace the subjects at stake and their conceptual representation in the debate.
[513] Some main online platforms and projects worldwide that represent this new trend of online participative science and innovation are listed in the French report by Houllier, F., & Merilhou-Goudard, J.-B. (2016).
[514] Microsoft's innovation team has produced the Civic Graph, a crowdsourced interactive online map tracking the new world of civic tech (civic innovation). See online: https://www.civicgraph.io
[515] Patel, M., Sotsky, J., Gourley, S., & Houghton, D. (2013). *The Emergence of Civic Tech: Investments in a Growing Field*. New York: The Knight Foundation. This publication by the Knight Foundation relies on a large-scale mapping of the civic tech field by combining semantic analysis and investment data tracking.
[516] The Knight Foundation's study identifies them as overarching themes.
[517] According to: Patel, M., Sotsky, J., Gourley, S., & Houghton, D. (2013).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

- 2) **data utility:** empowerment of users to analyse government data and leverage data to improve public service delivery;
- 3) **public decision-making:** encourage resident participation in large-scale deliberative democracy[518] and community planning efforts;
- 4) **resident feedback:** provide residents with opportunities to interact with government officials and give feedback about public service delivery;
- 5) **visualisation and mapping:** enable users to make sense of and gain actionable insight from civic data sources, specifically through the visualisation and mapping of that information;
- 6) **voting:** support voter participation and fair election processes.

On the side of community action:

- 7) **civic crowdfunding:** support local projects and organisations that generate a public benefit through peer-to-peer lending and crowdfunding;
- 8) **community organising:** manage social campaigns and initiatives;
- 9) **information crowdsourcing:** collect data from a large number of individuals to inform and address civic issues;
- 10) **neighbourhood forums:** power local groups of people to connect, share information and collaborate;
- 11) **peer-to-peer sharing:** promote resident-driven sharing of goods and services[519].

The predominance of peer-to-peer sharing initiatives in the global growth of civic tech hinders the variety of the field and the assets it offers in terms of embeddedness of deliberative democracy features with data access, as well as the diversity and costless access to a toolbox for participants inclusion.

The connection with responsible research and innovation attempted here aims to initiate a new reflection on the leverage of civic tech projects in the promotion of participatory practices for responsible research and innovation.

Challenges to be integrated in PRO-Ethics framework

In the absence of a common approach regarding ethics of participation and given the diversity of parameters and contexts, there is no single definition that could encompass the dimensions outlined so far. The main challenge to be tackled in the course of PRO-Ethics is a stabilised taxonomy of participatory practices, which could provide a common reference, and outline the ethical dimension of participatory practices.

What could help improve the governance system? How can an easy access to participation be achieved, with a representation of all societal groups relevant for each specific case? How to implement quality control mechanisms and address ethics of participation further to regulatory and institutional frameworks? What is to be mainly expected from participation of citizens and stakeholders? In the absence of clear identification of ethics of participation, how can practices and new initiatives be considered in a comprehensive framework?

[518] The tools to achieve this represent a major challenge, although the evolution of civic tech features seems to be promising in this regard.
[519] See: Patel, M., Sotsky, J., Gourley, S., & Houghton, D. (2013).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Within the overall RRI objective, rather than a policy element, participation could be seen as a guidance tool to be re-defined through precise framing of innovation processes:

> "Because innovation is an inherently complex and dynamic social process, there is tremendous value in connecting theory and practice. Indeed, effective policy requires policymakers to have a comprehensive understanding of what might work in theory and what is working in practice."[520]

The EU report on Research ethics mentions the connection of ethics with participation, the latter being embedded by definition: "the way research ethics is interpreted at the European Commission, aims to be collaborative and constructive"[521]. From past EU projects and the literature that has been reviewed in this deliverable, some blind spots raise the question of how to reach an ethical participation. Answering this question requires to take stock of: the needs of RFOs as well as the way ethical appraisal schemes (encompassing both Ethics review and regulations compliance) should be enhanced with participation; the current and future needs of a participatory dimension among project partners' activity; the incentives of and the means that would allow proper development of participatory schemes. Considering existing tools (ethical, legal frameworks within RRI, and ethical review processes), the question of what would be a useful direction of new interaction modes/novel participation configurations remains to be specified according to the context (sector; scope and impacts; potentially affected publics; ability to address ethical issues and participatory options).

According to the context, the definition of the dialogue configuration to be achieved can ensure deep-rooted participatory mechanism across ethical issues in R&D&I:

> "One future challenge for public dialogue is to ask whether one-off dialogue events are sufficient or whether a more synoptic, far-reaching form of dialogue, deeply embedded in governance, is required – a key issue for nascent programs of responsible innovation."[522]

A new participatory turn can be embraced with assessment of participatory mechanisms' requirements:

> "It is also necessary to consider a number of practical issues. Cost is one such issue; another is the typical lack of incentives for lay participation in decision making. To the extent that practical incentives to encourage participation are missing, or that agencies consider the administrative costs unacceptable, then institutional development and experimentation are unlikely."[523]

Another stream of challenges stands on the side of incentives and leverage that can support a democratic governance of publicly-funded R&I with ethics and participatory mechanisms blended in the whole duration of the process.

[520] Bogers, M., Chesbrough, H., Moedas, C. (2018): 7.
[521] European Commission - Directorate-General for Research and Innovation (2013): 3.
[522] Sykes, K., Macnaghten, P. (2013): 101.
[523] Fiorino, D. J. (1990): 239.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

The role of funders is crucial as, "by administering research funds they are in a strong position to shape future research directions"[524] and implement policy goals. Participatory mechanisms can be an added-value for funders and can allow them:

> "- To enhance transparency and accountability to the public;
>
> - To bring knowledge that comes from working with a specific societal interest;
>
> - To improve links between cutting edge research and societal interests;
>
> - To improve commercial viability of any innovative product that may be developed;
>
> - To give feedback during the research process."[525]

Taking stock of recommendations addressed to funders in the field of civil society organisations (CSOs), some remarks can be of use for PRO-Ethics wider scope of broad participatory mechanisms:

- Raise awareness of the issues to consider public engagement;
- Allow public engagement to help shape the research agenda;
- Create funding structures that are sensitive to public engagement needs;
- Facilitate building connections between public engagement and researchers/innovators;
- Emphasize the importance of dissemination and impact (follow-up and evaluation of project's results);
- Celebrate positive R&I outcomes involving public engagement;
- Ensure sensitivity to public engagement-related issues during evaluation.[526]

Ethical public engagement in R&I also implies substantial funding support through targeted funding schemes. Surveys undertaken on this subject show major discrepancies across EU Member States in the degree to which key public RFOs have developed an uptake of public engagement activities in funding schemes[527]. Furthermore, public engagement elements are only marginally used as criteria in research proposal evaluations in Europe, with the exception of funding agencies of Nordic countries who use it to a large extent[528].

Furthermore, ethics & public-private partnerships, can fuel publicly-funded R&I with substantial support that addresses risk-taking: "there is a need to increase private investment, especially for innovations where the levels of uncertainty (technological, business model, regulatory, and user acceptance) are high."[529] Such partnerships can be confronted to the hindrance of demanding ethical and participatory schemes: the level of this inhibiting factor is yet to be demonstrated.

The core challenge might be the level of uncertainty and the way to confront it:

---

[524] Stahl, B. C., Wakunuma, K. (2015). *Guidelines Handbook.* CONSIDER Deliverable D4.1, p. 25.
[525] These considerations on the inclusion of civil society engagement in funding calls can can be used here on more general views on participation, not limited to civil society organisations (CSOs). See: Stahl, B. C., Wakunuma, K. (2015): 25.
[526] These recommendations have been adapted from the CONSIDER's project recommendations for funders: CSO engagement has been here replaced by "public engagement" as a wider participatory category encompassing CSOs, citizens, stakeholders.
[527] See: Peter, V., Maier, F., Spaini, C., et al. (2018): 47.
[528] See: Peter, V., Maier, F., Spaini, C., et al. (2018): 48.
[529] Bogers, M., Chesbrough, H., Moedas, C. (2018): 10.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

> "In terms of impact, we also need to acknowledge that innovation does not always lead to results equally across organizations and people. In fact, while innovation can be the great leveler, it can also be the great divider. Uncertainty is also linked to the context we are living in and the trends we are experiencing. Specifically, there is uncertainty as to which emerging disruptive technologies we should publicly encourage in order to promote welfare"[530].

Participatory processes in R&I inevitably reinforce the ethical dimension as the closeness requires ethically sound decisions; although participatory R&I is always facing the risk of an unethical / interested use[531] if the attention to the outcomes is not developed enough.

Drawing on all the previous analysis, PRO-Ethics will provide case studies and further theoretical construction to meet the abovementioned challenges and the following assumptions listed below, notably through the upcoming PRO-Ethics framework.

Final assumptions and propositions	
1 – On ethics and law	Current regulations on ethics of R&I do not cover ethics of participation as such, as the link between ethics and participation is not developed enough. Further to regulations, ethical processes are already operative through formalised procedures in public funding schemes for R&I. However, ethics cannot be reduced to formalised/standard procedures only, and their occasional confusion with the legalisation of ethics (soft law, ethical compliance) blurs the scope of their contribution. Also, ethics should not be considered as a toolkit but as a field (from applied ethics until meta-ethics[532]) that extends the regulatory schemes and helps to decipher the legitimacy, the tensions, and the adequacy of processes and legal compliance in regards with contextual criteria.
2 – On participation definition	There is no single approach towards participative innovation processes, however, the clear distinction of activity dimensions, timelines, expected outcomes and types of participants can provide a common reference. In response to this need, the use of a common taxonomy and common indicators in PRO-Ethics will be the focus of the next deliverables of the PRO-Ethics theoretical framework (WP1). We may have to decide on our priorities since many possibilities exist.
3 – On potential transformation	This critical review of the literature underlined major gaps on several fronts, amongst which in regulations, in the ways to address participatory processes in a comprehensive way, and in the lack of

[530] Bogers, M., Chesbrough, H., & Moedas, C. (2018): 8.
[531] See: Bergold, T., & Thomas, S. (2012). Participatory Research Methods: A Methodological Approach in Motion. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *13*(1), Art. 30.
[532] See: Reber, B. (2016).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

	established connection of ethics with participation. All these will be part of the upcoming PRO-Ethics framework that will provide a comprehensive set of guidelines, to be used both in top-down and bottom-up approaches, as common reference on ethics of participation for policy-makers, funders and civil society. With the ambition to address ethics of participation in their multidimensionality, the PRO-Ethics framework will draw on the gaps and the theoretical difficulties that have been outlined.
4 – On ethical tensions	Ethics of participation provide orientation on priorities that are to be considered especially in the event of emerging technologies and sectors of rapid expansion with uncertain societal impact/acceptance. In PRO-Ethics, the focus on such cases will provide insight on specific contexts and sectors in which participatory processes are especially decisive. Although some of the requirements to reach a high quality level of participation can be convergent with ethics, ethics and participation are different. Indeed, ethics can focus on the types of relationships between actors, but may also turn towards problems to solve, where a more professional ethical expertise is expected in order to produce complete ethical arguments or counter-arguments with a technical knowledge of the problems to assess.
5 – On effective participation	A common reference base of ethics of participation can help setting criteria of good practices, as a combination of clear identification and matching of processes, actors and outcomes. The PRO-Ethics framework will provide guidance both for innovation projects and innovation funding practices, thus addressing participative innovation practices supported and implemented by regional and national RFOs. Guidelines to reach effective forms of participatory practices will be of use both in top-down and bottom-up approaches, as common denominator and reference.
6 – On the involvement of participants	Given the numerous ways to involve citizens or stakeholders in participatory processes for R&I, the questions of who is to be involved, by whom, when, and for what, imply also a clear identification of the publics: citizens and stakeholders are not overlapping categories and should be distinguished. Also, PRO-Ethics should maintain a wide spectrum of participation actors across all dimensions of participatory processes, since "citizen participation" as such does not reflect the wide spectrum of PRO-Ethics' scope.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

7 – On common frameworks	Given the discrepancy across regulatory frameworks and ethical practices at the intersection of ethics and participatory processes, how could a common framework be established? As the main divide could be considered between the use of formalised/standard procedures on ethics of participation and the lack of formalised procedures and guidance; future pathways of PRO-Ethics framework could be set in terms of criteria and understanding, on which an ethical approach of participation could be built on.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

CONCLUSION

The challenge to define participation is all the more intriguing as, three decades after the inception of technology assessment and a great amount of explorations in the field of participatory practices, essential questions remain unresolved as why, how and in view of what quality the processes are undertaken. The complexity of the merge between participation and ethics of R&I is not a quantitative problem that could be resolved by integrating a broader array of participants. The configuration of the involvement, the timescale, and the final outcomes of the processes can entail either strong or poor forms of participation. Depending on the stages of innovation processes, public participation - generally considered - embraces a variety of actors, who can either be lay people, persons directly involved in the R&I process, experts, individuals or groups representing specific interests. These audiences can relate either by interest or as affected publics, whereas future societal implications override the possibility of a clear identification of participation actors and the configuration of their possible involvement.

This urges to consider the reasons for participation and the expected outcomes, the nature and scope of the ethical issues, who is affected, interested or can contribute to solutions, the timescale and the resources. Overall, participation might be considered as the best resource to enable non-conventional views and thus help tackling the factor of uncertainty through a shared responsibility. As such, participation is an opportunity: RRI literature has highlighted this extension of the science-society discourse through public engagement and the benefits of co-production, upstream engagement and reflexive responsibility of science and innovation outcomes. Addressing the loss of public trust for science and innovation advancements, participation intervenes as a remedy, although a restrictive approach may restrain its potential to the existing assessment schemes.

Interferences between various dimensions both in theory and practice blur the landscape of what is termed “participation” in the field of research and innovation. The common thread throughout this study has been to analyse this stratified field in a way that could provide some general orientations, in an attempt to classify and explore the various levels - not exhaustively, but methodically. The analysis grid has firstly been set trough ethics of innovation and their implications in Research and Innovation (R&I) governance. This has shown the great potential of bottom-up initiatives and new configurations of innovation approaches, whose features connect to ethics diversely. Under the umbrella of “responsible research and innovation”, a strong European commitment has been taken for the promotion of sustainable and ethically sound R&I throughout its various stages. Across formalised procedures (Ethics reviews) and a wide set of policies that nurture research ethics, research integrity, and social/societal implications, policy-making has provided a wide spectrum of ethical standards, norms and regulations. For publicly funded R&I, ethical compliance has allowed for a monitoring of interests and ethical conflicts and their better identification, which could be considered as an asset on the qualitative guarantees it allows.

Setting the bootstrap of this critical review in the opening up of the meanings of participation, the varying approaches of participatory practices have shown the extent of a field that encompasses a great variety of features, which do not always share a common ground, neither in processes, nor in actors and outcomes. The very problematic nature of “participation” in this sense, raises the question, on governance level, of the possibility to have a unified framework. The closely-woven field of R&I reveals the lack of clear identification of participatory practices within research and innovation ethics.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 872441.

Consequently, ethics of participation appear as a new playground for experimentation, which can draw from general considerations from the scientific literature in the well-developed field of deliberative democracy, notably, or in institutionalised participatory forms such as citizen science, which allow for a more precise identification of processes and outcomes.

RRI has initiated a space for experimentation in R&I participatory practices that keeps evolving, alongside innovation issues and societal challenges. Finding some regulatory gaps and combining ethical issues with participation broadly defined, new indicators of efficiency arise. This theoretical framework has shown the precedence of ethics upon laws and regulations. By putting forward the notion of responsibility, RRI has opened new avenues of reflection. Yet, theoretical considerations rely on the capacity of public schemes to be attractive without falling into the trap of over-regulation and too restrictive frameworks.

In the path of responsibility in innovation, the way forward faces the question whether the existing operating governance systems for R&I – standards, norms, and regulations – are adequate for achieving desirable social outcomes? The benefits of publicly funded R&I might be the possibility it offers for a renewed questioning on ethics, benefitting from their prevalence over regulatory schemes. Given the weak link to participation that can be observed in ethics regulations, the very complexity of participatory practices can be tackled more easily on the side of RRI policies and the prevalence of ethics over law. With the objective to keep enhancing the science-society relationship in response to new trends, the European Commission has taken this commitment a step further thanks to RRI, which has highlighted the essential contribution of participation to ethics of R&I.

As regulations were particularly limited, this deliverable combined legal resources and soft law with scientific literature in an attempt to bridge the gaps. The ethics part is regulated via the GDPR for data protection, some complementary international codes on research integrity (mostly concerned with research on human subjects), and some voluntary codes to which some or all European universities have committed which are not legally binding (at national or EU level)[533]. Regarding participation, only few conventions or rules have been codified into laws with some binding legal status. The Aarhus convention is probably the most prominent one, applicable in the context of environmental regulations, but with particular relevance in the context of R&I ethics too.

On a theoretical level, scientific and grey literature provides guidance on criteria, indicators, and more generally on options helping to classify the internal diversity of the subject of this research. On an empirical level, the regulatory practices in R&I do not inform on participatory practices, despite their advocacy for the benefits of citizen engagement or what is commonly termed “public participation”, embracing all features. The complexity of participation is also due to the diversity of ethical grounds supporting participation, which can vary according to the normative/moral justifications that are considered and that can either refer to ethics (ethical concerns, ethics broadly understood); to policy (ethical reviews, RRI); or to laws (regulations). The complexity of participation is also due to the diversity of ethical grounds supporting participation, which can vary according to the normative/moral justifications that are considered, and which can either refer to ethics (ethical concerns, ethics broadly understood); to policy (ethical reviews, RRI); or to laws (regulations). Combining theory and practice can only result in a predominance of theory as guidance for the multi-faceted landscape of practices, across countries, regulations and policies. With the leverage of publicly funded research and innovation, the embeddedness of participation in ethics of research and innovation can act as a

[533] The EU has issued ethics guidelines that come as a complement to these legal resources.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 872441.

powerful multiplier. The content is yet to be defined across categories and indicators, while some configurations can be promoted as primarily representative of the ethical requisits, which should guide research and innovation. In the absence of a straightforward connection between ethics and participation, some good practices could be underlined in the direction of optimal inclusion of challenges raised on both sides. Also, the promotion of the ongoing process of participation throughout the whole timescale of research and innovation, from inception and design to outcomes, can ensure both public acceptance and process quality in view of final social impact.

Formalised participatory models are facing the tripartite distinction between information, consultation and participation as such (in decision-making): a distinction that could be considered as the common denominator across participatory processes. Similarly, the distinction of participants defines the related diversity of their contributions, depending on their role as: citizens/lay people, stakeholders, experts, politicians, policy-makers. The objectives of participatory processes are also another dimension with internal diversity, since active contribution to decision-making differs from advising, whereas the output of participation can diverge depending on whether it is oriented towards diversity or consensus. Taking into account all these parameters allows a more precise adequacy of participatory practices according to the context and reach "active" forms of participation. Ethics provide the adequate tools for an expansion of existing policies and regulations – the procedural dimension of compliance -, towards the identification of participation as the means to implement democracy in R&I processes, by embracing voices that may be at odds and understanding conflicting values or principles. Deliberative democracy enshrines participation as part of decision-making and, although the value of deliberative systems can vary, the need for clarification over the understanding of participation is a common requisite. Also, as most scientific resources insist on early engagement as well as the importance of social impact evaluation, the benefits of a long-term participatory approach are overriding fixed-term processes. As the *in itenere* assessment ensures an ethically sound evolution throughout all R&I phases, similarly, other dimensions of participation seem to gain from the temporal consideration of R&I in order to allow a satisfactory level of outcomes.

As part of the PRO-Ethics project, the categories and implications of "participation" could be re-opened as a toolbox, testing the various levels, depending on where, how, with whom participation is considered. Criteria can help in the identification of good practices, as contextual elements can be taken into account and connected to the configurations of participatory processes. At the same time, new digital technologies can reconfigure democracy and also reshape the field of participatory practices by relocating the various components of participation. Considering the course of PRO-Ethics, whose first analysis is outlined in this study, the very opening-up of the meanings of participation serves as the premises as well as the condition for the possibility to have a comprehensive framework proposal. In this perspective, the upcoming studies will focus less on governance and more on case studies that can complete this critical literature review, in order to balance these views and bridge the gaps towards the PRO-Ethics ethics framework. This comprehensive presentation of existing definitions, possibilities and indicators clearly indicated that participation might be considered as the epitome of innovation ethics, provided its multidimensionality is tackled at the outset.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

REFERENCES

AccountAbility (2015). *AA1000 Stakeholder engagement standard (AA1000SES)*. London: AccountAbility. Retrieved from: https://www.accountability.org/wp-content/uploads/2016/10/AA1000SES_2015.pdf (date accessed: 17 May 2020).

All European Academies (ALLEA) (2017). *The European Code of Conduct for Research Integrity* (revised edition). Berlin: ALLEA.

All European Academies (ALLEA), & European Science Foundation (2011). *The European Code of Conduct for Research Integrity*. Strasbourg: Ireg.

Arnstein, S. R. (1969). *A Ladder Of Citizen Participation*, Journal of the American Planning Association, 35(4), 216-224.

Asveld, L., & van Dam-Mieras R. (2017). Introduction: Responsible Research and Innovation for Sustainability. In L. Asveld, R. van Dam-Mieras, T. Swierstra, S. Lavrijssen, K. Linse, & J. van den Hoven (Eds.), *Responsible Innovation 3: A European Agenda?* Cham: Springer International Publishing.

Bergold, T., & Thomas, S. (2012). Participatory Research Methods: A Methodological Approach in Motion. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 13(1), Art. 30.

Bessant, J. (2013). Innovation in the Twenty-First Century, In Owen, R., Heintz, M., & Bessant, J. R. (Eds.), *Responsible innovation.* Chichester: John Wiley & Sons, 1-26.

Blok, V., Hoffmans, L., & Wubben, E. F. M. (2015). Stakeholder engagement for responsible innovation in the private sector: critical issues and management practices. *Journal on Chain and Network Science*, 15(2), 147-164.

Bogers, M., Chesbrough, H., Moedas, C. (2018). Open Innovation: Research, Practices, and Policies. *California Management Review*, 60(2), 5-16.

Brom, F. W. A., Chaturvedi, S., Ladikas, M., & Zhang, W. (2015). Institutionalizing Ethical Debates in Science, Technology, and Innovation Policy: A Comparison of Europe, India and China. In M. Ladikas, S. Chaturvedi, Y. Zhao & D. Stemerding (Eds.), *Science and Technology Governance and Ethics* (pp. 9–23). Cham/Heidelberg/New York/Dordrecht/London: Springer.

Council of Europe (2012, April). *Guide for Research Ethics Committee Members. Steering Committee on Bioethics. Strasbourg: Council of Europe.* Retrieved from: https://www.coe.int/en/web/bioethics/guide-for-research-ethics-committees-members (date accessed: 17 May 2020).

Cuppen, E., Klievink, B., & Doorn, N. (2019). Governing crowdbased innovations: an interdisciplinary research agenda. *Journal of Responsible Innovation*, 6(2), 232-239.

Dahlman, C. & Kuznetsov, Y. (2014). Innovation for the “base of the pyramid”: Developing a framework for policy experimentation. In OECD/The World Bank, *Making Innovation Policy Work: Learning from Experimentation* (pp. 71-122). OECD Publishing.

Davidson, S. (1998). Spinning the wheel of empowerment. *Planning, 1262*, 14–15.

Demeritt, D. (2011). Pathways to sustainability: perspectives and provocations, *Environment and Planning, 43*, 1226-1237.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 872441.

Dobson, A. (2011). Pathways to sustainability: perspectives and provocations, *Environment and Planning, 43*, 1226-1237.

Doorn, N., & Nihlén Fahlquist, J. A. (2010). Responsibility in engineering: Towards a new role for engineering ethicists. *Bulletin of Science, Technology & Society, 30*, 222-30.

Driessen, A. (2009). Ethical Aspects of Research in Ultrafast Communication. In P. Sollie, & M. Düwell (Eds.), *Evaluating New Technologies*. Dordrecht: Springer.

Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.) (2014). *Making Innovation Policy Work: Learning from Experimentation*. Paris: OECD and The World Bank.

Edwards, M. A., & Siddhartha, R. (2017). Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition. *Environmental Engineering Science, 34(1)*, 51-61.

Esterling, K. M., Fung, A., & Lee, T. (2015). How Much Disagreement is Good for Democratic Deliberation? *Political Communication, 32(4)*, 529-551.

European Commission (2018, November 14). *Ethics and data protection.* Retrieved from: https://ec.europa.eu/info/sites/info/files/5._h2020_ethics_and_data_protection_0.pdf (date accessed: 17 May 2020).

European Commission – Directorate-General for Research (2010). *European Textbook on Ethics in Research*, Luxembourg: Publications Office of the European Union.

European Commission, Directorate-General for Research and Innovation (2013). *Ethics for Researchers: Facilitating Research Excellence in FP7*. Luxembourg: Publications Office of the European Union. Retrieved from: https://ec.europa.eu/research/participants/data/ref/fp7/89888/ethics-for-researchers_en.pdf (date accessed: 17 May 2020).

European Commission, Directorate-General for Research and Innovation (2016). *Open Innovation, Open Science, Open to the World*. Luxembourg: Publications Office of the European Union.

European Commission, Directorate-General for Research & Innovation (2019). *Horizon 2020 Programme: Guidance – How to complete your ethics self-assessment.* Retrieved from: https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf (date accessed: 17 May 2020).

European Group on Ethics in Science and New Technologies (EGE) – European Commission (2015). *The ethical implications of new health technologies and citizen participation.* Luxembourg: Publications Office of the European Union. Retrieved from: https://op.europa.eu/en/publication-detail/-/publication/e86c21fa-ef2f-11e5-8529-01aa75ed71a1 (date accessed: 17 May 2020).

European Parliament and European Council (2014, 16 April). Regulation (EU), No 536/2014 on clinical trials on medicinal products for human use, and repealing Directive 2001/20/EC. *Official Journal of the European Union,* L158, 27.5.2014, 1–76. Retrieved from*:* https://ec.europa.eu/health/sites/health/files/files/eudralex/vol-1/reg_2014_536/reg_2014_536_en.pdf (date accessed: 17 May 2020).

Fagotto, E., & Fung, A. (2014). Embedding Public Deliberation in Community Governance. In J. Girouard, & C. Sirianni (Eds), *Varieties of civic innovation: Deliberative, collaborative, network, and narrative approaches*. Nashville: Vanderbilt University Press.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Fecher, B., & Friesike, S. (2013). *Open Science: One Term, Five Schools of Thought. Vol. 218*, German Council for Social and Economic Data (RatSWD).

Felin, T., & Zenger, T. R. (2014). Closed or open innovation? Problem solving and the governance choice. *Research Policy, 43(5),* 914-925.

Fiorino, D. J. (1990). Citizen Participation and Environmental Risk: A Survey of Institutional Mechanisms. *Science, Technology, & Human Values, 15(2),* 226-243.

Fisher, E., Mahajan, R. L., Mitcham, C. (2006). Midstream Modulation of Technology: Governance From Within. *Bulletin of Science, Technology & Society, 26(6),* 485–496.

Fishkin, J. (2009). *When the people speak: deliberative democracy and public consultation.* Oxford: Oxford University Press.

Fung, A. (2003). Associations and Democracy: Between Theories, Hopes, and Realities. *Annual Review of Sociology, 291(1),* 515-539.

Fung, A. (2008). Democratizing the Policy Process. In R. E. Goodin, et al. (Eds), *The Oxford Handbook of Public Policy,* 669–685.

Granqvist, K. (2016). *Policy brief: Funding frugal innovation. Lessons on design and implementation of public funding schemes stimulating frugal innovation.* Vienna: Centre for Social Innovation (ZSI).

Griessler, E., Lang, A., & Wuketich, M. (2015). *Analytical report on the dimension of research and innovation ethics. MoRRI,* Deliverable D2.4.2.

Grinbaum, A., & Groves, C. (2013). What is "Responsible" about Responsible Innovation? Understanding the Ethical Issues. In R. Owen, M. Heintz, & J. R. Bessant (Eds.), *Responsible innovation* (pp. 119-142). Chichester: John Wiley & Sons.

Guston, D. H., & Sarewitz, D. (2002). Real-time technology assessment. *Technology in Society, 24(1),* 93-109.

Gutman, A., & Thompson, D. (2004). *Why Deliberative Democracy?* Princeton: Princeton University Press.

Hossain, M. (2016) Grassroots innovation: A systematic review of two decades of research. *Journal of Cleaner Production,* 973–981.

Houllier, F., & Merilhou-Goudard, J.-B. (2016). *Les sciences participatives en France. État des lieux, bonnes pratiques et* recommandations. Rapport élaboré à la demande des ministres en charge de l'Éducation nationale, de l'Enseignement supérieur et de la Recherche. Retrieved from: http://www.sciences-participatives.com/Rapport (date accessed: 17 May, 2020).

Howaldt, J., Domanski, D., & Kaletka, C. (2016). Social Innovation: Towards a new innovation paradigm. *Revista De Administração Mackenzie*, 17(6), 20-44.

Howaldt, J., & Schwarz, M. (2010). Social Innovation: Concepts, research fields and international trends. *IMO International monitoring, 5*, Aachen: IMA/ZLW.

Humanitarian UAV Network, (2015). *Humanitarian UAV Code of Conduct*. Retrieved from: https://uavcode.org (date accessed: 17 May 2020)

International Association for Public Participation (IAP2) (2018). *IAP2's Spectrum of Public Participation*. Retrieved from:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf (date accessed: 17 May 2020).

Irwin, A. (2006). The Politics of Talk: Coming to Terms with the 'New' Scientific Governance. *Social Studies of Science, 36(2)*, 299-320.

Jasanoff, S. (2005). *Designs on Nature: Science and Democracy in Europe and the United States.* Princeton: Princeton University Press.

Kaplinsky, R. (2014). "Bottom of the pyramid" innovation and pro-poor growth. In Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.) (2014). *Making Innovation Policy Work: Learning from Experimentation* (pp. 49-70). Paris: OECD and The World Bank.

Karatzas, I. (2015). *The Ethics Appraisal Scheme in Horizon 2020*. [online presentation] Retrieved from: https://bestprac.eu/fileadmin/mediapool-bestprac/documents/Outputs/Learning_materials/Ethics_H2020_Appraisal_2017_Karatzas.pdf (date accessed: 17 May 2020).

Khan, S. S., et al. (2016). The framing of innovation among European research funding actors: Assessing the potential for 'responsible research and innovation' in the food and health domain. *Food Policy, 62,* 78–87.

Klüver, L., Bellucci, S., Bütschi, D., van Eijndhoven, et al. (2000). *EUROpTA: European Participatory Technology Assessment - Participatory Methods in Technology Assessment and Technology Decision-Making.* Copenhagen: Danish Board of Technology.

Kretser, A., Murphy, D., Bertuzzi, S., et al. (2019). Scientific Integrity Principles and Best Practices: Recommendations from a Scientific Integrity Consortium. *Science and Engineering Ethics, 25(2),* 327-355.

Kroll, H., Gabriel, M., Braun, A., Muller, E. & al. (2016). *A conceptual analysis of foundations, trends and relevant potentials in the field of frugal innovation (for Europe).* Interim report for the project "Study on frugal innovation and reengineering of traditional techniques" commissioned to Fraunhofer ISI and Nesta. Luxembourg: Publications Office of the European Union.

Kurt, A., Duquenoy, P., Lavelle, S. (2010). *Ethical Governance Models, Paradigm Recognition and Interpretation.* EGAIS Deliverable D3.1.

Laursen, K., & Salter, A. J. (2014). The paradox of openness: Appropriability, external search and collaboration, *Research Policy, 43(5),* 867-878.

Manders-Huits, N., & Van den Hoven, M. J. (2009). The moral relevance of technological artifacts. In P. Sollie, & M. Düwell (Eds.), *Evaluating New Technologies*. Dordrecht: Springer.

Mansbridge, J. (2014). A Systemic Approach to Civic Action. In J. Girouard, & C. Sirianni (Eds), *Varieties of civic innovation: Deliberative, collaborative, network, and narrative approaches.* Nashville: Vanderbilt University Press.

Mejlgaard, N., & Ravn, T. (2015). *Monitoring the Evolution and Benefits of Responsible Research and Innovation. Analytical report on the dimension of citizen engagement and participation of societal actors in research and innovation.* MoRRI Deliverable D2.1.

Monaghan, A. (2009). Conceptual niche management of grassroots innovation for sustainability: The case of body dispostal practices in the UK, *Technological forecasting & Social Change, 76,* 1026-1043.

Mouffe, C. (1999). Deliberative democracy or agonistic pluralism? *Social Research, 66(3),* 745–758.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Moulaert, F., et al. (2017). *Social Innovation as a Trigger for Transformations: The Role of Research.* Luxembourg: Publications Office of the European Union.

Mulgan, G., Ali, R., Halkett, R., & Sanders, B. (2007). *In and out of sync. The challenge of growing social innovations.* London: Nesta.

Mulgan G., Tucker, S., Ali, R., & Sanders, B. (2007). *Social Innovation – What It Is, Why It Matters and how It Can be Accelerated.* London: The Young Foundation.

Murray R., Caulier-Grice J., & Mulgan G. (2010). *The Open Book of Social Innovation.* London: The Young Foundation and Nesta.

Nascimento, S., et al. (2018). Citizen science for policy formulation and implementation. In Hecker, S. et al. (Eds.) *Citizen Science – Innovation in Open Science, Society and Policy.* London: UCL Press, 219-240.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (1979). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research.* Retrieved from: https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html (date accessed: 17 May 2020).

OECD (2015). *Innovation Policies for Inclusive Growth.* Paris: OECD Publishing.

OECD, & Statistical Office of the European Communities (2018). *Oslo manual: guidelines for collecting, reporting and using data on innovation (4th edition).* Paris: OECD.

Official Journal of the European Union (2010a). *Charter of Fundamental Rights of the European Union.* (30.3.2010), N° C 83/393.

Official Journal of the European Union (2010b). *Consolidated Version of the Treaty on the Functioning of the European Union.* N° 83/55.

Oldsman E., & Nexus Associates (2014). Making evaluations count: Toward more informed policy. In Dutz, M., Kuznetsov, Y., Lasagabaster, E., Pilat, D. (Eds.), *Making Innovation Policy Work: Learning from Experimentation* (pp. 229-246). Paris: OECD and The World Bank.

Owen, R., Heintz, M., & Bessant, J. R. (Eds.) (2013). *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society.* Chichester: John Wiley & Sons.

Owen, R., Macnaghten, P., Stilgoe, J. (2012). Responsible research and innovation: From science in society to science for society, with society. *Science and Public Policy, 39(6),* 751-760.

Owen, R., & Pansera, M. (2019). Responsible Innovation and Responsible Research and Innovation. In D. Simon, S. Kuhlmann, J. Stamm, & W. Canzler (Eds.), *Handbook on Science and Public Policy* (pp. 26-48). Edward Elgar Publishing.

Owen, R., Stilgoe, J., Macnaghten P., & et al. (2013). A Framework for Responsible Innovation. In Owen, R., Heintz, M., & Bessant, J. R. (Eds.), *Responsible innovation* (pp. 27-50). Chichester: John Wiley & Sons.

Patel, M., Sotsky, J., Gourley, S., & Houghton, D. (2013). *The Emergence of Civic Tech: Investments in a Growing Field.* New York: The Knight Foundation.

Pellé, S., & Reber, B. (2016). *From Ethical Review to Responsible Research and Innovation.* Hoboken: ISTE/ John Wiley & Sons.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Peter, V., Maier, F., Mejlgaard, N., et al. (2018). *Monitoring the evolution and benefits of responsible research and innovation in Europe – Summarising insights from the MoRRI project.* Luxembourg: Publications Office of the European Union.

Peter, V., Maier, F., Spaini, C., et al. (2018). *Monitoring the evolution and benefits of responsible research and innovation in Europe. The evolution of Responsible Research and Innovation – the Indicators Report.* Luxembourg: Publications Office of the European Union.

Pervez, T. & Maritz, A. (2013) Innovation and social entrepreneurship at the bottom of the pyramid - A conceptual framework. *South African Journal of Economic and Management Sciences, 16(5),* 54-66.

Powell, M., & Colin, M. (2009). Participatory Paradoxes. Facilitating Citizen Engagement in Science and Technology From the Top-Down? *Bulletin of Science, Technology & Society, 29(4),* 325-342.

Rask, M., et al. (2018). *Public Participation, Science and Society: Tools for Dynamic and Responsible Governance of Research and Innovation.* New York: Routledge.

Reber, B. (2005). Technologies et débat démocratique en Europe. Re*vue française de science politique, 5,* 811–833.

Reber, B. (2006). Technology assessment as policy analysis: from expert advice to participatory approaches. In F. Fischer, G. Miller, & M. Sidney (Eds.), *Handbook of Public Policy Analysis. Theory, Politics, and Methods* (pp. 493-512). Public Administration and Public Policy Series. New York: Rutgers University/CRC Press.

Reber, B. (2016). *Precautionary Principle, Pluralism and Deliberation: Science and Ethics.* London/New York: ISTE/John Wiley & Sons.

Reber, B. (2018). RRI as the inheritor of deliberative democracy and precautionary principle. *Journal of Responsible Innovation: Responsible Innovation and Brain, 5(1),* 38-64.

Reber, B. (2019). Taking moral responsibility seriously to foster Responsible Research and Innovation. In R. Gianni, J. Pearson, & B. Reber (Eds.), *Responsible Research and Innovation: from concepts to practices* (pp. 50-73). Oxford: Routledge.

Reed, M. (2008). Stakeholder participation for environmental management: a literature review. *Biological Conservation, 141(10),* 2417–2431

Richardson, A. (1983). *Participation.* London: Routledge.

Robinson, L. D., et al. (2018). Ten Principles of Citizen Science. In S. Hecker, et al. (Eds.), *Citizen Science: Innovation in Open Science, Society and Policy* (pp. 27–40). London: UCL Press.

Rodrigues R., Broadhead S., & Trilateral Research Ltd. (2018). *The consortium's methodological handbook.* SIENNA Deliverable D1.1.

Rothwell, R. (1992) Successful industrial innovation: critical factors for the 1990s. *R&D Management, 22(3),* 221–240.

Rowe, G., & Frewer, L. J. (2000). Public Participation Methods: A Framework for Evaluation. *Science, Technology, & Human Values, 25(1),* 3-29.

Rowe, G., & Frewer, L. J. (2005). A Typology of Public Engagement Mechanisms. *Science, Technology, & Human Values, 30(2),* 251-290.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy, 30(3),* 381-400.

Shelley-Egan, C., Brey, P., et al. (2015). *Ethical assessment in research and innovation: A comparative analysis of practices and institutions in selected other countries.* SATORI Deliverable D1.1.

Shelley-Egan, C., Wright, D., et al. (2014). *Report (handbook) of participatory practices.* SATORI Deliverable D2.1.

Slocum, N. (2003). *Participatory Methods Toolkit: A Practitioner's Guide.* Maastricht: United Nations University.

Smith, A., Fressoli, M., & Thomas, H. (2014). Grassroots innovation movements: challenges and contributions. *Journal of Cleaner Production, 63,* 114-124.

Smith, A., & Seyfang, G. (2013). Constructing grassroots innovations for sustainability. *Global Environmental change, 23(5),* 827-829.

Spina, A. (2017). A Regulatory Mariage de Figaro: Risk Regulation, Data Protection, and Data Ethics. *European Journal of Risk Regulation, 8(1),* 88–94.

Stahl, B. C., Wakunuma, K. (2015). *Guidelines Handbook.* CONSIDER Deliverable D4.1

Stanley, I., Glennie, A., & Gabriel, M. (2018). *How inclusive is innovation policy? Insights from an international comparison* (Working paper). London: Nesta.

Steiner, J. (2012). *The Foundations of Deliberative Democracy: Empirical Research and Normative Implications.* Cambridge: Cambridge University Press.

Stilgoe, J. (2013). [Foreword] Why Responsible Innovation? In R. Owen, M. Heintz, & J. R. Bessant (Eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society* (pp.XI-XVI). Chichester: John Wiley & Sons.

Stirling, A. (2005). "Opening Up" and "Closing Down". Power, Participation and Pluralism in the Social Appraisal of Technology. *Science, Technology & Human Values, 33(2),* 262-294.

Strand, R., Spaapen, J., et al. (2015). *Indicators for promoting and monitoring Responsible Research and Innovation. Report from the Expert Group on Policy Indicators for Responsible Research and Innovation.* Luxembourg: Publications Office of the European Union.

Sykes, K., Macnaghten, P. (2013). Responsible Innovation – Opening Up Dialogue and Debate. In R. Owen, M. Heintz, & J. R. Bessant (Eds.), *Responsible innovation: Managing the Responsible Emergence of Science and Innovation in Society* (pp. 85-108). Chichester: John Wiley & Sons.

Taebi, B., Correljé, A., Cuppen, E., et al. (2014). Responsible innovation as an endorsement of public values: the need for interdisciplinary research. *Journal of Responsible Innovation, 1(1),* 118-124.

Thapa, R. K., et al. (2019). Responsible research and innovation: a systematic review of the literature and its applications to regional studies, *European Planning Studies: Expanding the field of Responsible Research and Innovation - From responsible research to responsible innovation, 27(12),* 2470-90.

The Institute of Electrical and Electronics Engineers (IEEE) (2006). *IEEE Policies: Code of Ethics.* Retrieved from: https://www.ieee.org/about/corporate/governance/p7-8.html (date accessed: 17 May 2020)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.

The United Nations Economic Commission for Europe (UNECE) (1998, 25 June). *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.* Aarhus (Denmark). Retrieved from: https://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf (date accessed: 17 May 2020).

Tracey, P., & Stott, N. (2016). Social innovation: a window on alternative ways of organizing and innovating. *Innovation, 19(1),* 51-60.

University of Montreal (2017). *The Montreal Declaration for a Responsible Development of Artificial Intelligence.* Retrieved from: https://www.montrealdeclaration-responsibleai.com (date accessed: 17 May 2020)

Van Gorp, A., & Van der Molen, S. (2011). Parallel, Embedded or Just Part of the Team: Ethicists Cooperating Within a European Security Research Project. *Science and Engineering Ethics, 17(1),* 31-43.

Van den Hoven, J. (2014). Responsible Innovation: A New Look at Technology and Ethics. In M. J. Van den Hoven, N. Doorn, N., T. Swierstra, B. Koops, & H. Romijn (Eds.), *Responsible Innovation 1: Innovative Solutions for Global Issues.* Dordrecht: Springer.

Van Lente, H., et al. (2017). Responsible innovation as a critique of technology assessment, *Journal of Responsible Innovation: Into the wild: Futures and Responsibilities in Technology Assessment, 4(2),* 254-261.

Van de Poel, I. (2008). How should we do nanoethics? A network approach for discerning ethical issues in nanotechnology, *NanoEthics, 2(1),* 25-38.

Von Schomberg, R. (2007). *From the ethics of technology towards an ethics of knowledge policy & knowledge assessment.* Working document from the European Commission Services. Luxembourg: Office for Official Publications of the European Communities.

Von Schomberg, R. (2012a). The Precautionary Principle: Its Use Within Hard and Soft Law. *European Journal of Risk Regulation, 3(2),* 147-156.

Von Schomberg, R. (2012b). Prospects for technology assessment in a framework of responsible research and innovation. In M. Dusseldorp, & R. Beecroft (Eds.), *Technikfolgen Abschätzen Lehren.* Wiesbaden: VS Verlag für Sozialwissenschaften.

Von Schomberg, R. (2013). A Vision of Responsible Research and Innovation. In Owen, R., Heintz, M., & Bessant, J. R. (Eds.), *Responsible innovation.* Chichester: John Wiley & Sons, 51-74.

Weyrauch, T., & Herstatt, C. (2016). What is frugal innovation? Three defining criteria. *Journal of Frugal Innovation, 2(1),* 1-17.

Wilsdon, J., Willis, R. (2004). *See-through Science: Why Public Engagement Needs to Move Upstream.* London: Demos.

Young, I. M. (1990). *Justice and the politics of difference.* New Jersey: Princeton University Press.

Zwart, S. D., Van de Poel, I., Van Mil, H., & Brumsen, M. (2006). A network approach for distinguishing ethical issues in Research and Development. *Science and Engineering Ethics, 12(4),* 663-684.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 872441.