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Defining Ethics and Participation

The connection between science and democracy is first explored through the scope of theoretical considerations on the ethics of R&I. As a separate strand, the connection to participation is then the focus of a broad investigation of its meanings in the governance of R&I. With a view to circumscribing the links between responsibility in R&I and participatory practices, this first chapter examines ethics and participation as two separate strands with various meanings and institutional responses.

With a view to better defining, on the one hand, the ethics of R&I and, on the other hand, participatory practices in R&I, this chapter explores both dimensions in an equal manner. To do so, each strand is observed through the scope of RRI and the concept of responsibility more broadly. This diversity of ethics of R&I and participatory practices in R&I reveals a multidimensional understanding of what responsible R&I might be. While the ethics of R&I and attempts at participatory processes both overlap and are at the same time supposed to strengthen the science–society relationship, defining "ethical participation" in R&I is far from being obvious. In this perspective, trying to set the foundations of ethical participation in R&I depends closely on the identification of the ethical challenges to be found in R&I (section 1.1), on how the notion of responsibility is understood (section 1.2) and on the different understandings of participatory democracy (section 1.3). Following these distinctions, an attempt at classifying the diverse field of participation is made (section 1.4) in order to better identify the different participatory practices and their meaning.

To further define participation, and given the current theoretical gaps in the definitions, some categories are outlined as a first taxonomy. These new categories serve to provide a more granular delineation of the common understanding of public (or citizen/stakeholder) participation (or engagement), in order to clarify these blurry categories as part of a renewed definition of what is termed "participation".

1.1. Ethical challenges in research and innovation

1.1.1. *Ethics in governance of research and innovation*

Under the umbrella notion of R&I, a variety of scientific and technological fields refer to innovation strategies in a different way, each with different ethical challenges, depending on the type of funding, the end product, the beneficiaries and the maturity stage of the product or process at stake[1]. The identification of key ethical issues in R&I is inevitably a seriously flawed ambition that cannot embrace all new innovative features and the sectoral specificities that may arise. We here focus on the general ethical issues in R&I, broadly considered, and the specific needs that arise from this in terms of participatory practices.

Observing new innovation configurations (e.g. frugal innovation, grassroots innovation, inclusive innovation, open innovation and social innovation), each bears a strong yet different connection to society (the way science and technology developments connect with society). The overall goal that could be considered as a common denominator across all these forms is enhancing the democratic governance of R&I processes. Across the various emerging innovation approaches, participation is primarily taken into account in recent innovation literature, with a growing concern on deliberations and participatory approaches.

Ethical challenges can be found both in the governance of emerging technologies as well as in the implementation of new innovation modes, where they stem from the way societal challenges are dealt with, the ways of prioritizing these challenges, and the ways of addressing competitive

1 In this study, the term "R&I processes" systematically refers to any type of research and innovation process, at any stage of development and throughout the diversity of possible configurations.

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 internationalization and the precautionary principle, which will be hereafter examined. Particularly at the European level, these ethical challenges are under scrutiny either on a flexible basis in privately financed R&I or with a high adherence in the case of R&I supported by European Union (EU) funding.

Significant public and philosophical concerns regarding the ethical, social and economic impacts of R&I are arising in many areas that could be identified as key sectors in terms of ethical/societal challenges (e.g. brain research, artificial intelligence and robotics) and emerging technologies (e.g. CRISPR/Cas9). In the face of these concerns, publicly funded R&I is confronted with the internationalization of the debate, with regulation discrepancies, ethical divides and the varying 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 European level: a decade ago, the European Commission Expert Group on Science and Governance stated:

> there has been a shift towards the legalization 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. (European Commission, 2010, p. 147)

This observation underlines the growing internalization of ethics in legal affairs, while, more fundamentally, it points out the blurry frontier between the ethical and the legal spheres. As ethics processes exceed the legalization of ethics, the reinforcement of this latter may hinder R&I ethics and the possibility of an ethics of participation. In the context of the internationalization of R&I, the governance of emerging technologies may find efficient tools on the side of ethics 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.

As a first overarching commonality, all ethical considerations in R&I mainly abide by the precautionary principle, which aims at avoiding either irreversible and/or large-scale damage and ensuring security despite high scientific uncertainty. This principle is usually applied in the context of scientific controversies or in the acquisition of new knowledge. The framing of the precautionary principle is a pivotal question in R&I ethics, intervening either upon existing regulations and laws or beforehand, where regulations and laws do not exist yet (Von Schomberg, 2012a). First embedded in European policy in the 1992 Maastricht Treaty for environmental policy, it has expanded to other fields of policy (Von Schomberg, 2012a) under EU law, where it intervenes as "provisional risk management measures", 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" (Von Schomberg, 2012a, p. 147). The principle can be applied in cases: (1) of potential adverse impacts on the environment or human health with serious consequences; and (2) when governmental action should be taken regarding controversies over/lack of/insufficient scientific knowledge (Von Schomberg, 2012a). Usually, this principle applies within EU product authorization procedures, as an incentive to make safe and sustainable products (Von Schomberg, 2013). However, abuses of the principle can occur, such as disguised protectionist measures in the trade sector, which led the European Commission to set up guidelines for the precautionary principle's application (Von Schomberg, 2012a).

The precautionary principle is akin to the notion of responsibility: the key feature of its definition relates to its fundamental anticipatory nature and it "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" (Reber, 2018, p. 40). As a general rule, all cases associated with the precautionary principle imply an assessment of the state of affairs in science and technology and a review of the type of uncertainties involved, precisely because "uncertainty" can relate to several cases, depending on the context:

– *hypothetical effects and imaginary risks* requiring independent, transparent and publicly accessible scientific evaluation;

– *defined and quantified risks* requiring a risk management approach from policymakers;

– *fully or partially unreliable scientific information systems* requiring an estimation of possible adverse effects thanks to a precautionary approach;

– *impossibility of scientifically established cause–effect relationships* combined with known adverse effects requiring a precautionary approach (Von Schomberg, 2012a, pp. 151–152).

Applying the precautionary principle implies taking precautionary measures on a provisional basis. Given this time-based validity, precautionary measures are lifted when scientific knowledge has made progress to the point where former uncertainties (risk and adverse effects) turn into defined consensual levels of harm and damage (Von Schomberg, 2012a), even though it can sometimes be seen as a hindrance to innovation[2]. The risk of government reactions to emerging technologies being too early or too late can imply either failing to address their nature or missing the opportunity to intervene (Von Schomberg, 2012a). Other limitations can be found in prevailing institutional preference, when current practice is taken as the default norm among several alternatives (Von Schomberg, 2012a), which does not encompass proper assessment of future developments. Regarding normative standards, precautionary regulation implies that the standards remain open for discussion, with a view to assessing the societal acceptability of R&I outcomes.

Transposing the precautionary principle to participatory configurations, and in particular to deliberative ones, interesting interconnections can be identified, as precautionary approaches can arguably provide a "normative risk management exercise" involving "a shift in science-centered debates on the probability of risks towards a science-informed debate on uncertainties and plausible adverse effects" (Von Schomberg, 2012a, p. 156). In this respect, the application of the precautionary principle can facilitate deliberative processes (see also Reber (2016)) and further to this it could be argued, along with Von Schomberg (2012a), that, as a core ethical feature, the precautionary principle is in and of itself of a deliberative nature in that it implies deliberation on normative dimensions decided as soon as the principle connects to public policy.

2 The opposite is the "proactionary principle" promoted by transhumanists, among others, which suggests regulations should be lowered in favor of innovators. See Stilgoe (2013).

1.1.2. *Bottom-up approaches*

While there are several ways to frame innovation as a concept[3], distinctive innovation modes can be outlined as general categories, aligned with varying goals. The tendency to reduce innovations to technical innovations, prevailing since Schumpeter (Howaldt and Schwarz, 2010), has put forward prevailing patterns of innovation. With the great expansion of new innovation modes inviting parts of the civil society into the scientific and technological arenas, the so-called "bottom-up" innovation is thriving. The growing interest in such configurations lies in the renewal of the science–society relationship, with the promise of a more ethical way of conducting innovative changes.

Across the great variety of ways of defining innovation, some key characteristics can be identified in the emergence of the creation of or significant improvements 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)" (OECD, 2018, p. 20)[4]. 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 (Von Schomberg, 2013, p. 119), creating added value for society (Shelley-Egan et al., 2016).

Innovation is not necessarily of a technological nature, its main characteristic being the change it brings, which can be of various kinds: from incremental to radical change, innovation can provide a different good or service (product innovation), apply new methods in the production of a good or service (process innovation) or combine a change in both a product and a process (Kaplinsky, 2014). While technological innovation creates new products, processes or features, non-technological innovations are "usually

3 The concept of innovation can be segmented into 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 et al. (2016).

4 According to this publication, the term "unit" refers to the actor responsible for innovations, in any sector.

social or organisational in nature" and create "new strategies, organisational forms and ideas that strengthen civil society" (Shelley-Egan et al., 2016, p. 20).

Innovation strategies can be outlined in the following four dimensions (see Francis and Bessant (2005), quoted in Bessant (2013, p. 4)):

– *product* innovation: changes in products/services;

– *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.

Although the process of innovation varies depending on its nature and the actors, some main steps in producing an innovation can be identified: basic and applied research, development, scale-up or engineering, production and commercialization and dissemination and use (Dahlman and Kuznetsov, 2014). From the viewpoint of the value chain, innovation can be identified through four different dimensions: product innovation, process innovation, functional innovation and chain innovation (Kaplinsky, 2014, p. 52). This distinction allows for better identification of the involvement of participatory practices in the value chain.

In this variety of types and strategies of innovation, a great diversity of actors can intervene as main actors of the process chain: the government, state-owned enterprises (SOEs), private firms, individuals, grassroots innovators, universities and non-governmental organizations (NGOs) (Dahlman and Kuznetsov, 2014). Also, the role of public funding across the innovation value chain varies noticeably, in that across the innovation process the various actors do not have the same weight in innovation efforts – governments and private companies being the driving forces mostly (Dahlman and Kuznetsov, 2014). However, private companies often act as the main actors throughout all stages of the chain (from research to dissemination and use), the main role of government being mostly funding and performing basic research and development. 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 (Dahlman and Kuznetsov, 2014).

While the connection to new innovation configurations is variable, a sectoral view seems to weigh in favor of public scrutiny and participatory expectations in the specific case of areas of emergent science and technology (e.g. nanotechnology and synthetic biology), with acute public debate on the ways to control their development accompanied by reflection on the place of public participation both in setting research agendas and modulating research trajectories toward socially desirable ends (Fisher et al., 2006, quoted in Owen et al. (2012)). This shifts the debate from the contents toward the modes of innovation: in this sense, "the challenge is not whether or not to innovate, but *how*?" (Bessant, 2013, p. 1).

Among the great variety of innovation configurations, some of them bear a relevant connection with participation, as they embrace significant science–society interactions and a connection with participatory practices, at the process or outcome level:

– *Frugal innovation* consists of doing "more with less for more people" and encompasses many different strands and criteria. It could be considered an overarching notion rather than a sub-area of "bottom-up" innovation (Kroll et al., 2016, pp. 5–6), bringing promises of economic, social and environmental benefits (Granqvist 2016). It mainly originated in the context of emerging markets (Weyrauch and Herstatt, 2016) and, as a broad concept, it embraces various strategies, motivations and outcomes that share some common features in the product dimension, the process dimension and the context dimension (Kroll et al., 2016).

– *Grassroots innovation*: 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 (Seyfang and Smith, 2007, quoted in Hossain (2016)). The grassroots innovation approach relies on needs-based user experimentation and often leads to incremental innovations (OECD, 2015). Quite similar to what has also been labeled as "crowd-based innovation" or "community-based innovation"[5], grassroots innovation is

5 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 et al. (2019).

often devoted to energy and sustainability, although it is a broad category, encompassing other forms[6]. This bottom-up approach to 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. Regarding participatory processes, grassroots innovation offers interesting cases of the broadening of participation, creating linkages across sectors and across spaces, as it mainly emerges from citizens' innovations, unorganized lay people or local entrepreneurs, among others[7].

– *Inclusive innovation* focuses on the actors who benefit from, participate in and decide on the outcomes of innovation.

– *Open innovation* is based on the free flow of information and ideas across departments and organizations and is therefore a process of harnessing the distributed and collective intelligence of crowds, relying on collaboration, sharing, self-organization, decentralization, transparency in processes and a plurality of participants (Murray et al., 2010). The benefits of open innovation are better adaptation to dynamic market needs, shared resources and risks among partners and higher commercial returns. In short, open innovation can be defined as the "use of purposive inflows and outflows of knowledge to accelerate internal innovation" (Chesbrough, 2006, quoted in European Commission Directorate-General for Research and Innovation, 2016), involving all kinds of actors in the innovation process, "from researchers to entrepreneurs, to users, to governments and civil society" (European Commission, 2016, p. 86). Open innovation is "now envisaged as a quadruple helix which brings civil society into the triple helix of government, industry and universities" (Owen and Pansera, 2019, p. 39); however, the way R&I intersects with the concept of a quadruple helix and "its desire to embed civil society as a fourth strand remains little explored" (Owen and Pansera, 2019, p. 43).

– *Social innovation*: across its various forms[8], social innovation can generally be defined as "novel or more effective practices that prove capable

6 Frugal innovation strategies, for instance, may refer to a grassroots approach.

7 Also important during the scale-up phase, according to transition theory, where the engagement of citizens is essential for transition (Hossain, 2016, pp. 973–981).

8 Social innovation can refer to different types of innovation, such as 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); and social extrapreneurship (the process of inter-organizational action that facilitates alternative

to tackle societal issues and are adopted and successfully utilised by individuals, groups and organisations concerned"[9]: these innovative practices are therefore "motivated by the goal of meeting a social need" (Mulgan et al., 2007b, p. 8). Based on social desirability, social innovation relies on participation as a process of mobilization (Howaldt et al., 2016). As such, it can 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" (Crozier and Friedberg, 1993, p. 19, quoted in Howaldt et al., 2016, p. 27).

Each of these different approaches to innovation features some relevant science–society interactions. The connection to the ethics of participation can be considered indirectly, specifically in the quality and objectives of these interactions.

1.2. Facing responsibility

1.2.1. *The notion of responsibility in innovation*

Ethics in R&I can be broadly defined as a common platform for deliberation and discussion of values in society, based on normative perceptions, influenced by cultural norms and aiming at informing policy-making (Brom et al., 2015). Any ethical analysis in R&I encompasses specific aspects: ethical questions or the moral dilemma at stake; ethical questions per se (conformity with ethical standards); ethical issues; and ethical dilemmas when moral principles are in conflict: the evaluation of right or wrong is based on ethical/moral values (ideals), or principles and norms that define standards – identified as general ethical principles (Shelley-Egan et al., 2016). 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) (Shelley-Egan et al., 2016).

combinations of ideas, people, places and resources to address social challenges). This typology and the related definitions are developed by Tracey and Stott (2016, p. 53).

9 Definition proposed by the Centre for Social Innovation (ZSI) based in Vienna. See: https://www.zsi.at/en/about_zsi/profile##Definition.

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

– openness toward stakeholders and the public[10];

– public participation[11] (including information and consultation with public deliberation);

– transparency and accountability in 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 can be considered a key dimension in innovation (Bessant, 2013), in that it ensures innovations bring benefits only. Responsible innovation (RI) stems from radical uncertainty about the future (Grinbaum and Groves, 2013): on the policy-making level, responsibility can be considered here as the frontier of existing R&I ethics with a pluralistic, evolving field of reflection. Given the future-oriented nature of innovation and its transformative power, the notion of responsibility applied to innovation refers to the future it creates, although this carries conceptual and practical difficulties (Grinbaum and Groves, 2013). This foresight issue is a problem of knowledge linked to the limits of predictability between labs and real-world implementation, the unpredictability of interference effects (Grinbaum and Groves, 2013), while it is also, ultimately, a moral problem of capacity related to human finitude:

> 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. (Grinbaum and Groves, 2013, p. 124)

Responsibility bears an ethical stance that can refer to either the legal, moral or social spheres. Ethics and morals are often considered as interchangeable, and in either case different levels can be identified, leading

10 This could also be perceived as a participation criterion.

11 “Participation” could act as an overarching notion embracing all these ethical dimensions.

to the distinction between applied ethics, normative ethics (moral theories) and meta-ethics, despite their permeability (Pellé and Reber, 2016). Also – in addition to the pluralism of ethical levels – the pluralism of moral theories entails that although deontology prevails in our current context, several rational paths can be followed through an ethical pluralism applied to ethics assessment (in the context of justification):

– 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 toward the surpassing of regulations (as in ethics review/assessment) and deontologist ethics toward an inevitably broader scope, pluralistic, implying an enhancement of reflexivity and responsibility[12]. This latter is notably polysemic, and its historical roots are to be found in imputability and accountability (Grinbaum and Groves, 2013): "responsibility" derives from the Latin term *respondere* (to respond), which can be identified in 10 different situations or understandings: cause, blameworthiness, liability, accountability, task (role), authority, capacity, obligation, responsiveness and 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, the future being the horizon which determines morally desirable goals (Pellé and Reber, 2016). Among possible meanings of responsibility, the most relevant one appears to be the individualist and consequentialist[13] concept of responsibility that prevails, implying that moral agents anticipate the consequences of their actions: "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" (Grinbaum and Groves, 2013, p. 121). In that sense, taking responsibility is close to foresight, while ignorance at the time of the action

12 See the in-depth analysis provided on the law/ethics divide and the pluralism of ethical theories in Pellé and Reber (2016, p. 31 *sqq*).

13 The ideal consequentialist moral agent in this context might be Jeremy Bentham's utilitarian subject, who considers whether each action serves the aggregate happiness of society; see Grinbaum and Groves (2013, p. 122).

does not mean that there is no moral or legal responsibility (Grinbaum and Groves, 2013). Among 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; and 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" (Stilgoe, 2013, p. XV). This complex web includes users, scientists, entrepreneurs, governments and others (Stilgoe, 2013) where there is an endorsement of the relevant public values during the innovation process (Taebi et al., 2014). Responsible innovation "means taking responsibility in ways that are, respectively, quasi-parental and collectively political in nature" (Grinbaum and Groves, 2013, p. 134). 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: this can result in four types of *irresponsible* innovations (Von Schomberg, 2013):

– technology push[14];

– neglect of fundamental ethical principles;

– policy pull[15];

– lack of precautionary measures and technology foresight.

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 in 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 (Van Gorp and Van der Molen, 2011). Even though moral/ethical expertise is debatable, ethicists provide

14 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 (2013, p. 61).

15 When policymakers integrate new technologies/innovations beyond their technical feasibility, proper technology assessment and public scrutiny. See Von Schomberg (2013, p. 62).

experience in identifying ethical issues and usually have some formal education in ethics that provides a specialization useful to guide research: ethicists[16] have access to all relevant material and information and help broaden the discussion and reflect on the consequences of the choices during decision-making (Van Gorp and Van der Molen, 2011).

Furthermore, the moment when ethics intervenes determines the very possibility of having an impact: as ethical guidance could be ineffective once technology has been developed or introduced in society, this urges anticipation and upstream engagement[17]. 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 they can still be used to inform the design, implementation or utilization decisions. (Van den Hoven, 2014, p. 6)

While it seems clear that responsible innovation should be directed at socially desirable and socially acceptable ends, both in concept and practice its definition remains unclear (Owen et al., 2013).

1.2.2. *Ethics and technology assessment: at the root of responsible innovation*

The field of ethics has seen a significant development in the past century. From a predominantly meta-ethical enterprise in the beginning of the 20th century, the focus in the 1960s 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

16 Ethicists can be similar to the consultants, or researchers, who are conducting research within the considered project (Van Gorp and Van der Molen, 2011, p. 41).

17 Upstream engagement is examined in the section on new trends in innovation approaches and configurations.

ethical theories to practical problems, for instance deontology and utilitarianism (Manders-Huits and Van den Hoven, 2009). Since the 1990s, the ethics of technology has emerged as one of the important branches of applied ethics. Within this field, ethical research is increasingly carried out as the 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 specific technological research and development project. The ethicists provide skills that scientists, researchers or innovators do not have: this interaction allows the ethicists to co-shape new technological developments. Whereas pre-World War II management was aimed at increasing the pace of technology development and early technology assessment (TA) at inhibiting the pace, the third-generation TA attempts are aimed at informing the direction of technology development (Van de Poel, 2008, quoted in Doorn and Nihlén Fahlquist, 2010).

With the growing complexity of issues of participation and governance in the mid-20th century, science and technology policy evolved toward TA, which emphasized research on the social, ethical and environmental impacts of scientific and technological change (Shrader-Frechette, 1995, pp. 2484–2490, quoted in Fisher et al., 2006, p. 487) in response to the growing societal awareness of undesirable consequences (Van Lente et al., 2017) that are bound to technological offerings, thus offering guidance for funding and regulatory activities (Shrader-Frachette, 1995). TA started with statements about the future performance of technologies, thus assessing their impact on society (Van Lente et al., 2017), and over five decades has provided a set of philosophies, practices and approaches. Impact assessment reflected the belief that mapping the consequences of future technology on all relevant dimensions was feasible and also useful, as it was supported by probabilistic methods[18].

Thanks to its anticipatory nature, TA served for forecasting and research and development 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 criticized for the level of predictability (considering nonlinear and indeterminate processes of R&I) and the legitimacy of experts' knowledge in decision-making when several values are at stake (Van Lente et al., 2017). Several forms of TA

18 Risk calculations and decision theory are part of them; see Van Lente et al. (2017, p. 254).

have been developed, categorized in the literature through distinct features, which are mainly parliamentary TA, expert TA, participatory TA, constructive TA and 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 TA) (Fisher et al., 2006). 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 (Fisher et al., 2006). The inclusion of stakeholders in TA addressed the issue of experts' exclusive judgment and decisions in policies in order to reach a more democratic innovation policy process (Van Lente et al., 2017).

Public upstream engagement came along as a new form focusing on more interactive approaches to science–technology–society relations, using dialog and other engagement practices. This method aims at creating a communication loop, from the public to policymakers, scientists and engineers (Fisher et al., 2006): an information loop between science (and policy-making) and the public, such as the public participation model promoted by the Danish Board of Technology and its consensus conferences[19]. Public engagement methods imply the participation of scientists and engineers as citizens and a distinction can be made between upstream engagement techniques aimed at policy-making processes and midstream engagement techniques aimed more explicitly at influencing the self-governance of research and development processes (Fisher et al., 2006).

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 programs, upstream approaches emphasize the early consideration of sociotechnical implications (Fisher et al., 2006) in order to intervene from the outset as real-time TA, as an observation mechanism.

19 Practiced since the 1980s. See Fisher et al. (2006, p.488).

As well as TA and ELSI, methodologies for real-time TA have been developed, bringing elements lacking from TA and leading to an inherently reflexive research and development enterprise, where social science activities are fully integrated with the core science agenda (Guston and Sarewitz, 2002). This can be achieved through[20]:

– 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 research and development trends, major participants and their roles and organizational 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)[21].

In addition to the evolution from hard impacts toward soft ones (Van Lente et al., 2017), the journey from TA to CTA and then RRI[22] 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 drew from experts' knowledge, while its political legitimation was anchored in science mobilization. CTA's focus on inclusion and design is rooted in public/citizen knowledge (or TA agents), and its political legitimation lies in serving democracy and improving technology for societal reasons. However, all three forms – TA, CTA and RRI – have each been criticized for their possible biases: TA for the marginalization of relevant aspects and CTA for the intricacies of stakeholders' interests, while the next feature, RRI, is not immune to naive instrumentalization (Van Lente et al., 2017, pp. 255–256).

20 These TA approaches have been identified as such in Guston and Sarewitz (2002, p. 100 *sqq*).

21 The last two approaches have a higher degree of participation.

22 RRI is examined in the next section.

1.2.3. *From ethics of technology to responsible research and innovation*

As well as TA, responsible innovation is another strand at the intersection of ethics and technology: rooted in the ethics of technology, responsible innovation refers to the intention of making innovation consistent with important public and moral values by including these values at all stages of innovation, as a collective duty of care, with regard to both the desired outcomes of innovation and also the way to make its pathways responsive in a context of uncertainty (Owen et al., 2012). RI and RRI are parallel discourses[23], 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" (Owen and Pansera, 2019, p. 26)[24]. Also, both RRI and RI are interpretively flexible and politically malleable (Owen and Pansera, 2019).

As a policy discourse that emerged from the European Commission, RRI is rooted in the European Commission's Science in Society program, and shares much with the discourse of RI, which has in contrast emerged largely from academic roots (Owen and Pansera, 2019) and remains mostly an ideal, a guiding principle, unresolved in terms of its political, institutional and normative practices (Owen and Pansera, 2019). 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" (Owen and Pansera, 2019, p. 28).

On the other side, RRI aims at R&I processes that are more responsive and adaptive to societal grand challenges and requires broader foresight and impact assessments (Von Schomberg, 2013), without having an innovation strategy driven on its normative side by market demand[25]. As such, it can be considered as a strategy of stakeholders to better anticipate R&I outcomes

23 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 (2019, pp. 50–73).

24 The authors specifically refer to, for example, those relating to academic conduct and research integrity.

25 See René von Schomberg's analysis, who states that "the normative dimension of what counts as an 'improvement' is decided by market mechanisms" and that "positive impacts of innovations under public research and innovation policy schemes are solely justified in purely economic terms" (Von Schomberg, 2013, p. 54).

aimed at the grand challenges of our time for which they share responsibility (Von Schomberg, 2013). RRI's focus on outcomes is nurtured by ethics and aims at aligning to aspirational notions, which seals its legitimacy. It aims at several normative focal points such as, notably (Von Schomberg, 2013): ethical acceptance (compliance with fundamental values) sustainability and social desirability.

The roots of the RRI approach go back to research in applied ethics and the ethics of technology more particularly. The intersection of ethics with technological innovations, applied science and engineering provides practical innovative solutions for important social and global problems that could shift public policy and decision-making (Van den Hoven et al., 2014). In the applied ethics of technology research programs, participation (by stakeholders[26]) is considered a key element: input from civil society, consumer organizations, NGOs, decision-makers and politicians, professionals and market parties would ensure the connection with real-world matters (Van den Hoven et al., 2014). By integrating all affected parties, the assessment of innovative features necessarily embraces contextual elements, regulatory frameworks, incentives and institutional arrangements (Van den Hoven et al., 2014).

With the European Union's 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 R&I goals of the European Commission with broader societal needs through Horizon 2020 societal challenges themes (European Commission, 2013, quoted in Khan et al., 2016, p. 80):

> Responsible Research and Innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and 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 organizations, etc.) work together during the whole research and innovation

26 Representatives from the innovation and technology sector.

> process in order to better align both the process and its outcomes with the values, needs and expectations of society[27].

In its current framing in Horizon 2020, RRI includes six policy keys, one of which explicitly concerns ethics, another one public engagement[28]. The intrinsic value of ethics seems to contrast with its identification as a "key" of RRI: limitations have been reported with these keys, such as the fact they are isolated themes and do not substantively engage with innovation systems (Owen and Pansera, 2019).

As a concept, RRI has so far taken 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" (Van Lente et al., 2017, p. 255), as it embraces a broader set of values and focuses on morally ambiguous situations and moral controversies[29]. Early engagement of stakeholders in R&I 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[30], 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 (Reber, 2018).

27 See https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation [accessed 17 May 2020].

28 The six policy keys for RRI as set by the European Commission are: ethics, gender equality, governance, open access, public engagement and science education.

29 At the same time, RRI takes stock of soft impacts, which pertain to private sphere and individual choice matters. See Van Lente et al. (2017, pp. 256–257).

30 RRI 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 (2012b).

The various dimensions of RRI reflect distinctive perspectives and discourses[31]:

– for policymakers: "address grand societal challenges", "increase public trust" and "build a responsible future";

– for researchers: "incorporate other views", "evaluate the impact", "anticipate, reflect, engage, act", "share the process, make it worthy" and "share your responsibility";

– for business and industry: "invite all relevant actors", "boost socially acceptable innovation", "find new business opportunities", "reinforce your customers' trust" and "add value, secure your future";

– for the education community: "responsibility is a learnt behavior", "stimulate curiosity", "contextualize science" and "empower future generations";

– for civil society organizations and RRI for citizens: both relate to "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) and responsibility[32]. The second one refers to the integration and institutionalization of established mechanisms of reflection, anticipation and inclusive deliberation in and around the processes of R&I: this answers to the need for inclusive deliberation processes of dialog, engagement and debate, inviting and listening to wider perspectives from publics and diverse stakeholders (Owen et al., 2012). The main specificity of RRI in regard to 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 R&I 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,

31 According to the perspectives outlined in the SwafS program RRI Tools (community project for research, technological development and demonstration – rri-tools.eu), funded by the European Union's Seventh Framework Programme. In this project, six different perspectives on RRI are identified, each stressing different aspects of RRI.

32 Although this can be called into question; see Reber (2018, pp. 38–64).

RRI still has room for improvement if we consider some criticisms that have been noted.

Innovation governance goes beyond risk governance and, in the field of responsible innovation, it implies that processes and outcomes are taken into account (Von Schomberg, 2013). Among 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 (Von Schomberg, 2013). Responsible innovation requires responsiveness: making innovation more responsive to societal challenges entails more responsive governance choices and a better consideration of the underlying values, norms and principles behind policies (Stilgoe et al., 2013). In this perspective, responsiveness is an integral part of responsible innovation, which, according to Stilgoe et al. (2013), can be defined through four main dimensions: anticipation, reflexivity, inclusion and responsiveness. The latter implies addressing new knowledge and emerging perspectives and norms (Stilgoe et al., 2013) in view of societal challenges.

1.3. Public participation and the ideal of participatory democracy

1.3.1. *Public participation in research and innovation*

From information and consultation to more acute participatory forms, public participation in science/technology developments expands in various directions[33]. Public participation can operate in decision-making on science and technology policy, either at limited or enhanced levels, when public views are actively solicited; for instance, in strategy, program design and evaluation. Participation can refer to the involvement of stakeholders, of citizens (general public) or of specific categories of participants that are usually under-represented, as well as end-users of the targeted product/service/output of a given R&I process. These variations also cover different stages of R&I, while citizens as a wide category can refer either to individuals or to civil society actors – and citizens organized in associations

33 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 formalized participatory process and not addressed as such in the reviewed literature.

too – as the potential of these latter in revitalizing participatory impulses and ideals has been acknowledged[34]. Public participation – also labeled "public engagement" – is more widely known since it has been adopted and promoted by the European Commission (Rask et al., 2018).

Public engagement might be 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 (Van Gorp and Van der Molen, 2011). This has been 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 researchers, for example about research priorities and directions (Guston and Sarewitz, 2002).

The main formalized public participation methods are: referenda, public hearings/inquiries, public opinion/surveys, negotiated rule making, consensus conferences, citizen juries/panels, citizen/public advisory committees and focus groups. They can be grouped into five categories, regardless of the variability of the inner characteristics pertaining to each category:

– *public hearings*: a broad category which refers to several mechanisms, tending to be loosely structured as open forums, with the appearance of individual and community involvement;

– *initiative*: considered as the prototype of democratic processes, initiatives enable citizens to place issues on the ballot for voter approval;

– *public surveys*: these can complement participation through hearings or written comments by providing a more representative portrait of public opinion and by offsetting biases and seeking opinions more broadly from the uninterested but affected public;

– *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";

– *citizens review panels*: "participants can influence the agenda, question experts, evaluate evidence, balance competing considerations, and debate

34 On this topic; see Fung (2003, pp. 515–539).

issues, possibly with authoritative decision makers". However, this model reaches only a portion of the affected public (Fiorino, 1990, pp. 230–235).

Several other participatory methods can be identified, with different objectives, topics, categories of participants and degrees 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, interactive TA, constructivist consumer TA, ad hoc committees relating to the rules of negotiation, interdisciplinary work groups and political role play. (Reber, 2005, pp. 812–813)[35]

The extent in the selection of main participatory methods varies across the literature, as some authors consider fewer methods or additional ones, such as planning cells, for instance Slocum (2003). Across scientific and gray literature, participatory methods considered to facilitate higher levels of involvement are: the Charrette method, the Delphi process, citizens' juries, citizens' panels, consensus conferences, deliberative polling, the round table method, scenario workshops, search conferences, study circles and methods of sustainable community development (Shelley-Egan et al., 2014). Some attempts to classify methods can be found, for instance through an analysis grid that takes stock of the objectives, the topic, the participants and the time length of the process (Slocum, 2003).

Among these different models, no single one prevails, as contextual factors determine the effectiveness of each one (Rowe and Frewer, 2000). Judging on participation criteria, these models have diverse internal characteristics: allowing direct participation of amateurs (all except negotiated rule making), exercising full decision authority (in initiatives and negotiated rule making), and 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 mostly occurs in negotiated rule making, where the public's consent is a

35 The length of this list varies across the literature. This substantial list goes further than Slocum's 10-entry classification.

pre-requisite for the conclusion of the process (Fiorino, 1990). In addition to the limitations inherent to lower forms of citizen participation, the risk of distortion of participation also narrows the efficiency of participation in terms of actual outcomes.

Participatory processes are not obvious and public talk can be "derided as unsubstantiated words and empty rhetoric" or even occasionally perceived as an impediment to science-led progress (Irwin, 2006, p. 318). 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[36];

– scientific and ethics evaluations can diverge;

– public consultation can occur without a link to decision-making;

– potential lack of dialog or knowledge sharing with lay citizens;

– potential lack of dialog on future orientations/targeted impacts.

To reach equity and fairness and avoid biases, concerns regarding ethical issues must also be addressed, taking into account their impact on society, especially for emerging technologies in fields such as medical research and nanotechnologies: new science and technology can have a considerable impact upon vulnerable groups – including the unborn and those unable to defend themselves (Sykes and Macnaghten, 2013). 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 (Stirling, 2005). These latter can intervene in appraisal by framing it in a way that closes down the range of social choices: thus, a stylized participation could be opposed to an "opening up" participatory appraisal[37].

Contradicting the tendency in science study to resolve issues of governance through legal treatment (Irwin, 2006), participation shows another way in which open science–public relations can bring along

36 External stakeholders in assessment processes can represent interests as well.

37 Motivations underlying appraisal correspond to three types of imperatives that shape the role of intentionality: normative (the right thing to do), instrumental (aiming to secure particular ends) and substantive (aiming at generally better ends). See Stirling (2005, p. 264).

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 cannot in and of itself rebuild trust and be taken as an antidote for public skepticism over technical change and innovations (Irwin, 2006) when there is such a 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 offer a constant space for inclusive dialog.

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?" (Sykes and Macnaghten, 2013, p. 102). The importance of social agency in science and technology choices is of importance in policy-making, where public dialog is often claimed to increase the legitimacy of decisions. In other spheres, participation's legitimacy lies in the fact that it helps "explore the grey areas of public opinion, away from polarized discussion and media sensation, enabling more nuanced and in-depth thinking about an issue" (Sykes and Macnaghten, 2013, p. 97). The legitimacy of participatory processes depends as well on the time in which and the way they are conducted: addressing ethical dilemmas in upstream participation where science/innovation is at an early stage is, for instance, a determining factor in ensuring the ethical grounds of innovation processes.

1.3.2. *Participation in technology assessment*

Moving from loosely defined "participation" to the identification of participatory methods, one stumbles upon questions such as "what participation mechanism is most effective in enabling public participation" and "in what circumstances", while "to be able to test it, one must possess definitions of such important concepts as *participation mechanism, effective*, and *circumstances*" (Rowe and Frewer, 2005, p. 252).

Evaluation is probably the most institutionalized and long-standing field of participatory practices, notably renowned through participatory TA. Participation in TA does not cover the whole array of participatory practices in innovation but has extensive importance in ensuring the legitimacy and efficiency of funded projects. However, the distinction between *ex ante*

assessment and *ex post* assessment[38] is not always specified in the scientific literature on the topic (Reber, 2005), blurring the lines of criteria and implications.

In the evolution of public engagement, the development of TA organizations, in Europe and in the United States from the 1970s onward 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 (Sykes and Macnaghten, 2013). The Danish Board of Technology led this a step further, through a more inclusive approach to assessment, not only informing Parliament but also creating a space for dialog with public debates and the related model of public deliberation, broadly understood, through consensus conferences (Sykes and Macnaghten, 2013). 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 the Netherlands Organization for Technology Assessment (NOTA)) (Sykes and Macnaghten, 2013). These developments were propelled by intense public debate in the media and in civil society organizations on critical issues (e.g. on genetic modification of plants and animals), which required broad societal debates (Sykes and Macnaghten, 2013). The growing concern over scientific controversies kept directing attention towards the lack of the public's confidence in science and the need to embed dialog with the public in policy-making in science, which was notably spurred in the UK, around 2000. Further to this, upstream dialog projects between scientists and the public took place in the following years across Europe, mainly with the support of the European Commission[39].

Despite 30 years of participatory TA in Europe, issues such as "why participate", "how to participate" and in order to reach "what quality" are not yet solved, which arguably weakens the legitimacy of participation and calls into question the number of citizens to be engaged, their selection (demographically or legally representative), the way to ensure the participation of big groups and the legitimacy of the participants (Pellé and

38 See footnote 51.

39 Important projects for innovation and ethical implications have been supported by Frameworks 6 and 7 of the European Commission; see Sykes and Macnaghten (2013, p. 90).

Reber, 2016). In view of all these questions related to the engagement of citizens in technological controversies, Pellé and Reber (2016) conclude that socio-political experiences in the evaluation of controversial technologies have been implemented over three decades without dealing with these unanswered questions.

Four main criteria can be identified in participatory TA (Reber, 2005): public acceptance (encompassing criteria such as representativeness, independence, early engagement, impact and transparency); deliberative democracy requirements; reflection of procedural justice and fairness; and ethics of discourse. The combination of all these criteria can vary significantly according to the importance attached to each in decision-making and in normative choices. Among 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 and scenario workshops. With a varying focus on stakeholders or the public, participatory TA relies essentially on inclusion, its diversity and coherence in the process up to decision-making. Participatory TA 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 (Reber, 2005). Considering risks are being tackled more effectively through widened participation, participatory TA defends the diversity of views and aims at defending all affected persons[40]. Furthermore, the complexity of decision-making in a widened participatory context implies the need to deal with the pluralism of values and disagreement:

> In general, the handling of inter-personal problems has to balance 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 the opposite, to reject 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

40 However, the concern to widen the access to affected publics tends to outweigh the technical part of participatory TA. See Reber (2005, pp. 812, 825).

> for the process, as long as they are exerted with openness and transparency. (Klüver et al., 2000, p. 101)

This entails the difficulty of obtaining 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 in addressing the moral dimension remains as a methodological pitfall (Reber, 2005). Therefore, it is of utmost importance that justifications and decision-making reach the same transparency as that of scientific evidence and their public restitution (Reber, 2005). Furthermore, the literature focuses also on two weaknesses that are common to participatory TA: on a pragmatic level, improving the quality of decisions requires having 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 (Slocum, 2003). On a normative level, there is uncertainty regarding 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 (Slocum, 2003).

1.3.3. *From broad participatory practices to deliberation*

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 dialog, engagement and justifications are developed to respond to essential democratic requisites, reflecting 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 to facilitate a dialog with science and technology in the public sphere, in order to elicit public will (Van Lente et al., 2017). As opposed to the election-centered model, the deliberative model is talk-centered and wants ordinary citizens to deliberate issues on a regular basis (Steiner, 2012). Dialog draws from the knowledge of the public and is supposed to shed light on the stakes of the issue – from any perspective, for example political, economic, ethical or ontological – and to widen the assumptions of scientists and policymakers (Sykes and Macnaghten, 2013). In addition to its impact

on governance processes, dialog can also help funders to explore how to increase the social benefit of their R&I processes.

Deliberation refers to the conduct of debate and discussion to produce "reasonable, well-informed opinions in which participants are willing to revise preferences in light of discussions, new information, claims made by fellow participants" (Chambers, 2003, p. 309, quoted in Fagotto and Fung, 2014, p. 9). Similarly, *public deliberation* can be defined as "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" (Gutman and Thompson, 2004, p. 7). 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 (Fagotto and Fung, 2014), by correcting democratic deficits in policy-making (Fung, 2008) and aiming at providing "the most justifiable conception for dealing with moral disagreement in politics" (Gutman and Thompson, 2004, p. 10) – disagreement being both a condition and a challenge in deliberation (Esterling et al., 2015).

A number of successful practices in the field of deliberation have been underlined, such as good dialogic practices, the importance of hybrid forums[41] and pitfalls to avoid when conducting dialog (Sykes and Macnaghten, 2013). Deliberation can bring several positive effects such as a change in citizens' views through discussion, knowledge sharing, deepening of civic engagement, participation in public life and contribution to policy implementation. Also, moral values related to deliberative democracy are considered to strengthen the democratic fabric of our societies as greater participation contributes to fostering citizenship (Gutman and Thompson, 2004).

While deliberation could arguably be considered a key dimension in RRI, 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 and whose opinion it is that is being

41 In order to avoid the separation between lay values and science.

assessed (Fishkin, 2009), 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, such as which participants should be included or excluded, the nature of the decision-making method (e.g. majority, unanimity and veto right) and the way final conclusions are dealt with (Pellé and Reber, 2016).

The form of public opinion that is targeted can also vary (raw public opinion/deliberative public opinion) (Fishkin, 2009). 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 (Fishkin, 2009) or on democratically elected representatives of citizens; several methods of selection can be used: self-selection, non-random sampling, random sampling or everyone (Fishkin, 2009). Deliberation per se is arguably difficult to obtain from ordinary citizens, which entails the need for adapted approaches to increase the level of deliberation.

The problems and limitations of deliberative democracy derive from specific issues (Irwin, 2006) such as representativeness, with polarization seen as a possible negative antecedent for deliberation (Steiner, 2012) if the deliberation is not properly conducted[42]. Indeed, critics of deliberation have raised concerns over the possible domination of privileged members' views during deliberation processes (Fishkin, 2009). Also, the concern for public openness in deliberation arises as some theorists consider that deliberation is facilitated when it does not take place in the public eye (Steiner, 2012) – although the importance of public openness varies according to the phase of the decision process (Steiner, 2012). Another issue is the guarantee of a fair and equal representation, as the number of ordinary citizens that should be involved is debatable (Steiner, 2012).

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 (Gutman

42 Polarization could be considered as a consequence of improper deliberation; see Steiner (2012, p. 224).

and Thompson, 2004). Further to the reason-giving requirement[43], deliberative democracy also relies on some core characteristics, such as the accessibility of the reasons given, the binding nature of the decision produced for some period of time and a dynamic process (the dialog remains open and evolving) (Gutman and Thompson, 2004). 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 (Gutman and Thompson, 2004). Also, deliberation has to take place in public, and deliberative justifications must be understandable and clear to those to whom they are addressed (Gutman and Thompson, 2004). When citizens rely on experts, which frequently occurs, the reasons or the bases of the reasons should still be accessible.

Although the outcomes of deliberation aim at reaching the common good, there is disagreement over consensual or pluralist results[44]. 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" (Gutman and Thompson, 2004, p. 29). However, deliberative democracy does not in itself indicate a unique method for bringing deliberation to a justified conclusion (Gutman and Thompson, 2004), and, furthermore, can "rely on other procedures, most notably voting, which in themselves are not deliberative" (Gutman and Thompson, 2004, p. 18). 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 (Gutman and Thompson, 2004). Indeed, 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 that justice should be prioritized over deliberation (Gutman and Thompson, 2004, pp. 40–41). If public deliberation instances are usually born from the initiative and energies of civic organizations and entrepreneurs, their existence through time requires institutional support by politicians and

43 Usually opposed to aggregative social choice procedures and their voting processes, deliberation relies on reason-giving, which is its most important characteristic; see Fagotto and Fung (2014, p. 9).

44 It should be noted that philosophers in the footsteps of Mouffe and Young have criticized 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 (1999, pp. 745–758) and Young (1990).

decision-makers. With the support of local capacities[45], 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.

1.4. The diverse field of participation

1.4.1. *Defining participatory activities: types and timelines*

Even though citizen participation and public participation are commonly perceived as legitimate processes that facilitate an open relationship between science and society in accordance with RRI principles, the methods and outcomes of such processes are not self-evident or consistent. Moreover, participatory processes are not all integrated into R&I processes at the same stage, while participants from civil society can be individuals or groups, end-users or people affected by a certain issue, as well as a plethora of other categories, each having a different influence in an R&I process.

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 (Stirling, 2005). 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 concrete innovative frameworks. The wide spectrum of participatory practices is first analyzed 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 R&I and what these publics can bring to innovation processes.

Broadly considered, participation 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 an R&I process and how? What are the expected outcomes and how are they being taken care of? Such questions

45 Embeddedness requires a public deliberation that is iterative and that is anchored in community-based or governmental organizations; see Fagotto and Fung (2014, pp. 13–14, 19).

need to be answered in light of the innovation modes and current challenges in R&I. Even though the legitimacy of participation in R&I tends to be self-evident, a lack of definition of the proper process may lead to poor forms of participatory practices.

Considering participation in R&I from a general point of view, the first questions that arise are: with what purpose, how and, consequently, when does participation occur? As a generic term, participation can be circumscribed to 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 "dialog" or "engagement", "involvement" and "consultation", indicating public talk as a flexible construction[46]. Depending on their type, participatory processes can fulfill several roles, including the identification of policies/programs, the identification of undesired consequences, the improvement of quality/transparency (thanks to assessment) as well as knowledge sharing, and leverage on the impact – among 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 requirements to address transparency and openness are common drives aiming at convincing the public to trust decision-making, thus restoring legitimacy (Irwin, 2006). Parliamentary TA introduced a participative turn in TA, bringing public participation to the forefront, following the lead of, notably, Denmark and its consensus conferences[47], borrowing from the medical consensus conferences (Reber, 2006), which offer a public mediation between scientific expertise and public policies (Van Lente et al., 2017). While the Danish model focused on public debate, the Netherlands[48] developed another model based on co-production, where deliberative forums spurred interactions between mini-publics through hybrid deliberation (Van Lente et al., 2017). Regardless of their differences, these various models convey the same set of issues around the broad notion of participation.

46 In the sense that these terms are "open to variable interpretations"; see Irwin (2006, p. 314).

47 Invented by the Danish Board of Technology (DBT).

48 The Netherlands Office of Technology Assessment (later renamed the Rathenau Institute).

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" (Rowe and Frewer, 2005). At the same time, the number of processes, techniques and mechanisms to enact involvement has also grown (Rowe and Frewer, 2005).

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 (Rowe and Frewer, 2005). Citizens and stakeholders can variously connect to R&I processes in terms of contribution and proximity – either internally or externally to the R&I process[49]. Under this bipartite distinction, three categories of participatory activities are outlined:

– citizen and stakeholder engagement *in innovation projects*;

– citizen and stakeholder engagement *within agency processes*;

– citizen and stakeholder engagement *in evaluation processes*.

Within these categories, several types of activities can be outlined, helping to separate the different outcomes of activities involving the participation of citizens:

– *general consultation*: processes of engagement with any group of citizens or stakeholders, in order to obtain feedback on policies and programs;

– *evaluation (of projects and programs)*: evaluation of project proposals (i.e. the ethical and scientific evaluation) as part of the selection process intervening in funding schemes, interim and *ex post* evaluation for projects and programs that receive funding and program evaluation[50];

49 This distinction may have direct consequences in the way participants should be treated (e.g. in medical research on human participants, research on vulnerable people is often only allowed if they directly benefit from it).

50 Participation in assessment of science and technology has been developed for more than 30 years through technology assessment and contributes to agreements on substantial investments

– *information/knowledge sharing*: dissemination of information on R&I contents, outputs and scientific knowledge. Also one-way, like the communication of funding activities, knowledge sharing relates to the dissemination of scientific content only. This mostly relates to the one-way engagement toward any type of public and the sharing of information pertaining to the communication of funding activities (funding portfolio) and/or funded activities (funded research/development/innovation and its results);

– *monitoring*: systematic follow-up of funded projects in the context of funding schemes, as an activity usually carried out internally (but which can be supported by external experts: e.g. when doing interim or final reviews), although *ex post* monitoring of results can involve other actors, in addition to the involvement (feedback) of programs' beneficiaries;

– *program design*: in the context of R&I, program design refers to the identification of program objectives and of R&I priorities, resulting in the definition of funding opportunities;

– *social impact evaluation*: activities that aim at measuring the societal impact of R&I processes, including the development of indicators and the monitoring allowing such measurement;

– *project execution*: involvement of external participants[51] in the execution of an R&I program/project.

Other categorizations can be found in the literature, for instance a tripartite distinction based on the objectives of the policy process, which can involve: transmitting information (unidirectional), consultation (bi-directional) or active participation (when all involved parties contribute to the issue to a certain extent) (Slocum, 2003). 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

and technical options; better responses to social needs; agenda-setting; mapping of scientific controversies; more interactive surveys. 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 reach a more comprehensive view of a technological innovation and its impacts on society. Assessment can refer to distinct processes, depending on the stages of innovation processes: *ex ante* evaluation, *interim* evaluation and final and *ex post* evaluation. Each stage has a different array of implications, while evaluation can also be considered throughout the whole timeline, as *in itenere* assessment (during all phases).

51 The types of participants are explored in the next section.

"the public" (Slocum, 2003). According to this categorization, participatory approaches take place in three distinctive areas: evaluation, planning and implementation.

In a general sense, 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" (Rowe and Frewer, 2005, p. 253). With varying levels and ways of participation, the broad category of public participation could be opposed to non-participation situations related to traditional models of governance, where along with nominated experts elected policymakers set policy without reaching out to the public (Rowe and Frewer, 2005). According to the level of involvement and the goals, certain forms may not be considered as participatory.

1.4.2. *Defining participants: types of actors and visions of engagement*

Commonly identified as an "inclusion" mechanism, participation can embrace various kinds of participants[52], including 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 do they cover the whole array of potential participants. If participatory processes in innovation involve mainly citizens, with the aim of bridging science and society, other actors can be identified under the category of "stakeholders". As the variables in participation are multiple, so are the models, depending on who participates, what the underlying intention is, who conducts the procedure, what the distribution of (technical) expertise is and if there really is a choice addressed to participants (Rowe and Frewer, 2005).

Participants can be divided into internal or external actors (in relation to the R&I process), involved in activities happening either before, during or after R&I processes. According to the field – for example 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 usually refer to multi-actor approaches involving

52 In addition to the usual participants (experts, scientists).

societal engagement, stakeholder engagement, citizen dialog and any interaction that brings guarantees that the social impact of new technologies and innovations can be considered in R&I activities. Participation also relates to the wide category of participatory democracy, which is fundamentally a means to achieve the very ideal of self-government (Fung, 2003). 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" (Slocum, 2003, p. 9). On the contrary, a restrictive approach limited to participatory processes in funding schemes refers precisely to evaluation processes and ethical appraisals.

Some general divides can be outlined[53]:

– *participation orchestrated by funding/non-funding entities*: in ethics 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&I projects can be considered as "citizens participants" or "participants in novel modes of interaction", considering that 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-based and creative methods to involve citizens differ from stakeholders' involvement, being specifically focused on categories of citizens that may have an interest in R&I 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 to "stakeholders" as it implies an action toward the common good, ultimately raising 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&I activities differ from those involved in evaluation processes. Contributing to programs' design or implementation involves a different engagement than participation in evaluation, where the

53 The following distinctions concern different dimensions: these are not disjunct and can be combined.

contribution focuses on compliance with ethical frameworks, regulations and procedures.

Participants in R&I can 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 R&I products. Both citizens – as the general public – and stakeholders can contribute to 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 (see Blok et al. (2015)).

Stakeholders can be defined as individuals, groups or organizations 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" (Blok et al., 2015, p. 149). 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 (AccountAbility, 2015)[54]. On the level of inclusivity, participation of stakeholders aims at achieving accountable and strategic responses to sustainability (AccountAbility, 2015). Stakeholder engagement contributes to responsible innovation by bringing transparency, interaction, responsiveness and co-responsibility (Blok et al., 2015). On a wider scale, stakeholders also complexify 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 R&I requires specifying the context and the scope.

54 The AA1000SES (2015) is a generally applicable framework for the assessment, design, implementation and communication of quality stakeholder engagement.

A more detailed categorization would allow a distinction of roles according to the type of participation:

– *citizens*: ordinary people, defined as the general public[55], lay people and citizens as persons (or collectives) with civic expectations[56];

– *end-users/consumers*: a specific category distinct from citizens (sometimes with overlaps), referring to beneficiaries of the end product (including solutions and services) of the R&I process. This category specifically refers to the impact and the uses of the products of R&I activities in society;

– *experts*: individuals enrolled as (internal or external) experts in RFO activities, but at the individual level and not as part of any of the other categories. Therefore, lay experts for instance can be included in this category, if their involvement mainly values their expertise (as citizens) and if this category prevails over others (e.g. "citizens"). Experts can be individuals with any sectoral expertise (e.g. with a background in medicine, psychology, sociology, philosophy, among others);

– *private bodies' representatives*: representatives of small- and medium-sized enterprises (SMEs) or large companies (including those conducting research), considered as beneficiaries (actors who implement the funded proposals) or non-beneficiaries of funding schemes and involved in some way in RFO activities as participants, participating on behalf of their company. This category also comprises social entrepreneurs;

– *public bodies' representatives*: also understood as governmental institutions, this category encompasses national public bodies (e.g. government departments or ministries, excluding academic research institutions) that might be involved in the management of RFO activities and projects or that might operate as funding agencies. Public bodies relate to ethics through ethical compliance mainly, ensuring ethics requirements are met in grant agreements signed with the beneficiaries at a national level;

– *organized civil society representatives*: civil society organizations have different levels of knowledge and leverage compared to individual citizens.

55 Including citizen scientists and open science movements.

56 In this category, the main boundaries for the "citizens" category are anchored in the citizens/stakeholders distinction. Also, since end-users can be categorized as citizens as well, this distinction serves to underline the general dimension of involvement, referring to the broader sense of "public participation". This category may also relate to a broad participatory approach.

They may defend interests, often professional interests (trade unions), causes (e.g. animals and environmental issues) or rights (e.g. minorities and women).

– *research participants*: human participants who are part of the subject of research (for instance, in medical sciences, the public and patients' involvement).

– *scientists and research institutions' representatives*: individual scientists (any scientific or technical field) or representatives of research institutions involved in RFO processes either for their individual expertise or for their affiliation to a research institution, but speaking for themselves only. In cases when they are invited on behalf of a private company conducting research, these participants should be identified as part of the "private bodies" category. This category also includes researchers as physical persons working for a legal entity (SMEs, universities, research institutes) conducting research and to whom public or private funding has been granted to do so. Participants under this category can be considered as "experts".

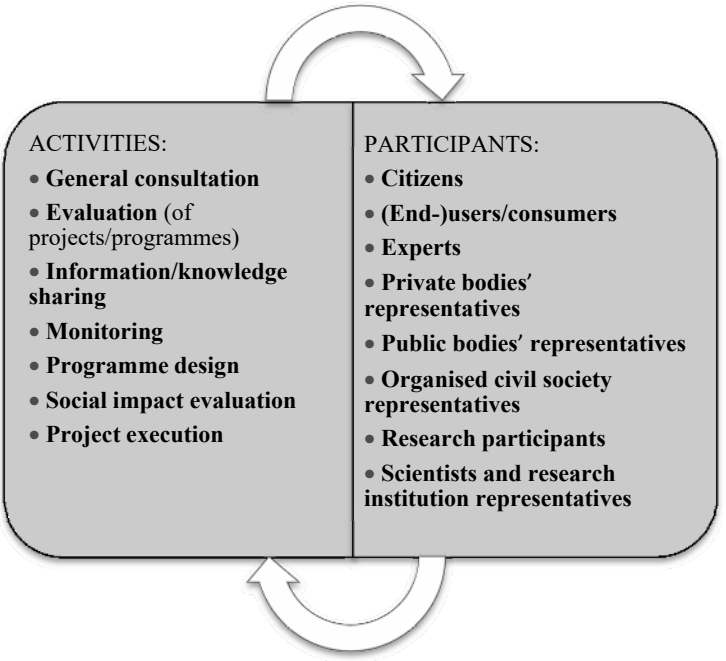

Figure 1.1. *Types of activities and participants in R&I participatory processes*

Some categories can overlap, according to the nature of the participation, as is the case for "citizens", who may be, for instance, directly involved as research participants. In assessment (evaluation), several types of experts/evaluators can be identified, depending on the proximity with the project: self-assessment, internal, external (neutral) and evaluation by beneficiaries (or users)[57]. Regarding knowledge sharing, both researchers and citizens can be involved, while both are also involved in other categories, since researchers participate in R&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 organizations and not necessarily through individual direct involvement.

1.4.3. *Finding value in participation*

Participatory practices introduce new challenges in RRI, requiring an additional layer of scrutiny on the review of ethical issues, whether formalized (as in ethical reviews) or not. At the same time, participatory practices are a core element of RRI: the RRI concept has emerged as an extension of the science in society discourse (Khan et al., 2016) about the co-production of solutions to global challenges and purposeful science (Jasanoff, 2005), upstream engagement (Wilsdon and Willis, 2004) and the reflexive responsibility of scientists and innovators (Owen et al., 2012). Within RRI, participation plays an important role as one of the pillars/keys, with a procedural nature[58]: although it is not an overarching dimension, its contribution to governance and ethics is as fundamental as its connection with open science. Seen as the cornerstone of a democratic approach to R&I, the meaning of participation evolves according to the specific focus that is considered, for example citizen participation or stakeholder participation, each having a distinctive scope. Beyond the inclusion of lay participants through consultation, participation is sought for values believed to foster the democratic construction of our societies. Contributing to responsibility in science and technology, participation is commonly seen as the corollary of democracy, ensuring that core democratic values are integrated throughout

57 Toward participation in the design and implementation of follow-up/monitoring.

58 It could be argued that participation, governance and openness are of a rather procedural nature, focusing on cooperation, whereas gender equality, scientific education and ethics are more of a substantial nature. See Pellé and Reber (2016, Chapter 2).

time and frameworks. At the core of the science–society relationship, participatory processes play a vital role in supporting democracy, even though democracy is not always mentioned in TA or RRI; see for instance Pellé and Reber (2016).

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 (Fung, 2008), especially considering these voices can be at odds with expert and scientific positions (Sykes and Macnaghten, 2013). 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 the interests of disadvantaged groups who have not been able to engage in participation. Considering their potential added value, participatory practices are considered to improve the quality of decisions, whereas on a normative level it can be argued that they ensure decision-making processes are more democratic (Slocum, 2003).

The value to be found in participatory practices also lies in the capacity to introduce dialog and debate in an arena that 50 years ago was rather undisputable. Acknowledging that science and technology can have unforeseen effects – and that they are no longer solely positive, neither for humans nor the environment – appeals for more dialog. Participation can help tackle this issue, especially taking into consideration that "[science] is also part of the contemporary social and economic order, and closely tied to processes of industrialism and consumerism" (Sykes and Macnaghten, 2013, pp. 86–87).

The question of the ethical grounds and the legitimacy of participatory processes points to the need for the contribution of citizens and stakeholders to R&I. Participatory processes have several benefits, in decision-making, in R&I processes themselves and in priority setting. These benefits could be summarized as follows:

– *impact measurement*: insight into undesired consequences, as well as on the degree to which R&I policies are aligned with societal needs, through the involvement of new actors, such as end-users and co-creators in the R&I process;

– *transparency and accountability*: there is an increase in transparency and accountability levels in R&I processes as a result of evaluation processes;

– *allocation of funding*: participation can help in priority identification and the justified allocation of resources through competitive funding;

– *science–society dialog*: participation can also consist of a consultation or dissemination endeavor 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&I policy aligned with societal needs), avoiding undesired consequences, setting priorities (and fostering competitive funding) and enhancing the transparency, quality and accountability of R&I processes. A thoughtful participation can also avoid conflicts of interests (which can occur both from internal or external stakeholders) by anticipating them and reasoning in terms of common good or finding compromises.

Could there be an ethical position advocating non-participation in R&I? Traditionally left in the hands of experts and scientists, technical issues cannot always be embedded in participatory processes (Rowe and Frewer, 2000). The traditional divide between experts and the 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 a traditional approach to science and technology governance. Furthermore, without participation, there may be a minimal representative policy process (Fung, 2008), where the representation of citizens is seen in the translation of citizens' interests into policies by politicians, and where accountability intervenes in the outcomes only through the voting process.

While fostering dialog can be considered as a key benefit of participation, debates can either be direct, through deliberation, or indirect, by allowing an inclusive approach on certain matters. The tendency toward the professionalization of public engagement has shaped dialog differently over the past decade, increasing the divide between academic social scientists and dialog practitioners, leading some to criticize a "public engagement industry whose commercial interests can compromise democratic ideals of participation" (see Chilvers, 2010, quoted in Sykes and Macnaghten, 2013, p. 100). This issue can be tackled by intensifying the process of dialog, in deliberative processes for instance, or more generally by ensuring participation takes place at all stages of innovation (Sykes and Macnaghten, 2013), 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 (Sykes and Macnaghten, 2013), bringing several criteria: intensity, openness, quality and responsiveness.

The main benefits of participatory science and innovation spread out in two directions: knowledge added value (cost benefits, speed of delivery, diversity of skills mobilized and diversified observations) and societal or social added value (in education, in fostering the science–society relationship, in citizen empowerment and in problem solving and skill building) (see Houllier and Merilhou-Goudard (2016)).

1.4.4. *Models of participation*

In the absence of regulations on participatory practices in R&I, the literature on the subject reveals the compartmentalization 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, categorizations reveal various viewpoints and criteria in terms of processes and objectives.

1.4.4.1. *Value-based categorization in view of empowerment*

One of the classic texts on participation is Arnstein's (1969) so-called "ladder of participation", where the bottom represents low active involvement (considered as non-participation) and the top represents high engagement through eight 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 "educate" or "cure" the participants. Going up in this ladder, the next degrees are ranked as degrees of "tokenism" as they allow the underrepresented categories to have a voice. While "informing" and "consultation" levels allow citizens to be informed and be heard, 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" (Arnstein, 1969, p. 217). 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 at higher levels, as "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 judgment on what type of participation is best, in an ascendant path (Davidson, 1998; Rowe and Frewer, 2000; Rowe and Frewer, 2005; Reed, 2008).

1.4.4.2. *Contextual models of participation*

As an alternative to the ladder, the wheel of participation (Davidson, 1998) states that four categories of participation (*inform*, *consult*, *participate* and *empower*), each of them different in intensity, can be equally appropriate, depending on the context. In this model, the term "participation" can refer both to the whole wheel or to categories within the wheel. When participation refers to the whole wheel in a comprehensive understanding of participation, it covers all the means by which affected publics take part in policy formulation or implementation[59].

Another model of participation that distinguishes contexts of use is the one rooted in the distinction of activities. Rowe and Frewer (2000, 2005) 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 (Rowe and Frewer, 2005, p. 284). The three concepts have been differentiated according to the nature and flow of information between the organizers of the participatory activity and the 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

59 This view is also consistent with Richardson's definition of participation (Richardson 1983).

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 population, with the efficient processing of that information by the receivers (the public/participants)" (Rowe and Frewer, 2005, p. 263).

Public consultation. Information is conveyed from members of the public to the sponsors of the initiative, following a process initiated by the sponsor. The information elicited from the public is believed to represent currently held opinions on the topic in question. The overall process seeks effectiveness, by "maximizing the relevant information from the maximum number of the relevant population and efficiently transferring it […] to the sponsor" (Rowe and Frewer, 2005, p. 263);

Public participation. Information is exchanged between members of the public and the sponsors. That is, there is some degree of dialog 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 dialog 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] the *combining* of it into an accurate composite" (Rowe and Frewer, 2005, p. 263).

This three-tier classification has been further detailed into a typology revealing four classes of communication mechanisms, six classes of consultation mechanisms and four classes of participation mechanisms (Rowe and Frewer, 2005).

A final interesting approach in this classification of participatory mechanisms is one that, instead of relying on the type of activities, focuses on the variability in the characteristics of responsible stakeholder engagement, in regard to the different phases of innovation. Following this approach, some key characteristics allow the following categorizations (Blok et al., 2015): "transparency", "responsiveness", "interaction" and "co-responsibility".

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

1.5. Conclusion

In the course of this chapter, several features have been separately explored, on the one hand, in the over-regulated field of ethics of R&I, and, on the other hand, in the under-regulated field of participatory practices. From the viewpoint of institutionalized processes in R&I governance, it seems difficult to draw a general picture of ethical participation, since both sides do not automatically converge. In the case of ethical considerations in R&I, both the theory and the regulations are quite advanced, delineating several sectoral and general guidelines to be followed, usually as part of binding tools (regulations) and frameworks, in particular in the case of public funding schemes emanating from the European Union's R&I programs. Quite different, if not opposed, participatory practices represent a variety of provisions, configurations, aims and objectives, which defy the possibility of a broad overarching approach. Several taxonomies and categories have been outlined in gray and scientific literature, without any concrete connection to the ethics of R&I. As a poorly regulated field, it is also a messy landscape of different practices, led without the existence of proper guidance. The taxonomies in participatory practices that have been presented are further connected to the ethics of R&I in the following chapter, in the attempt to better explore what ethical participation could bring in terms of added value and the legitimacy of R&I processes.