

Chapter 2

The Emerging Concept of Responsible Innovation. Three Reasons Why It Is Questionable and Calls for a Radical Transformation of the Concept of Innovation

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Abstract In this chapter, we challenge the presupposed concept of innovation in the responsible innovation literature. As a first step, we raise several questions with regard to the possibility of ‘responsible’ innovation and point at several difficulties which undermine the supposedly responsible character of innovation processes, based on an analysis of the input, throughput and output of innovation processes. It becomes clear that the practical applicability of the concept of responsible innovation is highly problematic and that a more thorough inquiry of the concept is required. As a second step, we analyze the concept of innovation which is self-evidently presupposed in current literature on responsible innovation. It becomes clear that innovation is self-evidently seen as (1) *technological* innovation, (2) is primarily perceived from an *economic* perspective, (3) is *inherently good* and (4) presupposes a symmetry between moral agents and moral addressees. By challenging this narrow and uncritical concept of innovation, we contribute to a second round of theorizing about the concept and provide a research agenda for future research in order to enhance a less naïve concept of responsible innovation.

Keywords Responsible innovation · Responsible research and innovation · Innovation management · Science and technology studies · Engineering ethics

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2.1 Introduction

The concept of ‘responsible innovation’ is relatively new. The use of the term suggests that over the past decades, innovation wasn’t all that responsible; the negative impact of innovations on individuals, societies and eco-systems was largely neglected in favour of economic growth and creating shareholder value. The emergence of responsible innovation has to be understood, then, as a new approach towards innovation, in which social and ethical aspects are explicitly taken into account (cf. European Commission 2011) and economic, socio-cultural and environmental aspects are balanced.

Because the primary responsibility for economic, socio-cultural and environmental aspects is allocated to different players in society—the profit sector on the one hand and governmental organizations, NGO’s and civil society on the other—it is argued that the balancing of *People*, *Planet* and *Profit* in sustainable business development presupposes the active involvement of and partnership with various elements of society (Hens and Nath 2003; Eweje 2007). These partnerships are also crucial from an innovation perspective per se. Nowadays, it is widely acknowledged that only a few firms have all resources and networks available to innovate in isolation (Ireland et al. 2002). Innovation seems to flourish in an open innovation environment, in which the interaction with various stakeholders is seen as a resource of competitive advantage (Chesbrough 2003). From this perspective, it can be expected that cross-sector partnerships with multiple stakeholders will lead to innovative *and* responsible solutions. Stakeholder engagement seems to be a key characteristic of responsible innovation (cf. Chap. 1, Koops 2015) and is understood then as “a strategy of stakeholders to become mutually responsive to each other and anticipate research and innovation outcomes underpinning the ‘grand challenges’ of our time for which they share responsibility” (von Schomberg 2013); the ongoing involvement of society in innovation processes will help to achieve social and environmental benefits (cf. Matter 2011).

The guiding assumption here is that “[r]ight from the start, research, development and design [can] incorporate relevant ethical and societal aspects” so that “technological and scientific advances become properly embedded in society” (NWO 2012). Responsibility is seen here as an *add-on* or extension to the concept of innovation; responsible innovation = regular innovation + stakeholder involvement with regard to ethical and societal aspects. With the help of this extension, innovation processes will be better enabled to balance economic (profit), socio-cultural (people) and environmental (planet) interests.

Although the concept of responsible innovation is relatively new and still evolving in different directions, we think the time is ripe to challenge the presupposed concept of innovation in the responsible innovation literature. Till now, most research is done from a policy or socio-ethical perspective and focusing on academic R&D environments, while most innovations take place in commercial or industrial settings (cf. Flipse 2012). It is precisely corporate innovation, which is underrepresented in current research (cf. Penders et al. 2009). An additional

problem is that empirical evidence how to put responsible innovation into practice is still scarce (Chap. 3, Davies and Horst 2015; Blok et al. 2015).

In this chapter, we primarily attempt to contribute to the conceptualization of responsible innovation. Based on a review of the existing literature on responsible innovation, we raise questions concerning the possibility of responsible innovation and point at difficulties with regard to the input, throughput and output of innovation processes. It will become clear that these difficulties can even undermine the responsible character of innovation processes (Sect. 2.2). In Sect. 2.3, we ask what concept of innovation is presupposed in responsible innovation. It will become clear that the presupposed concept of innovation is uncritical and cannot be *upgraded* to a more responsible concept of innovation; responsible innovation calls for a radical transformation of the concept of innovation itself. By challenging the presupposed concept of innovation in this article, we contribute to a second round of theorizing about the concept in order to enhance a less naïve concept of responsible innovation (Sect. 2.4).

2.2 Challenging the Concept of Responsible Innovation

2.2.1 *The Input of Responsible Innovation Processes: Fundamental Differences and Conflicts of Interest Among Stakeholders in Case of ‘Grand Challenges’*

According to much of the responsible innovation literature, the *input* of responsible innovation processes is not to be found in clear-cut and isolated problems which have to be solved, but in the so called ‘grand challenges’ of our time; climate change, resource depletion, poverty alleviation, ageing societies, etc. (von Schomberg 2013). This shift towards grand challenges as the main driver for innovation is also reflected in the most important framework program for research and innovation in the EU; Horizon 2020 prioritizes research and innovation based on these grand challenges (cf. European Commission 2011).

Grand challenges like global warming or sustainable development are also called ‘wicked problems’. According to Rittel and Webber, who described the concept of wicked problems as opposed to tamed problems for the first time in 1973, the former are difficult to pin down, highly complex and not amenable for definitive solutions. Wicked problems concern complex systems in which cause and effect relations are uncertain or unknown. Rittel and Webber have specified ten characteristics of wicked problems. Examples are that there is no definitive formulation of a wicked problem, that solutions to wicked problems are not true-or-false but better or worse and, that they have no stopping rule, i.e. the problem-solver does not know when an acceptable solution of the problem is found etc. (Ritter and Webber 1973; Batie 2008).

The complexity of wicked problems is partly related to the multiple stakeholders involved in solving these problems. Many stakeholders have different ideas

about what the ‘real’ problem is (Kreuter et al. 2004). Also, the solution to the problem is based on judgments of multiple stakeholders, which can differ widely and are not (always) based on shared values (Batie 2008; Ritter and Webber 1973). With regard to responsible innovation, various stakeholders have different ideas about the problem and its solution in general and about the societal and ethical aspects which have to be taken into account during the innovation process in particular (cf. Chap. 11, Kroesen et al. 2015). These differences among stakeholders are due to differences with regard to the *content* of the grand challenges, but also due to different agendas and divergent motives of profit and non-profit organizations for instance (Yaziji and Doh 2009). While non-profit organizations are mainly motivated by altruistic motives for instance (Milne et al. 1996), profit organizations are mainly self-interested (Iyer 2003). Furthermore, profit and non-profit organizations have divergent approaches to value creation; companies will naturally focus on economic value creation by producing and selling products and services, while NGOs for instance will focus on social value creation by advocating social norms and values (Yaziji and Doh 2009; cf. Bos et al. 2013).

Because of these differences between various stakeholders, actual efforts to involve stakeholders in innovation processes are liable to failure. The fundamental differences among stakeholders with regard to their vision, goal, sector and motive, can be seen as bottlenecks in responsible innovation. These bottlenecks at least indicate that it is not so easy to ‘incorporate relevant ethical and societal aspects’ so that ‘technological and scientific advances become properly embedded in society’, as is sometimes suggested in the literature (cf. Chap. 10, Correljé et al. 2015).

According to the collaboration and partnership literature, an important condition for stakeholder involvement is the initial agreement among stakeholders on the problem definition and the goals of collaboration (Selsky et al. 2005; Bryson et al. 2006). Such a common ground may be found in a process of public dialogue about the priorities, directions, implications and consequences of innovations (Jackson et al. 2005). Hardy et al. (2005) pointed at political processes involved in defining the problem and the objective of collaboration. Political processes are important, because the specific formulation of the problem definition already determines what potential innovative solutions are sought for and who are legitimate partners in realizing these innovations. If we conceive a grand challenge like sustainable development for instance in such a way that it affords a systems change, a wholly different set of innovations is at stake than if it is defined at a product level and only involves innovations in order to substitute depletable resources. This example shows that stakeholders have an interest in the specific way the problem is defined, because it has consequences for the shared objective of the innovation process and with this, for the investment of resources to solve the problem.

It is clear that some actors are more powerful than others in defining the problem and the objectives of the innovation process, i.e. that the involvement of societal and ethical aspects is not without any ‘push and pull’. It is presumable that power imbalances are especially at stake in the case of grand challenges, exactly because of the different problem definitions and different value frames of the

stakeholders involved. These power imbalances can be seen as a prime source of conflicts among stakeholders (Bryson et al. 2006).

The first reason to question the possibility of responsible innovation is therefore, that there is no consensus about the scope of the grand challenges and the goal of the innovation process among stakeholders. It is not only questionable whether responsible innovation is possible in case of grand challenges or wicked problems. Fundamental power imbalances among stakeholders can even undermine the incorporation of societal and ethical aspects in the innovation processes. When the *input* of responsible innovation processes is found in grand challenges, we may conclude, the presupposed responsiveness towards stakeholders is highly questionable.

2.2.2 The Throughput of Innovation Processes: Transparency and Mutuality Among Stakeholders Is Limited and Does not Make Innovation Processes More Manageable

With regard to the *throughput* of responsible innovation processes, it is acknowledged that social and ethical aspects are usually *not* included in the innovation process (cf. Flipse 2012). In order to develop a more responsible model of innovation, various technology assessment approaches have been developed (see Flipse 2012 for an overview). In these approaches, it is assumed that stakeholders should be involved ‘right from the start’ in order to incorporate relevant ethical and societal aspects in the innovation process (NWO 2012; Delgado et al. 2010; Owen and Goldberg 2010). Von Schomberg for instance defines responsible innovation as a “transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)” (von Schomberg 2013, p. 19). The throughput of the innovation process should be characterized by transparency, interaction and mutual responsiveness. Also in the collaboration and partnership literature, the necessity to reduce so called information asymmetries is acknowledged; by “linking and sharing of information, resources, activities, and capabilities”, it is expected that partnerships between companies and their stakeholders “jointly achieve an outcome that could not be achieved by organizations in one sector alone” (Bryson et al. 2006, p. 44).

Apart from the fact that the fundamental deviations in power, vision, goal, sector and motive will limit the possibility of the mutual responsiveness among stakeholders, it is questionable whether finding a common ground is desirable (Roelofsen et al. 2011). If too much emphasis is placed on finding such a common ground, certain stakeholders will become hesitant to participate in the collaboration (Hagendijk and Irwin 2006, cited in Roelofsen et al. 2011). Moreover, the call for transparency of innovation processes is highly naive. From a business

perspective, innovation is the main source of competitive advantage in the current economy. This advantage is exactly based on information asymmetries, i.e. additional knowledge which enables companies to identify business opportunities in the market. This additional or ‘prior’ knowledge (McMullen and Shepard 2006) may consist in the ability to “see where a good can be sold at a price higher than that for which it can be bought” (Kirzner 1973). In this case, information asymmetries are due to imperfect knowledge of market participants with regard to *existing* information and new business opportunities “arise out of the entrepreneur’s alertness to [these] information asymmetries existing in the economy” (Dutta and Crossan 2005). Information asymmetries may also be *created* by the development of new information or new knowledge. This information provides opportunities for new or alternative solutions for existing or anticipated problems, and in case of responsible innovation, for existing and anticipated grand challenges. From the perspective of a company or a consortium of collaborating companies,¹ therefore, information asymmetries have to be seen as a source of competitive advantage. Although transparency towards stakeholders is a necessary condition of open innovation processes, the call for a mutual responsiveness among stakeholders—i.e. the reduction of information asymmetries—in the responsible innovation literature is highly naive. For this reason, collaborations with stakeholders are sometimes explicitly restricted, especially in case of intellectual property (IP) and secrecy (Flipse 2012).

The full transparency to stakeholders—especially with regard to the core technology or the innovation itself—is not only highly riskful from a business perspective. Innovative companies even have an incentive to increase information asymmetries because it enables them to claim capabilities or features of their new products or services which are not (yet) justified, in order to receive economic (i.e. investment) or societal (i.e. societal or governmental) support (Millar et al. 2012).

The call for *mutual* responsiveness and *collective* responsibility is also unrealistic. Innovations are risky and involve high amounts of investment. The societal and ethical acceptability of an innovation can be seen as an important investment criterion and in this respect, stakeholder involvement is indeed an important indicator of the societal embeddedness of the innovation process. Nevertheless, the investor alone is responsible for the risk-reward assessment and therefore, for the investment decision as such. The mutuality of the responsiveness is also limited by stakeholders like NGO’s. Is it reasonable to expect that stakeholders cooperate constructively and live up to the commitments they make in the innovation process, when faced with an innovation process which is highly uncertain and with final impacts which are unpredictable? In the end, NGO’s will never take

¹On the one hand, it is assumed that the reduction of information asymmetries among partners will increase performance; by leveraging their resources, knowledge and capabilities—saving resources, elimination or reduction of waste, improving productivity etc.—inter-organizational partnerships may contribute both to the cost efficiency and the competitive advantage of the allied partners over other firms (Gulati 2007). On the other hand, this competitive advantage of the allied partners over other firms is based on increased information asymmetries.

responsibility for an innovation whose outcomes are so much uncertain. A further problem that occurs in the case of mutual responsiveness and collective responsibility is the blurring of tasks and responsibilities. This can lead to the loss of legitimacy; if an NGO collaborates with a company in responsible innovation and the innovation turns out not to be that responsible, they are nevertheless responsible as well. Instead of putting companies under pressure to innovate in a sustainable way, they could be accused of co-operation with their “traditional enemy” (Hemmati 2002; Van Huijstee et al. 2007).

We can even question whether transparency and mutual responsiveness during the innovation process will increase the desirability of the outcomes. Any purported attempt to steer the development of technologies in directions that will maximize their social benefits and minimize their negative social and environmental impacts sees itself confronted with the so-called “dilemma of control” or “Collingridge dilemma”. David Collingridge, chemist and analyst of technology policy, gave this dilemma its classic formulation: “The social consequences of a technology cannot be predicted early in the life of the technology. By the time undesirable consequences are discovered, however, the technology is often so much part of the whole economic and social fabric that its control is extremely difficult. This is the *dilemma of control*. When change is easy, the need for it cannot be foreseen; when the need for change is apparent, change has become expensive, difficult and time consuming” (Collingridge 1981, p. 11). In other words: In the early stages, when the technology is still malleable and thus amenable to social intervention, its effects are not yet sufficiently known to warrant such an intervention; when later on the effects become apparent, however, it is no longer easy to control or adapt the technology because it has meanwhile become ‘hardened’ and socially ‘entrenched’ (cf. Flipse 2012). Thus the dilemma results from the combination of an *information* problem at the earlier stages and a *power* problem at the later stages of development.

The Collingridge dilemma is widely known in technology policy circles and presents a clear challenge to anyone who aims to feed social concerns about possible negative consequences of a new technology back into the design and innovation process itself.

The second reason to question the possibility of responsible innovation is that the ‘transparency’ and ‘mutuality’ among stakeholders is limited. The Collingridge dilemma showed that transparency and interaction with multiple stakeholders doesn’t make innovation processes more manageable *per se*. It is not only questionable whether responsible innovation is possible in the case of grand challenges or wicked problems. Information asymmetries among stakeholders can even undermine the responsible innovation; it enables firms to deploy these asymmetries in support of misleading claims about the features or capabilities of responsible innovations under construction, in order to attract societal and ethical legitimacy (Millar et al. 2012). In conclusion: when the throughput of responsible innovation processes is characterized by information asymmetries, the presupposed mutual responsiveness towards stakeholders becomes questionable.

2.2.3 The Output of Responsible Innovation Processes: The Foresight of Responsible Innovation Is Limited Because of Our Epistemic Insufficiency with Regard to the Grand Challenges

With regard to the *output* of responsible innovation processes, it is assumed that the incorporation of societal and ethical aspects in the innovation process decreases unintended societal impact of technological developments and will therefore lead to more responsible innovations (cf. Rogers-Hayden and Pidgeon 2007). Although stakeholder involvement may result in more desirable outcomes, the involvement of stakeholders doesn't necessarily guarantee a more responsible output of the innovation process. For example, many stakeholders were involved during the development of biofuels and this innovation seemed to be promising according to various stakeholders; biofuel is inherently renewable, locally produced, less polluting, etc. An unexpected outcome of the increased demand for biofuels however, was that food prices increased because farmers started to grow more and more crops for biofuel production. Although multiple stakeholders were involved, it turned out that especially people in developing countries were negatively affected by the increased food prices.

Unexpected outcomes can be seen as a main characteristic of innovation processes. Recent literature tends to see innovation as a cumulative, stepwise process of collaboration between multiple actors with often unexpected outcomes (Rammert 1997). If innovation is a highly uncertain process, though, which is characterized by interdependency, serendipity etc., it is questionable whether this uncertainty can ever be steered in desired directions through relatively simple means. Well-known puzzles like the Jevons Paradox—innovations that increases energy efficiency for instance tends to increase the consumption of energy as well—show that the outcome of innovations may be contrary to what was intended (cf. Owen 2012).

Also, most of the responsible innovation literature starts from the plausible premise that innovations are radically uncertain and that their societal and environmental consequences are virtually unpredictable (for an example, see Ozdemir et al. 2011). The question then is what responsibility could mean if this premise were indeed true. Are responsible innovations those forms of science and technology development whose protagonists are willing and able to take accountability for, or 'stand up for', the societal and environmental consequences of their endeavors? If there is practically no way to predict or foresee such consequences, however, all talk about responsibility in this context would seem groundless and misleading.

This point can be illustrated with the requirement of 'accountability' that has found its way in the recommended Code of Conduct for Responsible N&N (Nano sciences and Nanotechnologies) Research for the European Union: "Researchers and research organizations should remain accountable for the social, environmental and human health impacts that their research may impose on present and future

generations” (European Commission 2008).² This extremely far-reaching commitment exposes Nano researchers, as two analysts rightly point out, to “unbounded hazards of moral luck” (Grinbaum and Groves). In the future, researchers could be held liable for any untoward effects of their research that are as yet impossible to predict but that may manifest themselves only after decades. Their fate could be even worse than that of the Italian seismologists who were sued and convicted for failing to accurately predict an impending earthquake. Or is being held ‘accountable’ deemed to have no consequences for the researchers? Then the stipulation in the Code of Conduct is just an empty play of words.³

We have to admit that the EU Code of Conduct for Responsible N&N Research is not representative for the essential meaning of responsible innovation. Nevertheless, while the radical uncertainty of innovations and the unpredictability of their societal and environmental effects is fully acknowledged, it is suggested that this uncertainty can somehow be overcome by making the whole process more inclusive and more reflexive from the very outset (cf. Flipse 2012). Owen and Goldberg for instance argue: “Embedding iterative risk (and benefit) analysis with technology assessment and public/stakeholder engagement approaches within innovation research proposals was seen as offering a mechanism that considers technical risk issues and associated uncertainties, but that could also provide opportunities for identifying as yet unforeseen effects (economic, societal, and ethical) as these emerge. It may also facilitate upstream engagement with stakeholders and the public as to how these emerging impacts are received” (Owen and Goldberg 2010, p. 1705). Regardless of the inherent unpredictability of the future, ‘foresight’ can still be exercised, it is claimed, when stakeholders are involved to deliberate on various scenarios for possible futures; societal values and concerns can still be taken on-board ‘midstream’ and then ‘modulate’ on-going technological trajectories. René von Schomberg expresses the underlying view as follows in an interview in LEV: “You need a smart innovation process in which you do not place your bets too much on one particular technology, because technology development is unpredictable. Bring all involved societal parties together and let them jointly determine what they expect from the research trajectory. Then you can formulate research agendas, which can be mutually adjusted in order to arrive at the desired end result”. In another publication he wrote that societal actors become “co-responsible for the innovation process by a constructive input in terms of defining societal desirable products” (Schomberg forthcoming). While he acknowledged that “an ethics focused on the intentions and/or consequences of actions of individuals is not appropriate for innovation”, he nevertheless held that there is “collective responsibility both for the right impacts and negative

²In the final Code of Conduct for Responsible N&N Research, the formulation has been slightly nuanced: “Researchers and research organizations should remain accountable for the social, environmental and human health impacts of their work”. However, this reformulation of the Code doesn’t solve the underlying issue.

³For an effort to develop a concept of ethical oaths which imply actual ethical behaviour, see Blok (2013).

consequences” (von Schomberg 2013). Arguably this still presumes that these impacts and consequences, although perhaps not attributable to the actions of individuals, can somehow be foreseen by the various societal actors that are involved in the innovation process, a presumption that had initially been denied.

The third reason to question the possibility of responsible innovation is, that the ‘responsibility’ or ‘accountability’ is principally limited because of the radical uncertainty of innovation processes. This uncertainty even increases in case of wicked problems like sustainable development, because no simple solutions exist; all our proposed solutions will have unintended consequences and remain finite and provisional compared to the complexity and depth of the sustainability problem itself. Because our *knowledge* of the solution of wicked problems is principally limited, we can call this an *epistemic insufficiency* (cf. DeMartino 2013). If the output of responsible innovation processes is characterized by a fundamental uncertainty, which means that our *knowledge* of the impact of our innovations is not only limited but principally *insufficient*, the presupposed ‘foresight’ of responsible innovation becomes questionable. In other words, our knowledge is principally insufficient to assess the impact of innovation processes and there will always be unintended consequences of our innovations which can be harmful.

The analysis of the input, throughput and output of innovation processes raised several questions with regard to the possibility of responsible innovation and pointed at several difficulties which undermine the responsible character of innovation processes. It became clear that the practical applicability of the concept of responsible innovation is highly problematic and that a more thorough inquiry of the concept is required.

In the next section, we therefore ask what concept of innovation is presupposed in the responsible innovation literature.

2.3 The Presupposed Concept of Innovation in the Responsible Innovation Literature

What concept of innovation is self-evidently presupposed in the responsible innovation literature? In a recent paper, Benoît Godin sketched the history of the innovation concept. Although innovation always existed throughout history, it became only very recently “the emblem of the modern society” (Godin 2009, p. 5; cf. Nowotny 2008). While the concept originally concerned *novelties* in the broadest sense of the word—including imitation, invention, creative imagination, change—it became only recently restricted to *technological* innovation and *commercialized* innovation. Nowadays, it is almost self-evident that innovation does not only concern the *exploration* of new technologies, but also the commercial *exploitation* of these new technologies.

According to Godin (2009, p. 21), the restriction of innovation to technological innovation is rooted in what he calls, the ‘culture of things’ or material culture: “The origins of this culture go back to the Renaissance: due to commercial

exchanges, exploration and travel, natural and artificial objects have been what is valued in arts, science, and real life". The focus on technological innovations is further enhanced by the introduction of patent laws from the fourteenth century onward, because only these kinds of innovations can be patented (cf. Macleod 1988). With the emergence of economic thought in the seventeenth century, the *utilitarian value* of innovations became most important (Godin 2009; Schumpeter 1943). As a consequence of this economic paradigm of technological innovation, alternative forms of innovation like systems innovations (for instance agro-ecological innovations) or attitudinal innovations (for instance prevention or life style interventions) receive less attention because it is difficult to develop a business model on the basis of these kinds of innovations. A good example is the case of agricultural science and technology (S&T). Because of the current technological regime of agricultural S&T, technological innovations like genetic engineering are locked in and systems innovations like agro-ecological innovations are locked out (Vanloqueren and Baret 2009; cf. Mortensen et al. 2012).

The same economic paradigm of technological innovation is presupposed in case of responsible innovation. The Dutch research council for instance started recently with a new responsible innovation program which is intended for "short-term research projects into the ethical and societal aspects of new technology". Besides the scientific quality of the research projects on responsible innovation, the "added value, societal relevance and knowledge utilisation" are the most important criteria for funding (our emphasis, NWO 2012; cf. Technology Strategy Board 2012). Also from the EU perspective, responsible innovation is, among others, characterized by "Assessing and effectively prioritising social, ethical and environmental impacts, risks and opportunities, both now and in the future, alongside the technical and commercial" (Matter 2011). The economic paradigm of technological innovation is also reflected in the fact that investments in responsible research and innovation (RRI) is primarily legitimized by the macro-economic arguments, i.e. that RRI will lead to the creation of jobs and economic growth (von Schomberg 2013). In the Lund declaration for instance, it is claimed that "meeting the grand challenges will be a prerequisite for continued economic growth and for improved changes to tackle key issues" (cited in von Schomberg 2013, p. 12).

The applicability of the economic paradigm of technological innovations on the concept of responsible innovation may be questioned, because exactly the imperative of economic growth and profit is at odds with the other P's People and Planet, to say the least. Some philosophers even argue that the growth imperative is above everything else 'responsible' for the rapid environmental destruction, resource depletion and impoverishment of populations all over the globe. Huesemann and Huesemann (2011, p. 256) for instance argue, that "our economic system's inherent dependence on growth for survival (i.e. more of everything: more markets, more consumers, more raw materials, more energy, more cheap labor, etc.) is the root cause of many environmental problems and is in direct conflict with sustainability". For our discussion of the applicability of the economic paradigm of technological innovations on the concept of responsible innovation, it is sufficient to raise the question whether the fundamental tensions between the growth

imperative and the demand for sustainability can ever be overcome, as long as we embrace the economic paradigm in our concept of responsible innovation. It is striking, in this respect, that corporate innovation is underrepresented in current research on the concept of responsible innovation.

Another assumption in responsible innovation is that innovations are inherently good, as they produce prosperity and jobs and meet societal challenges at the same time (von Schomberg 2013). Innovation is seen as a panacea for all problems (Godin 2009) and responsible innovation in particular serves the ‘public good’ (Matter 2011). Some researchers even argue for cognitive enhancement in order to increase the innovative abilities of the species (Greely et al. 2008, cited in Godin 2009).

With this focus on the inherently good of innovation, the ‘Faustian’ aspect of innovation processes is neglected. According to the godfather of innovation studies, Joseph Schumpeter (1883–1950), innovation is the product of *creative destruction*. To Schumpeter, “Capitalism [...] is by nature a form or method of economic change and not only never is but never can be stationary. [...] The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers’ goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates. [...] The opening up of new markets, foreign or domestic, and the organizational development from the craft shop and factory to such concerns as U.S. Steel illustrate the same process of industrial mutation [...] that incessantly revolutionizes the economic structure *from within*, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in” (Schumpeter 1943, p. 82–83). According to Schumpeter, it is exactly innovation which is responsible for creative destruction. The *construction* of new and innovative solutions is accompanied by the annihilation or *destruction* of the old rules and the old order (including the ‘writing off’ of ‘obsolescent’ skills, technologies and capital stocks), i.e. the positive impact of responsible innovation and contribution to the public good, is therefore accompanied by negative impacts elsewhere. This Faustian aspect of innovation processes is largely ignored by the responsible innovation literature. Furthermore, in line with the idea that innovation is a cumulative process with often unexpected outcomes (Sect. 2.2), we cannot claim that the outcome of responsible innovation will automatically contribute to the public good. Well-known puzzles like the Jevons Paradox—innovations that increase energy efficiency for instance tend to increase the consumption of energy as well—show that the outcome of innovations may be contrary to what was intended (cf. Owen 2012). Innovation implies pain, annihilation and destruction, and it is questionable whether this ‘Faustian aspect’ of innovation can ever be overcome by integrating social and ethical aspects in the design process.

The effort to integrate social and ethical aspects in the design process shows another assumption of responsible innovation. Mutual responsiveness means that multiple stakeholders participate or are able to participate in the formation of societal and ethical norms. These norms are valid if the participants agree to it as participants of practical discourses (Habermas 1990, 1993). In order to form societal and ethical norms together, stakeholders should be able to listen to others,

to be empathetic with regard to the interests of others, to take the perspective or standpoint of the other etc. (Kaptein and van Tulder 2003). Mutual responsiveness therefore presupposes symmetry between moral agents and moral addressees (Mackin 2011). Only because stakeholders can hear the voice of the other and can take the perspective of the other, they can become mutual responsive. Given the existing information asymmetries and investment imbalances, let alone the epistemic insufficiency with regard to future generations for instance (cf. Sect. 2.2), it is highly questionable whether the presupposed symmetry between moral agents and moral addressees is legitimized.

The analysis of the concept of innovation which is presupposed in current literature on responsible innovation, shows that innovation is self-evidently seen as (1) technological innovation, (2) which is primarily perceived from an economic perspective, (3) is inherently good and (4) presupposes a symmetry between moral agents and moral addressees.

2.4 Conclusions

In Sect. 2.2, we raised several questions with regard to the possibility and applicability of responsible innovation processes. We pointed at several difficulties with regard to responsible innovation, i.e. with attaining a more socially just and environmentally sound trajectory of innovation that will appeal to all the stakeholders involved. Especially with respect to the ‘grand challenges’ or wicked problems, it turned out to be very difficult if not impossible to satisfy the ideal of responsible innovation. But also more generally, it became clear that the wish for (more) responsibility clashed with the realities of existing innovation processes. As we have pointed out with respect to the input, throughput and output of innovation processes, the demand for responsibility runs into serious problems. The main difficulty of responsible innovation revolves around the *response-ability* of actors in the innovation process, due to ‘epistemic’ factors like the inherent complexity, uncertainty and unpredictability of technological innovation on the one hand, and ‘moral’ and ‘political’ factors like conflicting worldviews, interests and value systems among stakeholders and power imbalances on the other. We concluded that the practical applicability of the concept of responsible innovation is highly questionable.

In Sect. 2.3, we analyzed the presupposed concept of innovation in responsible innovation. With regard to the first two characteristics—innovation is technological and primarily seen from an economic perspective—we have to conclude that the prevailing concept of innovation is uncritically taken over in the concept of responsible innovation. With regard to the third characteristic of innovation—innovation is inherently good—we showed that the current concept of responsible innovation is highly naïve. Finally, our discussion of information asymmetries and our epistemic insufficiency to assess the future impact of our innovations (Sect. 2.2) raised fundamental questions with regard to the fourth assumption of responsible innovation—the symmetry of moral agents and moral addressees.

Because the possibility and applicability of responsible innovation is highly questionable and the presupposed concept of innovation is uncritical, narrow and naïve, we have to conclude that the conventional concept of innovation—innovation is technological and seen from an economic perspective—cannot be *upgraded* to a more responsible concept of innovation; responsible innovation calls for a radical transformation of the concept of innovation itself. Based on the findings in this article, we propose the following research agenda for future research on responsible innovation:

- With regard to the input of innovation processes, future research should focus on the question how to deal with power-, vision-, goal-, sector- and motive-deviations among stakeholders involved in responsible innovation processes, especially with regard to social and ethical aspects.⁴
- With regard to the throughput of innovation processes, future research should focus on the question how stakeholders become mutual responsive to each other, given the remaining investment- and risk imbalances and given the remaining information asymmetries among stakeholders involved in responsible innovation processes.
- With regard to the output of innovation processes, future research should focus on the question how to assess the future impact of responsible innovation processes, given the fundamental uncertainty of innovation processes and given our epistemic insufficiency with regard to the future impact of responsible innovation processes.

We can also raise more fundamental question with regard to the concept of responsible innovation itself. With regard to the concept of innovation which is presupposed in the majority of the responsible innovation literature, future research should broaden our conception of innovation, including non-technological innovations and non-market environments. Furthermore, future research should consider the concept of *response-ability* in the context of alternative strategies of innovation, in which the relationships between stakeholders substantially differ from those involved in conventional innovation processes. A particularly promising direction for future research might be the examination of user-based or user-centered innovations, free and open source, and commons-based peer-to-peer (p2p) innovation strategies. These alternative strategies have steadily proliferated over the last two decades in various domains of the economy, may possess characteristics that are less susceptible to the flaws that we have diagnosed in this article, and may therefore provide directions for more responsible innovation processes in the future.

With regard to the concept of responsibility which is presupposed in the majority of the responsible innovation literature, future research should consider the question what consequences our epistemic insufficiency will have for our concept of responsibility in general and responsible innovation practices in particular.

⁴For an attempt to deal with fundamental differences among multiple stakeholders during stakeholder dialogue, see Blok (2014).

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