ZAGADNIENIA
NAUKOZNAWSTWA
1 (219) 2019
PL ISSN 0044 – 1619

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Conceptual Investigation Within Area of Responsible Research and Innovation

DOI: http://dx.doi.org/10.12775/ZN.2019.001

Abstract. The aim of this paper is to contribute to the academic discussion on the proper understanding of the notions of responsibility and innovation. In recent years, the field of Responsible Research and Innovation has grown rapidly among academia and received considerable attention. One area of focus concerns the proper understanding of the notion of the terms themselves. They are especially problematic in light of the critique that the subject has already received (cf. Blok, Lemmens 2015). This article provides an answer to that critique and proposes an alternative approach to the notions discussed. On the one hand, it outlines the so called ambivalued notion of innovation (cf. Kawalec 2015) and on the other, it presents a four-point characteristic of responsibility relevant to the field of research and innovation. In the text, the term responsibility should be understood as collective, future-oriented, socio-political, and values-oriented.

Keywords: responsible innovation; critique; concept; innovation; responsibility

1. Introduction

The concept of Responsible Research and Innovation (RRI) is continuing to gain momentum with the present research and innovation policy of the European Union. It is especially promoted by the European Commission's Directorate General for Research and Innovation within the Horizon 2020 framework as part of the Science with and for Society programme. In short, the concept of "Responsible innovation can […] be used to refer, in the realm of innovation, to whatever invites, accommodates, stimulates, enhances, fosters, implies, or incentivizes responsible action" (van den Hoven 2013, p. 81). On one hand, RRI is concerned with the implications (both expected and unexpected) of research and innovation, and how they match society expectations towards them. This function is contained in the "for society" element. On the other hand, the "with society" element is emphasized by strong involvement of societal actors (e.g. researchers, citizens, policy makers, business or third sector organisations) in research and innovation activities. This means that the policy is intended to increase efforts aimed at achieving particular

goals. These goals are formulated in line with the societal challenges of the Horizon 2020 programme.[1]

Along with the practical interest of scientists and policy makers in fulfilling the objectives, there is a growing theoretical interest of academia in RRI (Owen, Macnaghten, Stilgoe 2012; van den Hoven 2013; Stilgoe, Owen, Macnaghten 2013a; van den Hoven et al. 2014a). One of the areas of focus is a proper understanding of the concept itself (c.f. Grinbaum, Groves 2013). This paper follows this line of research and aims to make a contribution to the correct understanding of both core concepts of responsibility and innovation. A relevant research question can be stated in the following way: "can an ambivalued conception of innovation, along with the new conceptualization of responsibility presented in this paper, be considered as the answer to Blok and Lemmens' call for a radical transformation of these concepts" (cf. Blok, Lemmens 2015)?

The question will be answered in the following order: firstly, the idea of RRI will be presented as an activity involving commitment to being anticipatory, reflective, deliberative and responsive (Owen et al. 2013). Secondly, the critique of the assumed notion of innovation will be discussed (Rittel, Webber 1973; Collingridge 1980; Grinbaum, Groves 2013; Godin 2014; Blok, Lemmens 2015). This will require a response and therefore, in the third part of the paper a new conception of innovation – an ambivalued understanding (cf. Kawalec 2015) – will be presented. Fourthly, attention will be directed to the notion of responsibility. Bearing in mind the notion of responsibility ambiguity, we will attempt to provide clarity by outlining the notion's characteristics (Wodzisz 2015). In the context of research and innovation, the notion of responsibility will be treated as collective (Owen et al. 2013; Stilgoe, Owen, Macnaghten 2013a), future-oriented (Jonas 1984; Owen et al. 2013; Stilgoe, Owen, Macnaghten 2013a), socio-political (Hellström 2003; von Schomberg 2011, 2013), and values-oriented (von Schomberg 2013). Finally, the above considerations concerning responsibility and innovation will be discussed and a guide that can be applied in order to reconsider RRI will be provided (Agazzi 2004; Logue 2019).

[1] The challenges include: Health, demographic change and wellbeing; Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the Bioeconomy; Secure, clean and efficient energy; Smart, green and integrated transport; Climate action, environment, resource efficiency and raw materials; Europe in a changing world – Inclusive, innovative and reflective societies; Secure societies – protecting freedom and security of Europe and its citizens (cf. Horizon 2020 webpage: https://ec.europa.eu/programmes/horizon2020/).

2. The idea of Responsible Research and Innovation

In his very influential book, the *Theory of Justice* (1999), John Rawls made a distinction between concept and conception. The term concept is general and usually shared by many, while the term conception is more specific and particular. For example, the concept of democracy is broadly understood as citizen's involvement in the political process. However, there are many competing conceptions of democracy (van den Hoven 2010, p. 73): direct, deliberative, participative, or representative. Similarly, it can be said that the general concept of RRI is broadly accepted due to its goals oriented towards society. However, the more specific the conception of RRI we want to define, the more ambiguities and discrepancies arise.

The idea of RRI is now more than a decade old. It originated in the Netherlands where the Netherlands Organisation for Scientific Research (NWO) funded the first programme in 2009, under the name Responsible Innovation. This was preceded by four years of consultations and discussions including participants from different ministries, companies, academic research institutions and NGOs. The question that the participants were trying to answer was summarized by van den Hoven (2014b, p. 5):

> How could applied ethics research be geared towards technological innovations and applied science and engineering in thinking about practical innovative solutions for important social and global problems so as to make a real difference in public policy and decision making?

The above question has at least two assumptions. The first one is that ethics, innovations, science, and engineering should be intertwined, and the second one is that, when combined, they can have real (positive) influence on policy and decision making, which would result in solving important social and global problems.[2]

The first assumption is interesting from a philosophical point of view as it is connected with the thesis regarding the value neutrality of technology.[3] It seems that the application of ethics to science and innovation implies rejection of the above thesis. The reason for the rejection is the holistic nature of the human environment. The technological artefacts surrounding us co-create the environment we live in. As a consequence, they can create completely new situations, e.g. countries

[2] Goal of solving important social problems can be seen as one that is convergent with the goal of social innovations. It can be debated which research field is more general, but most likely it is the area of social innovation which tries to harness innovative thinking and focus it on societal problems (Logue 2019), whereas RRI is limited to only some aspects of this general activity, i.e. organising and designing research and innovation activities to make the process itself more anticipatory and encompassing.

[3] This subject has been broadly discussed by Agazzi (2004) in the book entitled *Right, Wrong and Science: The Ethical Dimensions of the Techno-Scientific Enterprise* where rejection of the value neutrality of technology is a basis for deep considerations about the realm of science and technology and their ethical dimension.

possessing a neutron bomb. Such situations, in turn, lead to decision making processes which can have value-related consequences, e.g. the deaths of many people. It is important to note that the discussion on the value neutrality of technology is reflected in RRI. The two emerging opposite views are both reticent and do not attempt to define the normative ends of RRI in terms of values (Stilgoe, Owen, Macnaghten 2013b, p. 1577). They justify their claim on the basis of cultural relativity: in different cultural contexts, differing values are considered important, and therefore, at best, references to values should be removed. On the other hand, von Schomberg (2011, 2013) is explicit in formulating the goals of RRI with reference to the values shared by the European community and listed in the *Treaty on European Union* (European Union 2010). The second assumption of the above question seems to be dependent on the widely accepted thesis that innovations and technology can provide a positive contribution to solving serious social and global problems.[4] This assumption seems to be much less controversial and will not be explored here any further as the issue remains beyond the scope of this paper. As both assumptions are probable and reasonable to accept, it is time to move on to describing the main characteristics of RRI.[5]

In literature, there are several definitions of RRI which are presented in the table below (cf. Table 1). Their comparison reveals a common denominator for all the definitions. This common ground has been accurately summed up by Armin Grunwald (2011, p. 17–22) who notes that "debates over responsibility in science and technology" must take into account *epistemic*, *moral* and *governance* considerations. It seems that these three dimensions of RRI are present in each of the definitions, although to a different extent. The epistemic dimension regards the knowledge required to carry on a substantial dialogue with the interested parties. This may include what von Schomberg called "foresight knowledge" (cf. von Schomberg 2007). The dimension of governance is relevant due to the expected impact of RRI. Discussions about RRI should result in real life decisions of policy makers, entrepreneurs, engineers, consumers, and society. This complex interplay on the part of different actors expresses the idea of co-responsibility (von Schomberg 2007) in which multiple parties share the mutual commitment of bringing about "the right impacts" of the new technology. Finally, the moral dimension is taken into account. It refers to socio-ethical considerations about the impact and consequences of research and innovation. As Grunwald notes, these considerations are often reduced to the analysis of "Pragmatic Completeness, Local Consistency, Sufficient Lack of Ambiguity, Acceptance and Compliance" (Grunwald 2011, p. 18),

[4] Von Schomberg (2013) claims that these problems cause "grand challenges" which contemporary society needs to face. The notion of "grand challenges" is somehow related to what Blok and Lemmens, following Rittel and Weber, call "wicked problems" (cf. Rittel, Webber 1973; Blok, Lemmens 2015).

[5] In the second part of the text, especially the second of these assumptions will be critically approached.

which in practice do not pay any special attention to the reflection on ethics and responsibility. However, moral ambiguities inevitably come into play when we deal with novel artefacts. Therefore, there is an apparent need for making ethical considerations an integral part of the research and innovation processes. Otherwise, the adjective "responsible" will only function as an add-on to research and innovation activities, whereas it is meant to be a game changer that can take the development within the area of human activity to the next level.

Apart from the three overarching characteristics noted above, there are more points to emphasize. Firstly, for all the definitions, RRI refers to some sort of activity or process. As RRI assumes, an action is taken in order to achieve a certain goal, be it care for the future (Stilgoe, Owen, Macnaghten 2013b), expanding the set of options required to solve a moral problem (van den Hoven 2013) or formulating requirements for design and development of new research, products and services (European Commission, Directorate-General for Research and Innovation 2013). Secondly, taking into account the previous point, the question may be posed regarding the subject of such activity. It can be inferred from the definitions below that the principal stakeholders are innovators, researchers, society at large, or policy makers, while managers and innovation brokers are presumably the main actors in the given context. Thirdly, following this line of consideration, we may ask about the motives of the acting subjects. Motives include urgent social problems associated with demoting relevant values, for instance, wellbeing, justice, equality, privacy, autonomy, safety, and sustainability. This leads us to the fourth question about the aim(s) of RRI which are easy to recognize as at least in principle, should be aligned with the motives. For example, aims can be formulated as establishing a truly competitive social market economy; increasing the quality of life as well as the level of protection of human health and natural environment; achieving social justice and equality of women and men; defending fundamental rights; or promoting the advancement of scientific and technological progress (cf. von Schomberg 2013). Last but not least, it is worth mentioning the means by which the above goals are to be reached, i.e. innovations. These can have different forms, e.g. a product, process, or even something more abstract such as a theory, conceptual framework or software.[6]

To summarize this part of the text, the definitions of RRI have several points in common which should be explicitly addressed to obtain a full picture of what one is trying to achieve by introducing this concept. One must remember that RRI does not appear in vacuum; it stems from earlier discussions about ethical, legal

[6] We do not intend to enter the discussion about the ontology of innovations here as it is beyond the scope of this paper. However, we want to emphasize that there is a wide variety of innovations differing in ontological status, ranging from material products on the one end of the continuum to purely conceptual theories on the other.

and social implications of research and new technologies such as STS (science, technology and society) studies, TA (technology assessment) and VSD (value sensitive design) (cf. Fisher, Rip 2013; van den Hoven 2008, 2013; Owen et al. 2013). Discussions so far have mostly concerned the responsibilities and functions of science that need to be constantly updated in light of new as well as older developments such as GMO, nanotechnology, synthetic biology and geoengineering. In a sense, this means that RRI is evolutionary in nature rather than revolutionary.[7] This will become more visible when the manner in which the notions of innovation and responsibility should be modified is discussed. The discussion will follow the critique of the concept of RRI which is presented and analysed below.

[7] Van den Hoven (2008) drew a parallel line of development for ethics. According to him, there was a clear change in attention given by ethicists to particular issues. The first half of the 20th century is marked mostly by meta-theoretical considerations of ethics. The second half of the 20th century witnessed a growing interest in different types of applied ethics. Finally, at the turn of the 21st century, a growing interest in what van den Hoven calls "design turn in ethics" can be observed. At present, the emphasis in ethics is placed "on the design of institutions, infrastructure, and technology, as shaping factors in our lives and in society".

Table 1. Definitions of RRI

Author(s)	Definition	Source(s)
Rene von Schomberg	Responsible research and innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).	(von Schomberg 2011, p. 50; Owen et al. 2013, p. 39)
Jeroen van den Hoven	Responsible Innovation is an activity or process which may give rise to previously unknown designs pertaining either to the physical world (e.g., designs of buildings and infrastructure), the conceptual world (e.g., conceptual frameworks, mathematics, logic, theory, software), the institutional world (social and legal institutions, procedures, and organization) or combinations of these, which – when implemented – "expand the set of relevant feasible options regarding solving a set of moral problems." [original emphasis]	(van den Hoven 2013, p. 82)
Jack Stilgoe, Richard Owen, Phil Macnaghten	Responsible innovation means taking care of the future through collective stewardship of science and innovation in the present.	(Stilgoe, Owen, Macnaghten 2013b, p. 1570)
Expert Group of European Commission (chair: Jeroen van den Hoven)	Responsible Research and Innovation (RRI) refers to the comprehensive approach of proceeding in research and innovation in ways that allow all stakeholders that are involved in the processes of research and innovation at an early stage (A) to obtain relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them and (B) to effectively evaluate both outcomes and options in terms of societal needs and moral values and (C) to use these considerations (under A and B) as functional requirements for design and development of new research, products and services.	(European Commission, Directorate-General for Research and Innovation 2013, p. 3)
Richard Owen, Phil Macnaghten, Jack Stilgoe	[RRI] seeks to [guide] how we might conduct science and innovation responsibly under conditions of uncertainty and ignorance, collectively enlarging our role responsibilities to include a greater moral dimension, to those living now, those yet to be born, and those beyond our own species. […] The emphasis here is on the word 'we': this is a collective responsibility, reflecting the collective nature of science and innovation itself, where irresponsibility is a product not of the individual, but the system.	(Owen, Bessant, Heintz 2013, p. XIX)

3. The critique of Responsible Innovation

In their most recent paper, Vincent Blok and Pieter Lemmens (2015) formulated three reasons why RI is questionable and, consequently, why it calls for a radical transformation of the concept of innovation. This section will focus on the problematic character of RI.

The authors analyse three phases (input, throughput, and output) of the innovation process and show why it is hard to imagine them being responsible (Blok, Lemmens 2015). In their work, RRI is understood as the sum of "regular innovation and stakeholder involvement with regard to ethical and societal aspects". The integration of societal actors comes to the fore, who, at least in principle, participate in a particular innovation in different phases of its coming into being. But how does this integration work in practice?

Firstly, the input of innovation is defined as the so called "grand challenges" (von Schomberg 2013) which, in turn, come from the "wicked" problems described by Rittel and Webber (1973). The essence of the problem here is the scope of these challenges. By nature, the scope is so wide, and the problems are so complex that it is close to impossible to agree on what the goal of the new innovation should be. As a consequence, it remains unknown what can be obtained with the new product. Secondly, the throughput of innovation is characterised in terms of mutuality and transparency which should contribute to information symmetry among the interested parties. However, this point undermines the business case for innovation, because in order to benefit from innovations a surprise element is needed. Once an innovation is disclosed, i.e. raised for discussion with stakeholders, the possibility of losing the first mover advantage increases.[8] The situation might become worse, because even if we assume that communication with the stakeholders is fruitful and does not affect our business case, we still need to face the "dilemma of control."[9] The dilemma is connected with the fact that, while we are still able to manage the technology or innovation, we do not know enough about its potential implications. However, when we gain enough knowledge (e.g. via transparent communication), we usually lack the power to make any significant change, because it is already too late. Finally, considering the output of innovation, Blok and Lemmens (2015) point out that even advanced due diligence cannot prevent unexpected consequences. For instance, in the case of biofuels, it turned out that this innovation led to increased food prices (due to the use of crops for fuel production). To conclude, if even biofuels, which were a promising candidate for a model RI, fell

[8] For an interesting case study describing the limits of RI associated with involving numerous stakeholders, see (Hoop, Pols, Romijn 2016). The authors describe a biofuel innovation in Hassan, South India.

[9] The first person to point to the dilemma was David Collingridge, hence the alternative name the "Collingridge dilemma" (Collingridge 1980).

into the pitfall of unexpected consequences, we cannot expect that a truly responsible innovation will avoid any unexpected problems. It is not easy, to say the least.

Following their critique, Blok and Lemmens (2015, p. 28–31) note that RRI is not flawed *per se*; rather, it is the underlying notion of innovation which makes RRI vulnerable to critique. The question arises: what contributes to this understanding of innovation? There are four things that should be mentioned. Firstly, Benoit Godin (2014) points to historical changes that have led to the restriction of innovation to technological innovation only. The changes are associated with the development of the "culture of things" which goes back to the Renaissance when technological objects first became appreciated and valued.[10] Secondly, innovations are perceived mainly from an economic perspective. In an economy of growth, innovations are the game changers that help boost business. For that reason, businessmen for decades have had their radar set on technologies improving, for instance, the efficiency and quality of manufacturing. Also, on the policy level, it is claimed (von Schomberg 2013) that investments in innovation will "lead [indirectly] to the creation of new jobs and economic growth". Thirdly, innovation is perceived as inherently good (Godin 2014). It boosts the economy by creating jobs, as well as making technology more sustainable and the use of resources more efficient. Innovation seems to be the cure for the "contemporary cancers" such as unemployment, stagnated economy, unsustainable use of fossil fuels, etc. Finally, Blok and Lemmens (2015, p. 30–31) note the presupposed symmetry between moral agents and addressees of the concept of innovation. The symmetry is intended to indicate that innovations support transparency and mutuality and contribute to better communication among stakeholders. Given the above, one could get the impression that the concept of innovation is spotless. As shown below, this is hardly the case. All of the mentioned characteristics are contested.

Technological innovations are not the only type of innovation. However, in the course of history, technological innovations have gained so much attention that other types (such as system innovations or attitudinal innovations) have almost disappeared (Blok, Lemmens 2015, p. 29). We believe that innovations deserve broader understanding in two ways. Firstly, other types of innovations, like system innovations, need to be studied on their own; and, secondly, all types of innovations should be considered more holistically. This means that technological innovations cannot be studied in isolation from the systems and societies in which they are created and in which they are eventually implemented.

Economic benefits from innovations are probably the hardest to contest. There are numerous examples of technologies (*sic!*) which gave economy an incredible boost, e.g. the internet, the microchip, the radio, or the airplane. However, that is

[10] The second impulse for this restriction was the introduction of patent laws which were specifically aimed at protecting technological inventions.

just part of the problem. Economy of growth has a tremendous downside in the form of the depletion of natural resources and environmental pollution. Developments facilitated by humanity are almost always associated with a sacrifice which is not always made consciously. Some of the consequences emerge slowly such as running out of fossil fuels, whereas others strike head on, like unleashed nuclear power (Chernobyl, Hiroshima). Regardless of the pace, an innovation that would be once considered a blessing can simultaneously contribute to the development, or even creation, of another new challenge. There are no price tags on global challenges, but, considering their scope, be assured, the price will not be small.

Regarding the inherent goodness of innovation, a couple of years ago, Joseph Schumpeter pointed out that innovation is a product of creative destruction (Schumpeter 2010). The above-mentioned positive results of innovation are the creative part of the conception. However, the destructive element is also closely connected with innovation. Whenever a new piece of technology, infrastructure, or a new market is created, there is some "decay" caused by disposing of the old technology, the demolition of the old infrastructure or the collapse of the old market. Hence, in general, it can be said that whenever something positive comes from an innovation, something negative will appear elsewhere as it is directly associated with the former event.

Finally, the symmetry between moral agents and addressees can be challenged as information flow among different parties is often insufficient or simply impossible. Calls for diligent actions and anticipation are flawed by the dilemma of control (Collingridge 1980). Responsibility requires seriously taking into account the possible consequences of innovation (Grinbaum, Groves 2013). This is possible only to a limited extent (at the earlier stage of an innovation when it is uncertain what outcomes to expect) and, even when possible (at the later stage of an innovation's development), it might be too late to change the design of the technology. The goal of narrowing the gap between moral agents and addressees assumes that narrowing will "pay off", but this is not necessarily the case. As mentioned above, in some situations, it might be more beneficial to leave the gap open, because the gap indicates an opportunity to profit.

To summarize this section, throughout the innovation process, there are some basic and lasting assumptions that need to be challenged before it can be said that we are actually dealing with RI. After presentation of the critique and explication of the concept of innovation underlying RI (cf. Blok, Lemmens 2015), it is now time to give a positive account of the concept of innovation. While doing so, we will focus on showing the advantages of the proposed concept.

4. The ambivalued conception of innovation

It can be observed from above that the commonly accepted concept of innovation has several drawbacks and can be contested in several ways. This gives motivation to search for an alternative or to provide a more specific conception which would be more adequate for the purpose of RI investigations.

Invention and innovation are consecutive stages in the developmental process of "something new" – an innovation. The process starts with basic research which is conceptual by nature and aimed at creating pure knowledge that can be coded and transferred into the later stages of the innovation process in the form of cultural value (cf. Kawalec 2015). At some point, knowledge obtained from scientific research becomes utilized and, therefore, the applied stage of research aimed at innovation starts. The search for the application of knowledge generates its utility value (Kawalec 2015).

The opposition between the stages is apparent. In practice, only the emphasis changes and it is more a matter of a degree to which a given type of knowledge is exploited at each stage of the innovation process, but essentially, cultural and utility values are intertwined. This is the core of the ambivalued concept of innovation (Kawalec 2015). The two types of values differ: the cultural value remains the same throughout the process and is therefore called the "constant cultural value" of innovation, while the utility value changes and is thus called the "variable utility value" of innovation. In order to grasp the idea correctly, let us consider the following example. The R&D unit of company X has developed a ground-breaking design for a cell phone. One of the crucial features is the touch screen, a piece of technology that has been granted a patent,[11] but which was first only an idea in an engineer's mind. This idea was later developed by stages into a blueprint which was then successfully turned into a working prototype. The knowledge needed for this development had been abstract, symbolic and causal for a long period (Giere 2010), which actually made the manipulation of it easy and facilitated the R&D process. That, in short, is the cultural value part of the concept of innovation. In the course of history, mankind has learned to calculate the value of immaterial things. The same is true for invention; therefore, next comes the utility value.

When a prototype is tested and all the initial flaws are removed, the innovation is ready for mass production. If marketing is successful and consumers buy the product, the actual growth of an innovation utility value takes place. A single successful product is enough to turn a small family company into a global multimillion dollar corporation. However, as one might expect, success is not obligatory for each and every product. What is more, after an initial success, some innova-

[11] A patent should be considered as a necessary investment to protect future profits.

tions lose their momentum and market share. This leads to variability of the utility value throughout the innovation process, including marketing of the product, which is contrary to the constant cultural value. Still, variability of the utility value has its merit.

Today, science is strictly tied to society and functions within a network of many actors who cooperate in order to direct scientific action towards the most desirable societal goals. The "ivory tower" view of science (Polanyi 1962) is no longer tenable. Orientation towards society does not mean that basic research should be abandoned. To the contrary, basic research and pure knowledge create a commonly accessible storage of ideas from which society and companies can benefit at present and in the future (Kawalec 2015). An interesting observation made by Kawalec is that this characteristic may serve as a premise of an argument for new forms of innovation ownership: more open and combining private and public partnership.[12]

Taking into account the above considerations, it will now be shown in what ways the ambivalued conception of innovation overcomes the flaws of the earlier conception. Firstly, the new conception does not limit itself only to technological innovations. From the fact that it encompasses both basic and applied stages of research, it can be inferred that this new conception will apply equally well to innovations of different types, such as theories, frameworks, designs etc. Secondly, at its core, the conception of ambivalued innovation deals with the non-economic value of innovations which is expressed in the form of constant cultural value. Therefore, there is no threat that the economic aspect of innovation will be overly emphasized. Thirdly, we think that this new conception assumes inherent goodness of innovation. However, while a conception identifies the constant cultural value of innovation, it becomes less susceptible to critique against this characteristic. This is due to the fact that a conception shows the reason why at every stage of innovation development, and even later on, during its diffusion phase, the innovation remains valuable (regardless of economy). This is precisely because of the innovation's lasting cultural value. Finally, with respect to moral symmetry between moral agents and addressees, the new conception offers a promising possibility. It has been mentioned above that innovations are deeply rooted in the network of different societal actors who exchange the information they possess. Therefore, for the new conception to be viable, it is not enough to only note that fact, as the old conception does, but a more far reaching openness is required, one that would also help to break any existing barriers, some of which are created by forms of intellectual property ownership. New forms of innovation ownership might provide the expected solution. Private-public ownership and open access create a potential platform of exchange and help to narrow the asymmetry between agents and addressees.

[12] For more details on new and innovative forms of ownership please see (Leadbeater 2001).

An ambivalued conception of innovation seems a viable option in developing the way in which innovations should be understood. It points to a simple fact that, considering the demand and the supply powers (market forces), the utility value of a given innovation might change, while its cultural value remains the same, based on "the same ingenuity of an engineer who designed it in accordance with the causal laws" (Kawalec 2015). There can be no sharp distinction between the cultural and the utility value of knowledge. They continually co-exist.

5. The way we understand responsibility

As Owen et al. (2012, p. 756) stated, "[t]he framing of responsibility itself is perhaps one of the greater intellectual challenges for those wrestling with the concept or responsible innovation". Bearing in mind the modification of the notion of innovation, we propose a subsequent modification of the notion of responsibility. The modification is aimed at explicating all the relevant traits of responsibility which are important in the context of innovation. We distinguish four such traits. Responsibility should be described as collective (von Schomberg 2007; Owen, Macnaghten, Stilgoe 2012; Stilgoe, Owen, Macnaghten 2013b), future-oriented (Jonas 1984; Owen, Macnaghten, Stilgoe 2012; Stilgoe, Owen, Macnaghten 2013b), socio-political (Hellström 2003; von Schomberg 2011, 2013) and values-oriented (van den Hoven 2013; von Schomberg 2013).[13] The main conclusion is that the prevailing consequentialist approach to responsibility is insufficient and requires taking into account all of the above traits.

Historically speaking, there has been a change from a deontological to consequentialist approach (Grinbaum, Groves 2013) in the assessment of moral value of human action. Antiquity and the Middle Ages were dominated by an approach in which conformity with long lasting, or even "eternal", rules were decisive when trying to answer the question of what is right and what is wrong. The approach changed in the modern age when the focus moved to the consequences of an action. The change was substantial: following the former approach, the answer could be formulated prior to an action, whereas in the latter, only once the consequences have arisen or have become at least predictable can the moral value and associated responsibility be assigned to an action. An important development in science, associated with industrialization, happened along with the orientation towards consequences in ethics. This led to the proliferation of social roles and, in turn, to the development of role responsibility, as it is presently called. Professionals and experts in their domains had to face new questions not only about the consequences of their actions but also about the responsibility for such consequences. Such an

[13] For an extensive discussion on these characteristics of responsibility (see Wodzisz 2015).

approach was criticised. Without going into detail, it can be said that role responsibility is a notion that definitely has its merit in sociology but only limited application in ethics where it becomes a discussion about ethical dilemmas and conflicts, or is purely descriptive when cataloguing good and bad practices (von Schomberg 2007, p. 9). In both cases, the essence of ethical considerations is lost. We should be focussed on bringing the justification of moral responsibility of an action to light.

The focus of the discussion regarding moral responsibility is on consequentialism. This idea is flawed by the essential epistemic problem associated with the lack of knowledge of all relevant consequences of actions. Gathering the required knowledge is connected with science which provides good standards of telling if consequences had been "accurately" predicted (Grinbaum, Groves 2013, p. 124). It is paradoxical that science helps us better predict the consequences of actions taken by means of objects, things and/or machines constructed and designed with the help of science. Innovation stimulated by science leads to an epistemic problem. Furthermore, this problem can be explicated by looking at *foresight knowledge* (von Schomberg 2014), which is unverifiable, uncertain, complex, interdisciplinary, action oriented (chances and threats are taken into account), and aimed at formulating a unified vision of the future. In conclusion, it can be said that foresight knowledge is very different from everyday knowledge we are accustomed to. To explain why, it is not enough to refer to human finitude (Grinbaum, Groves 2013). We must also refer to naturalisation of technology (ger. *Naturalisierung der Technik*) (Nordmann 2005). It is a situation in which technology is abundant, complex and incomprehensible to such an extent that it is perceived as principally incomprehensible. Technology is a part of many complex systems. Elements of these systems interact while technology also interacts with nature. The more interactions that occur, the more unpredictable and autonomous the technology becomes.[14] All this makes the assessment of the consequences of an action very difficult. Therefore, there is a need to look for a different approach to take responsible action.

The first thing to notice is the need for a collective approach to responsibility, which at its essence resonates and follows directly from the nature of the process of innovation (cf. Bessant 2013) that is complex, nonlinear, and collective.[15] This last property is especially appealing. Innovative activities are no longer undertaken by single actors as was the case in earlier centuries. In today's modern world, an innovator is part of a vast network of actors involving scientists, researchers, policy makers, entrepreneurs, investors, NGOs, etc. Only their combined efforts can

[14] This is in line with Hannah Arendt's ideas (Arendt 1998, p. 13–14). She thinks that human beings' existence is conditional in a twofold manner. On the one hand, humans live in the world they did not create, and, on the other, they add something to the world which becomes the condition of their existence and may be hard to control.

[15] Lee and Petts (2013, p. 143) add the following traits: extended over a long timescale, involving multiple actors and the global aspect.

result in successful research and development, which often takes place in a corporate R&D facility or lab. Collective actions refer to groups which are not randomly chosen sets of people but those which have something in common – at least one of three things, as Marion Smiley (2011) points out. The group should have well-ordered decision-making procedures; or group members should share interests or needs and pursue their goals together; or, finally, the group should share attitudes. Once one of the three conditions is met, responsibility can be assigned to a group. As teams involved in the innovation process easily satisfy these conditions, the need of talking about collective responsibility in the context of innovation can be addressed.

The question can be asked as to what the focal point of a scientific investigation should be. In 1984, a book by Hans Jonas entitled *The Imperative of Responsibility: In Search of an Ethics for the Technological Age* was published in English. The work is an important point of reference for the present discussions about responsibility in our techno-society. As the subtitle indicates, the author aimed at creating up-to-date ethics that would suit our age which is without doubt dominated by technological developments. The main premise for Jonas' consideration is the threat of human extinction. However, the identified cause – armed conflicts and possible nuclear holocaust – is outdated, because today we would point to pollution, climate change and all associated effects of these. Nevertheless, Jonas stresses the need for responsible conduct for the sake of future generations. In contemporary literature, that kind of responsibility is called forward-looking (in contrast to backward-looking responsibility [van de Poel 2011]). It creates a positive obligation for the expected (and unexpected) effects. This obligation grows in direct proportion to human's power of influencing the environment, and this, in turn, is relative to (but not restricted to) developments in the field of technology. In an earlier part of this text (see § 2) we mentioned that today, innovation is mostly perceived from a technological perspective. Therefore, the link between innovation and future-oriented responsibility is established.

A person's responsibility is not only dependent on the person's choices and decisions (their free will) but also on the socio-political context of their action. For an innovator, such a socio-political environment consists of both personal (professional code of conduct, personal ethics) and institutional conditions. This characteristic of responsibility is especially relevant in the case of the occurrence of negative consequences of a particular innovation. Socio-political ramifications by which an innovator acts may be used to argue for a decreased level of responsibility. Two main situations are possible when describing the interrelation between responsibility and its socio-political context. On the one hand, particular socio-political context might be *necessary* for the ascription and exercising responsibility, while, on the other, some socio-political context might only be *better suited* for ascribing and exercising responsibility than other social ramifications. Whatever

the case, independence of responsibility from the context is impossible. As examples of socio-political ramifications relevant for ascriptions of responsibility in the context of innovation should be considered, e.g. national science and research policy, corporate social responsibility or sustainability agenda. Furthermore, the socio-political nature of responsibility is related to systemic risks (cf. Hellström 2003). "[Risks] are *systemic* in the sense that they tend to emerge from the interactive properties of complex and pervasive technologies and their social context, or more specifically, from the infrastructures that embed and enforce these technologies" [emphasis original] (Hellström 2003, p. 369). If risks, which can be understood as possible negative effects of innovations, are systemic in this sense, then responsibility for the risk taken will also be systemic by nature, or, as we call it, socio-political. This description seems to be more accurate as it directly refers to the two greatest powers at play, i.e. society at large and current policy. It must be noted that socio-political ramifications are not always clearly formulated, especially social ones. A large part of public discussion is formulated in terms of values which are important for society.

Why are values important in the context of responsibility? In his paper, Jeroen van den Hoven (2013) gives two examples of innovations in the development of which values became the crucial point leading to their rejection. One is the electronic patient record system and the other is the smart meter. Both cases were recorded in the Netherlands. As the author explains, "[a] real innovative design for an electronic patient record system or a truly smart electricity meter, would thus have *anticipated or pre-empted moral concerns and accommodated them into its design*, reconciling efficiency, privacy, sustainability, and safety" [emphasis original] (van den Hoven 2013, p. 76). The values mentioned were somehow neglected in the actual development process. However, van den Hoven also gives positive examples of innovations embedding values, i.e. privacy enhancing technologies and development of sustainability technologies in Germany.[16] In this example, early anticipation of the issues allowed for and stimulated the development of "responsible innovation". This point is in accordance with the general view of van den Hoven who thinks that the situations of moral overload – with two or more conflicting moral demands – can be overcome with innovations, and because of that fact we actually have an obligation to innovate (Arendt 1998; van den Hoven 2013). The role of values in the context of RI is also important for Rene von Schomberg (2011, 2013). According to the scholar, values are the defining concepts of the European community and are therefore indispensable in formulating "the right impacts" that we might expect from innovations. Research and innovation policy should anticipate what is included in the public policy of the EU, and because

[16] It has to be noted that van den Hoven explicitly refers to the positive economic effect of these two cases and, therefore, his approach cannot be accepted to the full extent (van den Hoven 2013).

the latter is entrenched in an identity built up by values, it is surprising that up to this point values have been barely present in formulating goals of innovation policy. Van den Hoven makes a similar remark when he admits that technology is value-laden. As a result, if we abstain from discussing what values are important for a particular innovation, then we simply run the risk of "commercial forces, routine and bad intentions" doing that work for us (van den Hoven 2013). This paragraph has been intended to show that values and responsibility are closely intertwined. In principle and in practice, there are reasons to take values as guiding posts in the strive after RI.

With the above description of responsibility, we will now discuss the advantages and disadvantages of the proposed understanding of innovation and responsibility and try to assess their adequacy and applicability in the context of RRI.

6. Responsible innovation reconsidered – discussion

The two separate considerations about responsibility and innovation discussed above come together within the idea of RRI. In terms of its content, RRI is hardly a new idea, but one that carries much influence if its current role in the research and innovation policy, for instance, in the European Union is considered. By overcoming the decades-long dominance of the old economic paradigm of creating innovations only for money, RRI can help introduce a new paradigm focused on the constant cultural value of innovation (Kawalec 2015). The above considerations were intended to shed some light on the meaning of RRI. New definitions of both innovation and responsibility bring us closer to the proper conception of RRI.

It would be too ambitious to attempt to abandon the consequentialist approach completely when discussing responsibility. However, what can be done is to provide some guidance on how to proceed in order to arrive at the desired outcome. Some suggestions on how to make innovations more suitable for RRI are presented below. These suggestions encompass all dimensions of responsibility.

1. *Start with a problematic situation and specify it for the particular context* – innovations should be created in order to remedy problems and to fulfil societal expectations. Innovations should not be considered as only as a simple part of technology (Godin 2014); they should also be perceived in the systemic perspective that allows for their proper placement and right development with the help of interested stakeholders and in light of the specific socio-political context (Hellström 2003). A collective approach is essential in solving problematic situations. Although we accept Blok and Lemmens' (2015) critique of RRI, we still find that addressing these so called "wicked problems" in a responsible manner is possibly the best option available at

the moment. The focus is placed on the problem and solution, and not on the technology.

2. *Identify stakeholders (direct and indirect), values, social and policy issues relevant for the innovation's development* – these contain crucial context information and should be maintained in a flexible manner, i.e. the stakeholders identified initially should not exclude further expansion of the group. An exemplary list of values and issues presented to stakeholders should only help identify the final list and not serve as one.[17] Human values and ethical import are especially included as values to be focused on. The most common of such values are: human welfare, ownership and property, privacy, freedom from bias, universal usability, trust, autonomy, informed consent, and accountability (Friedman, Kahn, Borning 2008, p. 92).
3. *Conduct conceptual investigation of values* – the earlier in the process these steps are undertaken, the greater the chance of avoiding unnecessary ambiguities later on. A good starting point has been provided by Friedman et al. (2008, p. 90–91) who describe three case studies of innovations and how the main values associated with them have been conceptualized. Returning to Rawls' distinction, the aim should be to find one concept and not a conception as the latter can change over time.
4. *Identify benefits and harms (B&H) for all the stakeholders and map them onto particular values* – that is one of the future oriented parts of the process. Here, the active role of stakeholders would not only expand the list of the perceived benefits and harms, but could also serve as a guide on how to distribute responsibility among different parties (von Schomberg 2007). Identification of B&H should be driven by socio-political context, i.e. it should be indicated what kind of benefits or harms would influence a particular socio-political issue (von Schomberg 2011, 2013). Associating B&H with values is the first step, but more thorough investigation would require considering the differences with respect to different stakeholder groups. Things to consider under this include, e.g. how particular benefits and harms can promote or demote the values (van den Hoven 2013) and whether they influence all the stakeholders in the same way (Owen, Macnaghten, Stilgoe 2012).
5. *Identify value conflicts, design trade-offs, and, subsequently, try to find constructive ways of overcoming them* – occurrences of conflicts are not only unavoidable, but also indispensable as they are often the starting point for gaining awareness of problematic issues. As explained by van den Hoven et al. (2012), moral progress can be boosted by technology. Even though cases

[17] Friedman et al. (2008) propose to use the heuristic of semi-structured interviews for that purpose.

of conflicts seem troubling, they do not have to be disturbing as they still should be able to make a positive contribution to the dialogue: make suggestions, guide alterations, etc. The idea here would be to stay open-minded and if case A conflicts with B we should rather look for C instead of trying to prove why A is better than B or vice versa.

6. *Integrate value considerations into the organizational structure underlying the innovation process* – this point is especially interesting in the context of RI. Organizational structure (private or public) is the right environment for the innovation process to take place.[18] Both kinds of an organizational structure provide an organizational framework in which the guideline which was only outlined here could be applied. Managerial supervision by a professional should be implemented for an easier control of the innovation process.

One might be surprised that in the guideline for RRI outlined above there is no direct reference to the outcome(s) of innovation. This omission has a twofold purpose. On the one hand, the focus here has been on the prospective character of responsibility and, therefore, anticipation of the outcomes is more important than the outcomes themselves. On the other, harms and benefits are considered only in reference to a particular group of stakeholders and not in general. Furthermore, with this guideline, our intention was to show that innovators are simultaneously *choice architects* (cf. Thaler, Sunstein 2008). Designing and developing innovations is a sequence of decisions that are tacitly accepted by the end users of the innovation. Finally, the task of RI is to provide a meta-level guideline. The responsibilities that are discussed here are the second-order responsibilities (cf. Marcus 1980, p. 135; van den Hoven 2010, p. 75). This again points to the relevance of managerial and organizational activities in achieving truly Responsible Innovation.

7. Acknowledgments

The research presented in this paper was possible thanks to the financial support by the National Science Centre – grant no. 2013/11/N/HS1/04822.

Additionally I thank anonymous reviewers of the journal for their valuable comments to earlier versions of this paper.

[18] About the systemic nature of innovation and risks associated with them (Hellström 2003; Bessant 2013; Tidd, Bessant 2013).

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