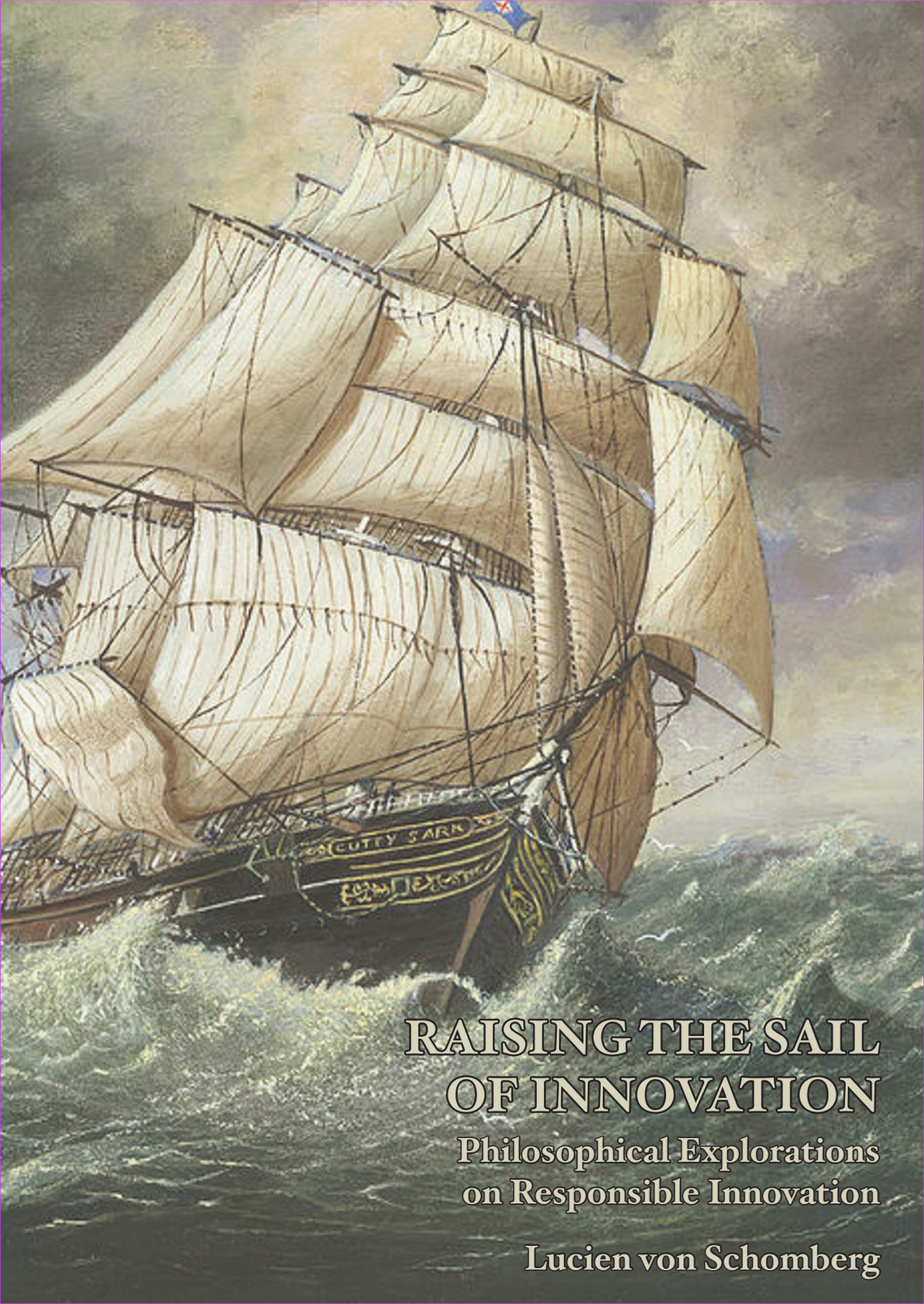

RAISING THE SAIL OF INNOVATION

Philosophical Explorations on Responsible Innovation

Lucien von Schomberg

Propositions

1. The assumption that innovation can be regulated towards societally desirable outcomes cannot be maintained.
   (this thesis)

2. The inclusion of society in innovation requires active involvement of individual citizens beyond representative stakeholders.
   (this thesis)

3. The most urgent priority for science is to restore societal trust in its practice.

4. In the current research system, the pursuit of science conflicts with the pursuit of profit.

5. The commodification of personal data is morally indefensible.

6. The inclusion of philosophy as a mandatory part of the education system will contribute to the creativity and resilience of the next generations.

Propositions belonging to the thesis, entitled

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Lucien von Schomberg

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Raising the Sail of Innovation

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Lucien von Schomberg

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"The seemingly self-evident has become incomprehensible. But this means, in so far as we want to linger over and further examine this incomprehensibility, that it has become *worthy of questioning*."

– Martin Heidegger, *The Essence of Truth*

CHAPTER 1

Introduction

Chapter 1 Introduction

I. The Nature of Innovation in the Emerging Context of Responsible Innovation

What other place to seek inspiration in than the London Underground during rush hour? It was there, on a wintery day anno 2017, that I spotted a fellow commuter reading a book titled *Innovation*. Intrigued as I was, I pushed my way through the slightly overcrowded tube and asked the avid reader how the book defined innovation. He was quick to turn to the back cover and started reading out loud: "True innovation is about delivering value to customers" (Carlson and Wilmot 2006).

I then realized two things. First, the concept of innovation defines our age. It fuels the global economy, promises a sustainable future, and stands at the heart of our interconnected society. Not only was the underground surrounded with all kinds of innovations, but we have even reached a point in history where people are reading about innovation and – as the commuter would later confess – dream of becoming innovators themselves, for public icons like Steve Jobs and Elon Musk are praised in the same way artists and scientists were in previous times. Second, the concept of innovation is widely presupposed in terms of the *commercial value* it generates. In this view, innovation is only considered valuable insofar customers are willing to pay for it. As claimed in the tradition of economic analysis, innovation is characterized by its competitive dynamics and is primarily directed at developing marketable products and services (Stoneman 1995).

At the same time, our geopolitical landscape faces an unprecedented crisis, overwhelmed with global issues such as climate change, overpopulation, water shortage, a loss of biodiversity, food security, and the more recent COVID-19 pandemic. The reality of these issues increasingly urge innovation to generate *societal value* beyond mainstream economic incentive. This is particularly the case in the context of the European Union (EU), which strives to represent high ethical standards on the world stage and thus prioritizes normative objectives on its political agenda. To this end, the EU policy discourse has paved the way for Responsible Innovation (RI). The core idea here is to steer innovation processes towards societally desirable outcomes, specifically in response to the so-called grand challenges of our time (European Commission 2015). A frequently cited and particularly influential definition of RI calls for "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 societally

desirability of the innovation process and its marketable products" (von Schomberg 2013, p. 63). Under the sway of science *with* and *for* society, the hypothesis is that innovation can only respond to the needs and ambitions of society by including all its actors throughout the process. As such, in 2011, RI made its entry by the name of Responsible Research and Innovation (RRI) as a cross-cutting issue under the EU Framework Program for Research and Innovation 'Horizon 2020'. More recently, RRI has been articulated in terms of six keys – ethics, societal engagement, gender equality, open science, science education, governance – through which the EU imposes a strong normative view of what constitutes responsibility in innovation processes (European Commission 2020).

Visions of RI also circulate within academia, typically proposing that to innovate responsibly requires a permanent commitment to be anticipatory, reflective, inclusively deliberative, and responsive (Owen et al. 2013). Some suggest incorporating human values into design requirements (Van de Poel 2013) while others focus on embedding innovation processes in the established treaties of the EU (Von Schomberg 2013). Approaches of RI further vary between coping with the institutional landscape and pushing to transform it entirely, between implementing practices locally and enforcing objectives globally, and between proposing incremental change and disruptive change (Ludwig & Macnaghten 2019). There are also social, political, and cultural differences. For example, China advocates for governmental and collective responsibility rather than the democratization of innovation processes, which thus differs from a European approach. As such, there is no essential characteristic that is shared by all RI ideas and practices (Cf. Timmermans & Blok 2018). The fluidity of RI is analogous to the way in which philosopher Ludwig Wittgenstein argued that there is no common denominator to determine the essence of a concept; there is only a complex web of overlapping similarities and relationships (Kenny 1973). Instead, RI may be conceived of as an intellectual movement that continuously rearticulates its core (Brundage & Guston 2019).

Throughout the different RI approaches, however, much effort is dedicated to *governing* innovation, while little thought goes to what innovation itself means conceptually. Questions often revolve around where and how to innovate, leaving aside the very question of what it means to innovate. This remains to be the case after the recent release of the *International Handbook on Responsible Innovation*, as noted in a review by Robert Frodeman (2019). What understanding of innovation underpins the framework of RI? What implications, if any, does this have for the ambition to achieve RI? These are important questions to raise as

they enable us to critically reflect on the relation between responsibility and innovation, broadly speaking. Does the 'R' in RI entail an application of ethical keys to an already existing concept of innovation, or does it require us to rethink the concept of innovation altogether?

Against this background, this thesis raises the following research question: *What is the nature of innovation in the emerging context of RI?* On the one hand, this is a descriptive question, asking how the concept of innovation *is* generally understood in the RI discourse and to what extent such an understanding is compatible with the societal ideal of RI. On the other hand, it is a normative question, asking how the concept of innovation *should* be understood to genuinely serve the societal ideal of RI. In this respect, I distinguish between weak RI and strong RI, and propose two corresponding propositions:

> P1. Weak RI seeks to govern a techno-economic concept of innovation through an applied set of ethical keys.
>
> P2. Strong RI seeks to transform a techno-economic concept of innovation and constitutes a shift towards a fundamentally political concept of innovation.

First, under the sway of technological innovation, I argue that for a large part the RI discourse presupposes a techno-economic concept of innovation (P1). The technological focal point resulted from earlier efforts to institutionalize ethical and social dimensions of new and emerging technologies. These include technology assessment (Rip et al. 1995), science and technology studies (Hackett et al. 2007), anticipatory governance (Guston 2014), and research on ethical, legal and social implications (ELSI) – or aspects (ELSA) – of emerging technologies (Zwart & Nelis 2009). At the same time, this technological focal point projects a strong economic orientation that tends to limit the discussion to marketable and profitable technologies, such as synthetic biology, nanotechnology, and ICT (Blok & Lemmens 2015). This economic orientation is particularly reflected in the EU policy discourse of RI which finds itself embedded in the overarching goal of the EU to become a genuine 'innovation union' that turns "great ideas into products and services that will bring growth to our economy and create jobs" (European Commission 2014, p.3). I consider this as weak RI because it does not account for the concept of innovation as object of reflection. Instead, ethical keys are uncritically applied to innovation-as-usual.

In turn, the academic discourse originally introduced RI as a holistic approach that explicitly advocates against mainstream economic incentive (Owen et al. 2021). It departs from the observation that innovations currently delivered by the market insufficiently serve the public good, which thus urges the call to govern innovation processes beyond mere private interests. The question, however, is whether the ideal of RI to genuinely serve the public good is feasible insofar the scope is limited to governing a techno-economic concept of innovation. Defining technology as Enframing, Martin Heidegger (1977) warned us that in the illusion of controlling technology, we are in fact ourselves summoned to a technological, calculative if you will, mode of ordering reality. In a similar vein, I argue that in trying to govern a techno-economic concept of innovation we remain subject to its dominance. This also explains why, at the operational level, RI is often employed for mere strategic and instrumental purposes, while falling short on its promoted ambitions (Novitzsky et al. 2020).

To this end, I propose that strong RI requires a critical reflection on the concept of innovation itself, where the 'R' in RI suggests a transformation of – rather than application to – innovation-as-usual. In this respect, my second proposition is that strong RI constitutes a shift towards a fundamentally political concept of innovation (P2). Frameworks of RI emphasize the democratization of innovation processes, aim to 'change the world', and are thus inevitably entwined with the realm of politics. This is especially the case in discussions on global issues like climate change, where RI is shown to be much more complex and political than usually perceived (Stilgoe 2019). Even so, questions about the politics in and of innovation processes are largely unaccounted for, as critically remarked by Michiel Van Oudheusden:

> RI proponents have little to nothing to say about the politics and power that play out in, and through, deliberative governance processes. How do actors 'co-create' outcomes? How do they deliberate? On whose terms is participation (i.e. deliberation) established, and why? What, in fact, is 'public' about the 'public interest', 'public expectations', and 'the public', and whose definition of the public counts? (p. 73, 2014)

Hence, rather than focusing on the governance of innovation and seeing politics as an add-on, this thesis ultimately brings into question what a political concept of innovation in itself consists of and how it can contribute to the societal purpose of RI.

My aspiration to establish a political concept of innovation for the RI discourse is both historically motivated and philosophically grounded. Historically, innovation has little to do with technology, let alone with the market. In fact, it initially emerges in Ancient Greece with a political connotation, where it is fundamentally understood as "introducing change into the established order" (Godin 2015, p. 5). Such an understanding of innovation is carried through all the way up to the period from the Reformation to the 19th century, and only recently developed into a techno-economic concept. As such, the history of innovation inspires me to reflect on what a political concept of innovation could mean today, particularly in the emerging context of RI. In doing so, I find philosophical revelation in the work of Hannah Arendt (1998), one of the most influential political philosophers of the twentieth century. Although Arendt does not explicitly talk about innovation herself, I believe her equation of politics with the human capacity to begin something completely new and unexpected provides the RI discourse with meaningful insight to understand what it really means for innovation to be embedded in the public sphere.

II. The Effort of Philosophy

As etymologically defined by the Ancient Greek term *philosophia*, philosophy originates out of a 'love of wisdom'. This is not to be confused with a love of truth, because while the notion of truth is loaded with presuppositions, philosophy is precisely about questioning these presuppositions and about taking a critical distance of the context in which they are presupposed. In the context of military education, for instance, Socrates challenges an Athenian general and stateman to define what it means to be courageous. In a first attempt, the general claims that courage means "to stand and fight" but gets quickly refuted by Socrates who points to military occasions, as well as other occasions of life, that do not include fighting and where courage is nonetheless required. In a second attempt, the general equates courage with "a certain perseverance of the soul", explaining that a man of courage is one that stands firm in the battle. This is again refuted by Socrates, arguing that there are many situations in which enduring a battle is rather foolish than brave. The dialogue ends in philosophical confusion, confirming what Socrates knew all along: "I neither know nor think that I know" (Plato 2010, 21d).

In this spirit, and in a fundamental sense, philosophers may dismantle the metaphysical absoluteness proclaimed by religion and critically account for the epistemological status

accredited to the natural sciences. At the same time, philosophy enjoys the applicative power to challenge and rethink basic conceptions in any concrete field of study. In neoclassical economics, for instance, philosophy may question the so-called Law of Demand which postulates the rationality of economic agents and regulates the market accordingly. Such questioning, in turn, gives rise to behavioral economics, focusing on psychological mechanisms excluded in formal economics (Henckel 2017). It is precisely through this effort of philosophy that I reflect on the nature of innovation in the emerging context of RI. When *true* innovation is understood to deliver commercial value, the philosophical question is to what extent such an understanding really enables the possibilities of innovation, and by extension, of RI.

Philosophically, the nature of innovation can be assessed from different perspectives. A metaphysical approach would be to account for the *ontos on* of innovation, i.e. the 'really real', that what essentially makes all innovations to be what they are. For Plato, for example, the *ontos on* of innovation is accessed through contemplation and characterized by an ultimate idea or genus. In doing so, he considered innovation to be subversive, denoting that its genus consists in seeking to renew the eternal and a priori determined values of truth, beauty, and justice. In contrast to Plato, phenomenology encourages us to go 'to the things themselves' (Husserl 2001). This would mean to account for the nature of innovation in terms of *ars* and *techne*, i.e. artefacts and socio-technical systems. Many contemporary philosophers of technology take inspiration from this phenomenological approach and reflect on what in the 20th conference of the Society for Philosophy and Technology was marked as the 'grammar of things', closely examining the way in which actual things work.[1] This includes studying the way in which concrete artefacts operate, and how they can even come to function as moral agents. Post-phenomenologists, such as Don Idhe (1998) and Peter-Paul Verbeek (2005), often do so in remarkable ways. Departing from the Husserlian idea that we always see and interpret the world in a certain way, they argue that this human-world relation is mediated by concrete technologies and altered when new configurations emerge. The smartphone mediates the way in which we communicate, while a drone changes the way we conduct war, to name some examples (Verbeek 2011).

One could argue, however, that by examining the 'grammar of innovation' and by thus inquiring into all the bits and pieces of innovations, we lose grasp of the very context in which these innovations are embedded (Zwier et al. 2016). Parallel to what Carl Mitcham (1994) has

called ‘technology as volition’, the question is not only how a specific innovation mediates the human-world relation, but also how the concept of innovation itself is mediated. What is the mode in which we are inclined to think of innovation? To what extent does this mode determine the way in which we effectively innovate? In fact, we are dealing here with a distinction between the ontic and the ontological. Although this distinction is subject to philosophical interpretation, throughout this thesis it is applied as follows: Where innovation at the ontic level refers to concrete innovative artefacts, innovation at the ontological level refers to the mode through which we see, understand, and create those artefacts (Zwier et al. 2016). This distinction was clearly present in my encounter in the London Underground, where the concept of innovation refers to its representing innovations, as well as to the ontological category of our age. This distinction becomes all the more relevant in the discussion of RI. At the ontic level, the question is whether a particular innovation is ethically acceptable and societally desirable. For example, solar energy contributes to sustainable energy and can thus be considered a responsible innovation. At the ontological level, the question is whether the current techno-economic mode in which we innovate is compatible with the societal purpose of RI. While the RI literature provides a critical analysis of innovation at the ontic level – i.e. concerning the introduction and usage of particular innovations – it still lacks a critical analysis at the ontological level – i.e. concerning the techno-economic mode of innovation. In other words, an ontological reflection is necessary (1) to analyze the way in which RI generally understands innovation, thereby exposing weak RI, and (2) to explore a political concept of innovation which addresses the public good beyond the current privatization wave, thereby laying the foundation for strong RI.

III. Thesis Objectives and Outline

The overall purpose to reflect on the nature of innovation in the emerging context of RI is divided into the following four research objectives:

1. To understand the emergence of RI and the main challenges it faces.
2. To analyze and break open the concept of innovation in RI.
3. To assess the feasibility of RI from a perspective of the philosophy of technology.
4. To operationalize a political concept of innovation in RI.

The thesis consists of four main chapters, each of which tackles one of the objectives. The four chapters are preceded by the introductory remarks and followed by a final discussion.

Chapter 2 sets the stage for the discussion. I depart from the observation that the emergence of RI explicitly calls for a paradigm shift in the innovation discourse, away from private interests and towards the prioritization of public interests. We learn that, to a certain extent, this objective is the result of a longer history of efforts and movements whereby the development of emerging technologies was initially left without the interference of democratic institutions, but then increasingly became a topic of wider concern. However, unlike its more nuanced precursors, the paradigm shift at stake in RI promises to overthrow mainstream economic thought, along with a radical transformation of the current research and innovation system. In this respect, I outline three generic challenges which bring the feasibility of RI into question. First, the epistemic challenge suggests that innovation as defined by its unpredictable nature simply cannot guarantee desirable and responsible outcomes, even if dimensions of responsibility are incorporated into the preceding process. Second, the political challenge reflects the difficulty of responding to the conflicting values and interests of different stakeholders, facing particular issues with recurring power imbalances. Third, the conceptual challenge demonstrates that the societal purpose of RI fundamentally conflicts with the imperative of maximizing economic growth inherent in the way we commonly understand innovation. I suggest that the latter challenge ties all three together and essentially encourages us to rethink what it means to innovate. To what extent does innovation necessarily relate to the market? Is it possible to develop an alternative concept of innovation that is separated from economic ends? How can we intellectualize and implement, for example, a political concept of innovation? In light of these closing questions, I conclude the first chapter with the call for RI to explore an alternative, perhaps more political, route of innovation.

Chapter 3 examines what in the proceeding chapter was labelled as the conceptual challenge of RI. Through an extensive analysis of the RI literature, I demonstrate that the concept of innovation is not yet considered as a proper object of reflection. Instead, innovation is uncritically presupposed as *technological* innovation. This is reflected in the vocabulary used to denote innovation and in the particular innovations to which the dimensions of RI are applied. Upon closer examination, it becomes clear that within the context of RI, technological innovation has two main characteristics. First, as the term itself implies, technological innovation refers to the creation of new technologies. Second, it is specifically concerned with

technologies that contribute to the market and can for this reason also be understood as *commercialized* innovation. Hence, while the dimensions of RI are broad and varied, innovation processes coupled with these dimensions are essentially limited to a techno-economic context. At the same time, I philosophically reflect on the historical findings of Benoit Godin to show that the concept of innovation has in fact political origins and very little to do with the way we commonly understand innovation today. I conclude the chapter with an analysis of the implications of a techno-economic concept of innovation for the RI discourse and provide some initial directions for future research to explore a political concept of innovation.

Chapter 4 engages with the philosophy of technology to investigate the relation between RI and a techno-economic concept of innovation. In this respect, I provide two reflections. First, at an ontic level, I show how RI plays a significant role in steering concrete technological innovations towards societally desirable outcomes as they help confront, for example, loss of biodiversity, and pollution. Second, at an ontological level, I emphasize the central role innovation plays in the current age and depict the specific techno-economic mode in which we think of innovation. This leads me to argue that parallel to Heidegger's view on technology as Enframing, the dominant mode of calculative ordering constrains the RI discourse to a techno-economic concept of innovation, which disables the possibility of other ways in which we can think of innovation. Accordingly, even if RI attempts to exceed the market, the concept of innovation remains technologically and economically oriented, as reflected in the particular innovations that currently dominate the RI discourse which despite their respective differences project a techno-economic mode. I conclude with the call that RI is in need of an ontological reflection that not only exposes the techno-economic paradigm of innovation, which this chapter does, but that also explores an alternative concept of innovation which addresses the public good beyond the current privatization wave. The political origins of innovation, along with the political ends that RI prioritizes, suggest that we should inquire into a political orientation of innovation. A crucial task of this inquiry would be to account for what such a political orientation of innovation precisely entails at the ontic level, and how it relates to the current techno-economic paradigm of innovation at the ontological level.

Chapter 5 articulates an orientation shift from a techno-economic concept of innovation towards a political concept of innovation in the RI discourse. First, I account for *why* this orientation shift is urgent. In this respect, I diagnose the RI discourse with a conceptual

ambiguity, struggling to accommodate both private and public interests. In light of this diagnosis, I distinguish between weak RI, which seeks to govern a techno-economic concept of innovation through an applied set of ethical dimensions; and strong RI, which seeks to conceive a political concept of innovation beyond techno-economic ideology and practice. Second, I account for what this political concept of innovation consists of. To this end, I consult *The Human Condition*, in which Arendt refines the division between the public sphere and the private sphere through articulating the *vita activa*, a tripartite distinction between the activities of labor, work, and action. Building on Arendt's *vita activa* while also moving beyond it, I establish a political concept of innovation that enhances the human capacity to speak up and take action, inspires radical novelty, and empowers the public sphere. Finally, I account for how the discourse on RI can operationalize this political concept of innovation.

Chapter 6 recaps the research objectives and brings together the key findings of each chapter. On the basis of these findings, I will discuss the main contributions of this thesis, account for the limitations it faces, and provide some recommendations for future research to explore. Additionally, I will reflect on a range of broader insights, particularly in relation to (1) the philosophy of innovation; and (2) the ethics of socially disruptive technologies, before closing off with some final remarks.

Notes

1. https://www.philosophie.tu-darmstadt.de/media/spt2017/SPTCallforPapersShort.pdf.

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CHAPTER 2

Challenges for Responsible Innovation

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Chapter 2 Challenges for Responsible Innovation

I. Introduction

In launching the *International Handbook on Responsible Innovation* (RI), René von Schomberg and Jonathan Hankins (2019) bring together renowned authors from around the globe to address the need for a paradigm shift in the innovation discourse, driving innovation away from mainstream economic interests towards societally desirable outcomes. This aspiration departs from the observation that innovations currently delivered by the market insufficiently serve the public good, which thus urges the call for a new – that is, responsible – approach to innovation in fields ranging from agriculture and medicine to nanotechnology and robotics. Although the concept of RI is subject to a variety of perspectives and assessments, proponents generally agree that the innovation process is neither inherently good nor unmanageable. They argue that by engaging governmental bodies, industries and societal actors within the innovation process, it can be regulated in accordance with the values and expectations of society and steered towards normative goals concerning for instance global sustainable development.

The realization of RI comes with several challenges. At an *epistemic* level it faces the complexity of anticipating the unexpected outcomes of innovation, which conflicts with the ideal of steering innovation into a predetermined direction (Grunwald 2019; Nordmann 2014). With regard to this predetermined direction, frameworks of RI have also been questioned at a *political* level for insufficiently addressing the different values and interests of stakeholders involved in the innovation process (Blok 2019; van Oudheusden 2014). Moreover, at a *conceptual* level the discourse of RI is arguably confined to an intrinsic relation between technology and the market, thereby undermining its attempt to liberate innovation from economic ends (von Schomberg and Blok 2019; Blok and Lemmens 2015).

Against this background, this chapter poses the following research question: *To what extent is the attempt of RI to develop a paradigm shift in the innovation discourse feasible?* As a first step, I elaborate on the emergence of RI, particularly in relation to its precursors. I then report on the three aforementioned challenges – the epistemic, political, and conceptual challenge, respectively – and discuss to what extent they bring the feasibility of RI into question. Finally, in light of the conceptual challenge, I suggest that the epistemic and political implications of RI relate to the widely presupposed concept of technological innovation and

commercialized innovation. In this vein, I argue that the ideal of RI is inhibited by the overarching incentive of technological and economic progress and, as such, has difficulties to achieve the paradigm shift in question. This in turn leads me to conclude with a call for future research to explore an alternative concept of innovation which addresses the public good beyond mainstream economic thought.

II. The Emergence of RI

Over the past decade the concept of RI has taken a central place in the discourse on science and emerging technologies. Several research funding bodies, such as the Netherlands Council for Research (NWO), have dedicated entire programs on the subject matter. The UK Engineering and Physical Sciences Research Council (EPSRC) continuously show interest in the field, along with the US National Science Foundation (NSF) which supported the construction of a range of projects, including for instance the Virtual Institute of Responsible Innovation (VIRI) and the Program on Responsible Innovation and Corporate Social Responsibility (SAMANSVAR). Likewise, China has included RI as a formal policy in their latest five-year plan on science, technology and innovation, which resulted in ongoing initiatives such as the introduction of ecological seaports (Wang and Yan 2019). The reality of today's global issues has also urged the European Commission to introduce the concept of Responsible Research & Innovation (RRI), which was presented as a cross-cutting issue under the European Union's Framework Program for research and innovation 'Horizon 2020' (European Commission 2015).

The emergence and increased usage of the term RI implies that innovation is not always that responsible. Particularly the imperative of economic growth inherent in innovation is said to be fundamentally at odds with the imperative of solving today's societal and environmental issues. To be sure, innovation understood as "the development of new ideas into marketable products and processes" (Stoneman 1995, p. 2) – primarily focusing on delivering value to customers (Carlson and Wilmot 2006) – is arguably one of the main sources of today's increasingly unequal distribution of wealth (cf. Rolston III 2012; Naudé and Nagler 2016), and as "the root cause of many environmental problems" it stands "in direct conflict with sustainability" (Huesemann and Huesemann 2011, p. 256). For this reason, the discourse on RI calls for innovation processes to exceed the mere purpose of generating commercial value. Instead, they should primarily focus on generating the right impact, particularly with regard to

today's global issues. In response to the complexity of these issues and to the indeterminacy of the right impact, a frequently cited and particularly influential definition of RI calls for "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 societally desirability of the innovation process and its marketable products" (von Schomberg 2013, p. 63). A commonly used framework of RI builds on this definition by featuring four specific dimensions: anticipation, reflexivity, inclusion and responsiveness. In this view, innovators and organizations are to anticipate the future outcomes of innovation processes, reflect on what responsibilities they have as moral agents, engage with a broad variety of stakeholders, and respond to the values and changing circumstances of society. These dimensions present several governance mechanisms and management practices that claimed to enable more RI (Owen et al. 2012; Stilgoe et al. 2013).

The call to institutionalize ethical and social dimensions of science and technology is not entirely new. Risk identification and analysis, as a separate activity that is executed by unbiased professionals, dates back to late 1960s (Evers and Nowotny 1987). The call for such an activity became particularly urgent in the early 1970s when it became clear that there was no immediate solution for the storage of nuclear waste, which would eventually lead to many efforts on nuclear disarmament (Kevles 1995). Likewise, already at the initial stages of recombinant DNA research many ethical concerns were raised both within and beyond biology circles (Krimsky 1984). In addition to this, many public debates on food crises related to genetically modified organisms and other food products involving nanotechnology resulted in the early adoption of the precautionary principle, which highlights "the importance of informing people and policy makers about what is known and where uncertainty persists" (Commission of the European Communities 2001, p. 19). Later efforts of governing science and technology include technology assessment (Rip et al. 1995), science and technology studies (Hackett et al. 2007), anticipatory governance (Guston 2014), and research on ethical, legal and social implications (ELSI) – or aspects (ELSA) – of emerging technologies.

RI does not emerge as a response to its pre-history, but much rather as an incremental reform that further builds on it (Guston and Valdivia 2015). Specific to this reform is distributing responsibility "*throughout* the innovation enterprise, locating it even at the level of scientific research practices" (Fisher and Rip 2013, p. 165, original emphasis), which differs from previous approaches that focus much more readily on the interference of democratic

institutions, for example technology assessment. Moreover, RI moves "beyond an ethics of constraints (for example, focusing on what should be prohibited or limited) to an ethics of construction" in which professional bodies "look into the type of outcomes we want to achieve from research and innovation processes" (von Schomberg 2019, p. 29). For this reason, the rise of RI can be understood in relation to the precautionary principle, which does not merely point to the negative consequences of innovation, but also accounts for its potential benefits, thereby providing an incentive that paves the way for new research and development trajectories (European Environmental Agency 2002). In this respect, Miles Brundage and David Guston (2019) characterize the rise of RI as part of a scientific/intellectual movement that features "significant contestation of the knowledge core that they are oriented towards, and that much of their activity involves (re)articulating that core" (p. 106). In other words, RI is not an isolated process, but is instead inevitably intertwined with prior debates on similar topics.

Although the intimate relation between RI and its precursors evokes the impression that RI is merely an umbrella term used to denote any activity pertaining to discourse on science and emerging technologies, in some respects it promises to be much more revolutionary and fundamental. For example, RI takes a critical position against the dominance of mainstream economics and calls for a radical transformation of the entire research and innovation system. In practice, however, RI still widely adheres to current techno-economic practices and ideologies (von Schomberg and Blok 2019). The duality at stake points to the ambiguous conceptual stance of RI, to which I will return later in this chapter.

III. The Epistemic Challenges of RI

The notion of RI does not only cover an ethical dimension, as implied by the term 'responsible', but it also includes an *epistemic* dimension. Decisions made throughout innovation processes require values and criteria as well as valid and reliable knowledge of the outcomes and impacts of these decisions. Grunwald (2019) points out that without this knowledge "any ethics of responsibility may well fail, lead to arbitrary conclusions (Hansson 2006) or end up in political rhetoric and appeals without practical impacts" (p. 326). A crucial characteristic of innovation is that its outcomes cannot always be known (Rammert 1997), which thus conflicts with the ideal of RI to *steer* innovation into a responsible and desirable direction. This concern is illustrated in cases such as the development of biofuel, in which the involved stakeholders concluded that since biofuel is inherently renewable, locally produced and less polluting, its

introduction to the market promises responsible and desirable outcomes. However, as a result of the higher demand for biofuels, farmers needed to grow more crops for biofuel production, which in turn led to an increase in the food prices. An increase in the price of food was not initially anticipated and now raises the question if introducing biofuels was in fact responsible and desirable, especially considering that people in developing countries were harmed by this unforeseen outcome (Blok and Lemmens 2015).

The epistemic challenge at stake – also identified by the literature as the challenge of 'epistemic insufficiency' (Blok and Lemmens 2015) – is particularly prominent in the field of new and emerging science and technology (NEST). While the effects of technologies such as synthetic biology are unpredictable, they are said to be deep-ranging and revolutionary (Ilulissat Statement 2007). The result of this radical uncertainty is that the 'responsibility' of RI no longer has reasonable purpose (Bechmann 1993) or at most becomes principally limited:

> 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. (Blok and Lemmens 2015, p. 28).

The unexpected outcomes of innovation thus bring into question the extent to which innovation can be steered, let alone into a responsible and desirable direction. This in turn hinders the attempt of RI to develop a paradigm shift in the innovation discourse, which for a great part consists precisely in the call for steering innovation.

The discourse of RI acknowledges the above problematic but specifies that while "an ethics focused on the intentions and/or consequences of actions of individuals is not appropriate for innovation," an ethics of "collective co-responsibility" is (von Schomberg 2013, p. 59). Here R. von Schomberg stresses that since modern innovations are not intentionally created by a single actor, the unforeseen effects are more likely the result of collective action. In a recent article, R. von Schomberg (2020) provides further substance to this view by articulating the ethics of responsibility that underlies the notion of RI. Departing from Karl-Otto Apels'

diagnosis of the shortcomings of philosophical ethics, particularly those concerning individual accountability, he demonstrates how these shortcomings currently prevail in the context of an ecological crisis and socio-technical change. To this end, he suggests that under the sway of RI a further social evolution of the systems of science, economy and law will enable the institutionalization of collective co-responsibility. Accordingly, responsibility should not be assigned to the individual, but instead shared by all stakeholders involved in the innovation process. This goes in line with the philosophical argument that plurality rather than singularity provides "the remedy for unpredictability, for the chaotic uncertainty of the future" (Arendt 1998, p. 213). This idea is implicit throughout the literature on RI as reflected in arguments such as the following:

> 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)

In other words, in the face of uncertainty, an inclusive approach to innovation can still ensure the uptake of societal values and concerns.

In a similar vein, Nordmann (2010) warns us that responsibility debates concerning new and emerging technologies should focus on wishful futures rather than on speculative anticipations. This enables more visionary and critical ideas for improving the future. Likewise, Grunwald (2019) argues that RI must accept the thesis that anticipation is impossible on any sound epistemic ground and should therefore move beyond consequentialist modes of orientation. In this respect, RI can gain further insight from earlier proposals, such as vision assessment (Ferrari et al. 2012), explorative philosophy (Grunwald 2010) and the various hermeneutic responses given to the unpredictable nature of emerging technologies (e.g. van der Burg 2014).

IV. The Political Challenge of RI

The uncertainty of the future results in many disagreements among stakeholders as to what the problem is and how to solve it (Kreuter et al. 2004; Batie 2008; Rittel and Webber 1973). These conflicts are often the result of opposing agendas and motives of, for example, for-profit and non-profit corporations (Yaziji and Doh 2009). In the procedure of RI, initiatives such as RRI Tools attempt to account for the different viewpoints by organizing debates with all types of stakeholders, ranging from civil society organizations to business and industry. However, power imbalances among these stakeholders – the funders of an innovation process tend to have the upper hand – often contribute to more disparities. Hence, a collective solution is difficult to reach (Bryson et al. 2006). In this respect, the epistemic challenge of RI brings us to a range of *political* questions: Who defines the grand challenges? On the basis of which values and criteria should these challenges be confronted? What are the outcomes RI aims for?

There are at least three reasons for why stakeholder engagement plays a crucial role in the implementation of RI. First, in relation to the epistemic challenge, the conflicting interests and value frames of the involved stakeholders allow for a better assessment of the future impact of innovation processes like biotechnology and nanotechnology (Chilvers 2008). Second, it enables stakeholders to learn from each other according to which shared objectives and decisions are easier reached (Gould 2012). Third, it helps them to better understand each other's roles and interests, thereby setting one step closer to collectively determine the direction of innovation processes (Jackson et al. 2005). Consequentially, stakeholders share knowledge and values (von Schomberg 2013), attempt to reach common objectives (Flipse 2012) and thus take co-responsibility for the outcomes of innovation processes (Owen et al. 2012). However, stakeholder engagement conceptualized in light of this ideal of unity fails to embrace systemic and political issues; it lacks a second-order reflexivity that broadens normative standpoints and policies (Owen and Pansera 2019). Precisely for this reason Michiel van Oudheusden (2014) criticizes the discourse of RI because it largely ignores questions about the constitution and contestation of power:

> How do actors "co-create" outcomes? How do they deliberate? On whose terms is participation (i.e. deliberation) established and why? What, in fact, is "public" about the "public interest," "public expectations," and "the public," and whose definition of the public counts? (van Oudheusden 2014, p. 73)

Noticeably, in a recent series of workshops on the challenges of RI,[1] scholars showed similar concern with regard to the presupposed harmony and transparency among stakeholders. They pointed to a certain naivety, raising questions as to how to deal with the different values and interests of stakeholders. They pointed to problems of inclusion as well as to power imbalances that undermine shared viewpoints and mutual responsiveness and understanding. Likewise, Richard Owen and Mario Pansera (2019) demonstrate that stakeholder engagement is "usually narrowly configured to include a limited range of (internal and sometimes external) stakeholders, and that second-order reflexivity and the political are almost entirely beyond scope, or at least deeply tacit" (p. 41). Also from a business perspective the presupposed harmony and transparency can be seen as naive because it is undermined by the competitive advantage a new innovation needs in order to succeed on the market (Blok and Lemmens 2015). To achieve this competitive advantage, companies rely on information asymmetries, that is, additional knowledge they have about business opportunities that other companies are oblivious of. In the context of RI, companies pursue such information with regard to discovering new solutions for existing and anticipated grand challenges. However, transparency among the involved stakeholders naturally implies a reduction of these information asymmetries, thereby taking away the main source of competitive advantage. For reasons as these, the ideal of achieving harmonious and transparent collaboration among all stakeholders may be perceived as rather unrealistic.

Contrary to traditional conceptualizations, Vincent Blok (2019) proposes a non-reductive and ethical approach to stakeholder engagement which "does not presuppose a direct or indirect ideal of harmony and alignment […] but acknowledges and appreciates the role of difference and constructive conflict without allowing only bridgeable or complementary difference among multiple stakeholders" (Blok 2019, p. 255). Instead of a priori conceptualizing stakeholder engagement in light of a unity among stakeholders, Blok suggests departing from their radical differences. Contrary to the argument that today's global issues demand a dialogue in which multiple stakeholders should depart from a common goal (Gorman et al. 2009), he explains that for stakeholders to engage in a dialogue they first of all need to have their own definition of and solution to the problem, according to their own interest and value frames (van Huijstee et al. 2007). Inspired by the philosophy of Emmanuel Levinas, he further argues that stakeholder engagement serves as a platform for stakeholders to combat each other's viewpoints and values in the ultimate attempt to deconstruct them. This point can

be illustrated by the engagement between Shell and two human rights organizations, Amnesty International (AI) and Pax Christi International (PCI) (Lawrence 2002). The deliberation did not depart from a common ground, where the company's concern for their reputation met the request of the organizations for cooperative support for human rights. Instead, AI and PCI essentially deconstructed the business operations and core values of Shell.

The political challenge of RI, and the significance of the above debate, is best captured in the following question:

> Are innovation, and responsible innovation, always destined to be bedfellows of a market-based Schumpeterian model of competitive, creative destruction, or can they – and should they – allow space for other alternatives of innovation and responsibility based on other political beliefs, ways of organizing, ways of distributing power, ways of relating to each other and ways of being; a quality deliberation that favors the confrontation of various arguments and conceptions of the good? (Owen and Pansera, p. 41)

This question reflects a political challenge, but it also demands the discourse of RI to take a clear conceptual stance. For this we turn to the next section.

V. The Conceptual Challenge of RI

In 'Pathways to Transformation', a recent conference of RI organized by two EU-funded projects NUCLEUS and RRI-Practice, the concept of RI was continuously addressed by the general public – and more remarkedly by many of the invited speakers – as "vague and unclear." Numerous times the *conceptual* question was raised: what *is* RI? The discussions that followed generally revolved around how to employ 'the responsibility dimension' of RI. In this respect, Phil Macnaghten, professor of Technology and International Development at Wageningen University, provided a thorough overview of different understandings and implementations of RI, hinting at tensions between RI working within the current political landscape and RI working towards transforming this political landscape, between applying RI locally and applying responsible innovation globally, and between RI as incremental change and RI as disruptive change. To a certain extent these tensions reflect the mainstream challenge of RI, in which the discourse has to decide whether to continue business as usual or to take a

radical stance against it. While the concept of RI has revolutionary potential, it also contains conservative force. Which way is it heading towards?

Noticeably, throughout visions, frameworks and policies of RI much focus is dedicated to the governance of innovation processes, while little thought goes to what innovation itself means conceptually (von Schomberg and Blok 2018). This remains the case even after the release of the latest handbook, as noted in a review by Robert Frodeman (2019). Therefore, RI still requires to critically consider the concept of innovation as an object of reflection. What is meant by innovation? When innovation is said to be the chief mission of universities and of the European Union, what presupposed understanding of innovation underpins this mission? What implications does this presupposed understanding of innovation have for the realization of RI?

To this end, I argue that while the revolutionary potential of RI is illustrated in the call for innovation to generate a good impact rather than mere commercial value, the conservative power lies in the way the discourse uncritically presupposes the concept of innovation as technological innovation and commercial innovation. This is particularly reflected in the exclusive focus on economically beneficial technologies, such as synthetic biology, nanotechnology, and information and communications technology (ICT). Conversely, other forms of innovation like social innovation (e.g. fair trade) and attitudinal or behavioral innovation (e.g. lifestyle interventions) receive minimal attention. It is also worth considering that the broader policy context within which EU projects on RI operate is characterized by the overarching goal to become a genuine innovation union that turns "great ideas into products and services that will bring growth to our economy and create jobs" (European Commission 2014, p. 3). Analysis thus shows that while the dimensions of RI are broad and varied, innovation processes coupled with these dimensions are subject to a technological and commercial context. The question is whether this context is at all compatible with the dimensions that the discourse of responsible innovation so eagerly endorses.

> To what extent is it possible to operationalize the dimensions of responsible innovation within a context where innovation is understood in light of an intrinsic relation between technology and the market? For instance, reflecting upon the ethical significance of technologies could be jeopardized by the self-interested pursuit of economic welfare. Similarly, inclusion and deliberation may proceed

> strategically in function of maximizing one's own profit, while responsiveness may easily amount to window dressing (von Schomberg and Blok 2019) [*chapter 4*].

In this respect, the epistemic implications and political implications of RI could be understood in relation to the presupposed concept of technological innovation and commercialized innovation. That is to say, the lack of foresight and transparency in innovation processes is specifically the case when these processes are limited to a mainstream economic understanding of what it means to innovate,[2] So long as this understanding is left uncriticized, RI will struggle to realize its ideal.

In other words, it seems problematic for RI to achieve a paradigm shift when it is merely applied to the existing concept of innovation. What is needed is a radical transformation of the concept of innovation itself. To this end, I urge future research on RI to explore an alternative concept of innovation which addresses the public good beyond the current privatization wave. The political origins of the concept of innovation (cf. Godin 2015), along with the political ends that the RI literature explicitly prioritizes, suggests that we should inquire into a political orientation of innovation. It is in this direction that Blok (2021) develops a political dimension of innovation in which the direction of the innovation process is essentially determined by a political agenda. In this view, the innovation process is no longer set by commercial ends, but rather by, for example, the Paris Agreement on mitigating global warming and the UN Sustainable Development Goals. This enables a more encompassing understanding of innovation that could also, for instance, draw attention to social innovations that are currently overshadowed by their commercial alternative. Instead of, for example, limiting the discussion of the overconsumption of meat to the possible benefits and implications of in vitro meat, this broader concept of innovation may also include considering innovative ways of simply empowering non-meat protein sources and may further enlarge the scope to apply, for instance, user-based innovations, and open source and peer-to-peer (p2p) innovation strategies. Hence, by employing a political understanding of innovation, societal and environmental issues would no longer have to solely depend on technological and commercial solutions, thereby enabling RI to primarily respond to its political ideals.

VI. Conclusion

In this chapter I departed from the observation that the emergence of RI explicitly calls for a paradigm shift in the innovation discourse, away from private interests and towards the prioritization of public interests. We learned that, to a certain extent, this objective is the result of a longer history of efforts and movements whereby the development of emerging technologies was initially left without the interference of democratic institutions, but then increasingly became a topic of wider concern. However, unlike its more nuanced precursors, the paradigm shift at stake in RI promises to overthrow mainstream economic thought, along with a radical transformation of the current research and innovation system.

I outlined three main challenges which bring the feasibility of RI into question. First, the epistemic challenge suggests that innovation as defined by its unpredictable nature simply cannot guarantee desirable and responsible outcomes, even if dimensions of responsibility are incorporated into the preceding process. Second, the political challenge reflects the difficulty of responding to the conflicting values and interests of different stakeholders, facing particular issues with recurring power imbalances. Third, the conceptual challenge demonstrates that the societal purpose of RI fundamentally conflicts with the imperative of maximizing economic growth inherent in the widely presupposed concept of technological innovation and commercialized innovation. The latter challenge ties all three together and essentially encourages us to rethink what it means to innovate. To what extent does innovation necessarily relate to the market? Is it possible to develop an alternative concept of innovation that is separated from economic ends? How can we intellectualize and implement, for example, a political understanding of innovation? In light of these closing questions, I conclude with the call for RI to explore an alternative, perhaps more political, route of innovation.

Notes

1. For a summary report of the workshops see: https://renevonschomberg.wordpress.com/challenges-for-responsible-innovation/.
2. For a more detailed account of the relation between the limitations of RI and the presupposed techno-economic concept of innovation see von Schomberg and Blok (2019) [*chapter 4*]. The central point in this chapter is to illustrate the ambiguous position of RI, where its ideal to exceed the market in order to serve society conflicts with today's general adherence to a techno-economic view on innovation.

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CHAPTER 3

The Turbulent Age of Innovation

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Chapter 3 The Turbulent Age of Innovation

I. Introduction

Even though the concept of innovation has traveled through a rich history of different meanings, today it is uncritically understood as 'technological innovation' and 'commercialized innovation'[1] (Godin 2008). That is to say, it has become remarkably common to associate innovation with the field of commercialized technologies. At the same time, the global issues of our age, such as climate change or epidemics related to lifestyle diseases, urge innovation to go beyond its usual intent of generating commercial value. In this respect, ongoing research under the heading Responsible Innovation (RI) calls for a political discourse of innovation in which innovation processes should primarily be concerned with generating the right impact, particularly with regard to the grand challenges of our time (von Schomberg 2013). Although the concept of innovation is thus widely understood in terms of commercialized technologies, recent frameworks of RI have attempted to shift the focus toward formulating what a political discourse of innovation precisely entails and how it can be achieved in practice (cf. Owen et al. 2013).

However, little thought goes into what innovation itself means conceptually (Blok and Lemmens 2015). According to the Cambridge Dictionary, to innovate means "to introduce changes and new ideas." Innovation is, therefore, a very broad concept. Changes and new ideas can be introduced at the level of science and technology, but also in other domains, such as management and education. The RI literature suggests that innovation has a particular societal role, but this does not mean that innovation itself is understood as societal. While both policy makers and researchers focus on enabling *outcomes* of innovation processes to become more responsible and desirable, the technological and commercial nature of these processes is rarely questioned. Can technological innovation ever lead to more responsible types of innovation? Does the imperative of economic growth inherent in the concept of innovation as it is currently understood stand at odds with a political discourse of innovation? To what extent does RI, in order to attain its societal purpose, need to question the way innovation is widely implemented today?

One of the commonly used frameworks of RI features four important dimensions: anticipation, reflexivity, inclusion and deliberation, and responsiveness (Owen et al. 2013; Stilgoe et al. 2013). In this view, innovators and institutions should anticipate the possible

outcomes of innovation processes, reflect on their wider moral responsibilities, expand their engagement with particular stakeholders to members of the larger public, and they should do all of this in response to the values of society and its changing circumstances. The question is whether it is feasible to operationalize these dimensions in practice where the concept of innovation is largely understood in light of an intrinsic relation between technology and the market. This dominant view of innovation could restrict, for example, the dimension of reflexivity and allow the self-interested pursuit of economic gain to dominate. Similarly, inclusion and deliberation may be used to maximize profit, while responsiveness may simply amount to window dressing.

In order to open up the concept of innovation for further philosophical reflection within the emerging context of RI, the present paper poses the following research question: *What concept of innovation is implicitly taken up by the RI discourse and what implications does this concept have for the societal purpose of RI?* In Section II we analyze the extent to which the concept of innovation in the RI literature is uncritically presupposed to be technological. In Section III we examine the diverse meanings innovation has had over time and argue that while innovation originally had a political connotation it is only recently restricted to the meaning of technological innovation (Godin 2015). In Section IV we go on to show that even though the concept of techno- logical innovation can contribute to the societal purpose of RI, this requires certain conditions that are difficult to guarantee. Finally, we argue that future research should explore alternative understandings of innovation that better enable the overall feasibility of the emerging frameworks of RI.

II. The Concept of Innovation in RI

Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society is a central book in the RI literature (Owen et al. 2013). Its core theme is the ways in which the dimensions of RI can be conceptualized and operationalized. These dimensions are very broad and vary throughout the book. In addition to the four dimensions described earlier, the book highlights, for example, the importance of democratically governing the purposes of innovation (Owen et al. 2013) and provides a theory about how by reflecting values of the EU the innovation processes will ensure that outcomes become ethically acceptable, sustainable, and societally desirable (von Schomberg 2013). Yet, while the book continually discusses how to achieve *responsible* innovation, the question of what innovation means is rarely raised. In

the opening chapter, questions specifically revolve around *where* and *how* to innovate (Bessant 2013), thus overlooking the very question of *what* it means to innovate. To what concept of innovation are the four dimensions applied? What type of innovation processes is being democratized? These questions call for an investigation into what concept of innovation is presupposed to be self-evident by the RI discourse. This is an important step as it enables us to ask whether *this* concept of innovation is at all compatible with the dimensions that the RI discourse so eagerly endorses.

The opening chapter, entitled 'Innovation in the Twenty-First Century,' is written by John Bessant. He is a professor of innovation and entrepreneurship at Exeter University and is considered to be a top researcher in the field. In this chapter, he elaborates on the context in which the discussion of RI has to take place, namely the changing environment and challenges of the twenty-first century. Even though he does not explicitly account for the concept of innovation as such, he does provide an interesting distinction between incremental innovation and radical innovation. In his words:

> Innovation is about change and this can take place among a spectrum of increasing novelty. From simple incremental improvements – "doing what we do, but better" – through to radical, new to the world changes. (Bessant 2013, p. 1)

Noticeably, incremental innovation, 'doing what we do, but better,' and radical innovation, 'doing something new,' are both understood in terms of technological advancement. At the level of incremental innovation, Bessant specifically refers to improved technologies, that is, technologies that already exist but that have been made to supposedly work more efficiently: Windows 10 replacing Windows 8, for example. At the level of radical innovation, Bessant speaks of innovations that are completely new to the world technologies, such as the first speech recognition program. In both instances, innovation is therefore conceptualized as technological innovation.

This conception stretches further into later chapters of *Responsible Innovation*. This is certainly the case in 'A Vision of Responsible Research and Innovation' (2013), written by Rene von Schomberg, who is with the European Commission and introduced the concept of RI at the level of the EU, thereby playing a dominant role in the RI discourse. Here he characterizes innovation within a distinction that presupposes from the start that innovation is

necessarily technological. On the one hand, he accounts for mere technical inventions, which specifically refer to the development of a new technology, such as Bartolomeu's "machine for sailing through the air" (p. 52). On the other hand, R. von Schomberg accounts for modern innovations. Also in this respect the use of the term 'technology' continues to prevail. In fact, throughout the text, R. von Schomberg alternates between the words 'innovation' and 'technological innovation' as if they are self-evidently the same. For example, when speaking of the impact of innovations, he argues that "technological innovations are unpredictable" (p. 55). This association between innovation and emerging technologies is further illustrated by the particular innovations that R. von Schomberg takes into account, such as video-gaming technology, genetically modified organisms (GMOs), the electronic patient record system (EPRS), body-scanning technology, and nanotechnology. His view on innovation is also reflected in official documents of the European Commission, in which emerging technologies are considered to be the main innovations that shape our future (cf. Matter 2011).

Technological innovation prevails throughout any framework of RI. In fact, the four dimensions—anticipation, reflexivity, inclusion and deliberation, and responsiveness—originate from public debates that explicitly concern new areas of technology (Owen et al. 2013; cf. Stilgoe et al. 2013). In other words, this framework is grounded in the presupposition that enhancing responsible innovation is ultimately a matter of creating responsible technologies. Similarly, Grinbaum and Groves (2013) argue that while innovation involves a "process of bringing something new into the world" (p. 119), in order to understand the meaning of responsible innovation we have to reflect "on the ethical significance of technological innovation" (p. 119).

Another crucial characteristic of the presupposed concept of innovation in the RI discourse is its inherent economic structure. Although Bartolomeu's machine is referred to as a 'mere' technological invention, it is also stated that "modern innovations are distributed through market mechanisms" (von Schomberg 2013, p. 54). In other words, modern innovations are not simply conceptualized in terms of emerging technologies, but more specifically in terms of technological *products* that are essentially shaped by the successes they make on the market. This is confirmed by Bessant, who argues that radical innovation is managed by entrepreneurs and smart firms who set up "the competitive dynamics which *characterize* innovation" (Bessant 2013, p. 5, own emphasis). The terms 'innovation,'

'technological innovation,' and 'technological *products*' are used interchangeably throughout the RI literature; again, as if they are self-evidently the same.

Technological innovation, understood to mean commercialized technologies, also plays a central role in EU-funded RI governance projects, such as 'Promoting Global Responsible research and Social and Scientific innovation' (ProGReSS). The project aims to establish a global network for RI involving academia, SMEs, international organizations, policy advisors, research funders, NGOs, and industry. Therefore, ProGReSS initially seems to go beyond the scope of commercialized technologies. In an attempt to ensure this, the project categorizes RI into three building blocks: innovation should be (1) ethically acceptable, (2) sustainable, and (3) societally desirable. See Table 1 for an overview of how ProGRess has interpreted these building blocks.

Table 1 Extracted from ProGReSS (2015, p. 4)

RI Principle	Definition	Identifiable Through
Ethical acceptability	Research and innovation which respects fundamental values during its conduct and through its outputs	Code of conduct, ethics guidelines and sustained public engagement efforts
Sustainability	Research and innovation which meets the needs of the present without compromising the ability of future generations to meet their own needs	Environmental protection and health and safety
Societal desirability	Innovation which may benefit all without discrimination	For instance, tackling grand challenges

Beyond ethical acceptability and sustainability, ProGReSS focuses on what the project believes is the underexplored and least converging part of RI, namely achieving societal desirability. The project aims to advocate a European normative model for RI globally, using constitutional values as a driver to inform societal desirability. Accordingly, ProGReSS has delivered reports in which it describes and analyses how research funding can drive innovation toward positive outcomes, especially with regard to societal desirability. Through comparing innovation policies in Europe, the US, China, Japan, India, Australia, and South Africa, the project shows how, on the one hand, societal desirability differs from country to country. On the other hand, it stresses that we are ultimately globally linked through the societal desirability of tackling certain grand challenges, such as climate change. While ProGReSS thus admits that

the definition of societal desirability is contested, defining it in terms of tackling the grand challenges "allows a comparison and a glimpse of how [RI] could become a global framework where the attempt to guide innovation toward resolving humanity's challenges functions as a common denominator" (ProGReSS 2014a, p. 5).

However, when it comes to understanding the concept of innovation itself, no such comparative scheme with a common denominator is suggested. Instead, ProGReSS unquestioningly reports on case studies that focus on the societal desirability of technologies that are particularly economically beneficial (ProGReSS 2014b). These specifically involve synthetic biology, nanotechnology, and information and communications technology (ICT). With regard to ethical acceptability and sustainability, ProGReSS reports on these exact same technologies.

Res-AGorA is another EU-funded project that has the objective of developing a comprehensive governance framework for RI (Lindner et al. 2016). Instead of providing top-down normative anchor points, which tend to contradict each other, Res-AGorA attempts to provide a framework in which responsibilities are reached through shared and agreed understandings. In order to reach shared responsibilities, during the project's three-year life cycle, Res-AGorA, practitioners, and strategic decision makers co-constructed an orientating governance framework called the "Responsibility Navigator" (Kuhlmann et al. 2015). Through ten identified principles and requirements—see Table 2—the Responsibility Navigator should support decision makers to govern research and innovation activities in a more responsible way. Unlike virtue-based frameworks of RI, the framework of Res-AGorA acknowledges the contested definition of responsibility and the role it has within the different contexts of Europe. The project advocates for a constant renegotiation of and deliberation about what the definition of responsible should be.

While Res-AGorA is strategically different from ProGReSS, its overall focus is also on the 'what is responsibility?' aspect of RI. Conversely, the research and innovation aspect is hardly explored. Instead, the ethics that are formulated specifically apply to economically beneficial technologies. The Responsibility Navigator is supposed to guide innovation processes through the application of ten principles, but most of these principles are exemplified and applied within the context of market-based technology (see Table 2).

Table 2 Ten guiding principles of Res-AGorA

Responsibility Navigator	Example
1. Inclusion	Promoting inclusion to ensure "synthetic biology and its contribution to a range of societal objectives across health, well-being, environment, sustainability, and economic growth" (Kuhlmann et al. 2015, p. 17)
2. Moderation	Balancing research funding of the Science and Technology Advisory Council (STAC) so that the grand challenges can be tackled.
3. Deliberation	Organizing workshops to test technological controversies (energy, climate change, and shale gas fracking; and the genetic modification of food) in different contexts.
4. Modularity and flexibility	Opening "a large semi-public lab in the field of nanotoxicology … committed to the highest ethical standards and the accommodation of societal concerns and needs, with recruitment procedures and training aimed at establishing and promoting a diverse workforce" (Kuhlmann et al. 2015, p. 23).
5. Subsidiary	Introducing a global governance body and initiating a conversation about how to standardize and upscale RI by upholding "participative governance, orientation to societal challenges, and futures-oriented anticipation of technological development and the global political economy" (Kuhlmann et al. 2015, p. 25).
6. Adaptability	Institutionalizing ethical business practice in highly contested technological areas.
7. Capabilities	Building the capabilities and awareness of researchers, starting with the young generation of researchers and their employing organizations. Nothing is said about what sort of researchers or what type of employing organizations this refers to.
8. Capacities	A large civic society organization (CSO) should be established to encourage a more fundamental role for civil society in constructing R&I pathways, with earlier participation in technology assessment dialogues, and involving values-centered small and medium-sized businesses and social enterprises.
9. Institutional Entrepreneurship	A newly appointed president of an American university transformed the organization of the university to drive its students in a 'responsible' direction (e.g., sustainability). Res-AGorA uses this example to illustrate that principles 7 and 8 cannot be self-organized and require leadership.
10. Culture of transparency, tolerance and rule of law	Emphasis on how governance mechanisms are required to reflect a commitment to democratic principles and to allow actions to be taken according to the rule of law.

The above analysis shows that the RI literature does not yet consider the concept of innovation to be an object of reflection. Instead, innovation is uncritically presupposed to be technological. This is reflected in the vocabulary used to denote innovation and in the particular

innovations to which the dimensions of RI are applied. Upon closer examination, it becomes clear that within the context of RI, technological innovation has two main characteristics. First, as the term itself implies, technological innovation refers to the creation of new technologies. Second, it is specifically concerned with technologies that contribute to the market and can for this reason also be understood as commercialized innovation. It is important to note, therefore, that while the dimensions of RI are broad and varied, innovation processes coupled with these dimensions are essentially limited to a technological and commercial context (Table 3).[2]

Table 3 An overview of the concept of innovation in RI

RI Publications/projects	Responsible	Innovation
von Schomberg (2013)	Ethical acceptability, sustainability, and societal desirability (anchored in EU values).	Definition: ?? Examples: video-gaming technology, GMO, EPRS, body-scanner, nanotechnology.
Owen et al. (2013)	Anticipation, reflexivity, inclusion and deliberation, and responsiveness.	Definition: ?? Examples: case study on geo-engineering (cf. Stilgoe et al. 2013).
ProGReSS	Societal desirability.	Definition: ?? Examples: synthetic biology, nanotechnology, ICT.
Res-AGorA	Ten guiding principles (Table 2).	Definition: ?? Examples: synthetic biology, nanotoxicology

III. The History of Innovation

Beyond the RI literature, the concept of innovation also receives little attention. Serious investigations into what innovation means conceptually are scarce, although there are a few (cf. Godin 2008, 2015, 2016; Bontems 2014; Blok and Lemmens 2015). Almost any study related to innovation quite naturally departs from a technological and commercial understanding of the concept. Especially the commercial understanding of innovation becomes more and more dominant. Today innovation is uncritically seen as "the development of new ideas into marketable products and processes" (Stoneman 1995, p. 2); its essence lies in delivering value to customers (Carlson and Wilmot 2006). Perhaps the commercial character of the way innovation is widely understood is best captured by the words of American

industrialist J. Paul Getty: “True innovation is coming up with a product that the customer didn’t even know they needed.”[3]

Innovation has not always been conceptualized in the current technological and commercial way. In fact, as Benoît Godin[4] reminds us, innovation initially emerges in Ancient Greece with a political connotation and is fundamentally understood as “introducing change into the established order” (Godin 2015, p. 5). Consider, for example, the following citation from Plato’s *Republic*, in which Socrates despises the role of innovation in gymnastics and music:

> Now, to state it briefly, the overseers of the city must cleave to this, not letting it be corrupted unawares, but guarding it against all comers: there must be no innovation in gymnastic and music contrary to the established order; but they will guard against it as much as they can, fearing that when someone says “Human beings esteem most that song. Which floats newest from the singer” someone might perchance suppose the poet means not new songs, but a new way of song, and praises that. Such a saying shouldn’t be praised nor should this one be taken in that sense. For they must beware of change to a strange form of music, taking it to be a danger to the whole. For never are the ways of music moved without the greatest political laws being moved, as Damon says, and I am persuaded. (Plato 1991, 424b–424c)

It is important to note here that innovation does not refer to the simple introduction of new music but to the introduction of a new *way* of making music. For Socrates, a new way of making music may lead to new laws and ultimately change the political order. By playing this dangerous, subversive, and revolutionary role, Socrates thus shares a political understanding of what innovation means. Aristotle carries a similar understanding of innovation as he places the concept within the context of changes brought to political constitutions (Aristotle 1984). Aristotle further emphasizes the subversive role of innovation when he accuses Plato of innovating the supersensible world (Evangeliou 2006), an innovation that would radically change the course of Western philosophy.

The political connotation of innovation continues to dominate in the period from the Reformation to the nineteenth century (Bontems 2014; Godin 2015). Throughout this era the

concept is mostly used to denote radical changes that ruin, trouble, and dissatisfy the state (cf. Burton 1976). In this respect, the Catholics of the time see the Reformation as a dangerous innovation (Godin 2016). Hence, similar to how innovation was understood in times dating back to Ancient Greece, during this later period innovation is fundamentally understood as a political concept used to denote whatever threatens the established order.

Although historically the concept of innovation has been understood as subversive and revolutionary, it is to a lesser extent also referred to in a more positive sense. As opposed to Plato and Aristotle, Xenophon, for example, says that innovation increases revenues for the city of Athens (Xenophon 2013). Likewise for the Romans, and later on for Renaissance thinkers such as Machiavelli (1961) and Bacon (1625), innovating ultimately means contributing to the stability of society rather than to its destruction (Bontems 2014). Nevertheless, up until the nineteenth century, it is the subversive and revolutionary understanding of innovation that dominates over any other of its connotations (Godin 2015).

As Godin's historical analysis reveals, it is only after the beginning of the nineteenth century that the concept really starts to have a positive connotation. This is mainly because innovation now gradually enters a context in which progress and utility are widely praised. In response to this new context, innovation becomes an honorable concept (Godin 2015). Whereas in the preceding centuries the term innovation had mostly appeared in religious and political pamphlets, it now increasingly appears in books, scientific journals, and magazines aimed at the general reader. In this literature the subversive aspect of the concept has disappeared, and the concept is instead used to denote the achievements of and developments made in mechanics, mathematics, geography, astronomy, and basically all the useful arts and science (cf. Pigott 1792; Robinson 1782). Noticeably, throughout this period the concept of innovation does not yet designate any intrinsic relation between technology and the market, as is implicit in the way we commonly understand innovation today. It is used to characterize new technologies such as mining (Blavier 1806) and printing (Comte 1877), but is by no means restricted to them, let alone to their commercial value.

The field of commercialized technologies only enters the daily discourse of innovation insofar as the domain of mainstream economics becomes more prominent. Especially after political economists such as Joseph Schumpeter introduced the term 'technological innovation,' the concept of innovation generally becomes defined in terms of technological goods and products (Godin 2015). Over the last 60 years, main- stream economics has become

so dominant that it has largely taken over the entire discourse of innovation. The concept is now claimed to first and foremost pertain to the business world and is even said to originate in a tradition of economic analysis (Staudenmaier 1985; Cajaiba-Santana 2013).

Arguably, the history of innovation teaches us that the meaning of innovation shifts according to the dominating worldview of the context in which it emerges. In times when the ideal of maintaining stability is most prominent, innovation is considered a threat to society and thus widely labeled as a pejorative concept. As the ideal of maintaining stability is replaced by the ideal of achieving progress, both within and beyond technology, innovation gradually starts to have a positive connotation. After the industrial revolution, and with the rise of mainstream economics, the commercial value of new technologies becomes more acknowledged than ever before. This ultimately leads to the current dominance of technological innovation, a concept that presupposes an intrinsic relation between technology and the market; overshadowing the original political character it once had (Table 4).

Table 4 An overview of the concept of innovation throughout history

Historical period	Worldview	The concept of innovation
± 450 BC – AD 300	The ideal of maintaining stability.	Understood in terms of cultural and political change brought to the established order.
± AD 300 – AD 1800	The ideal of maintaining stability.	Understood in terms of revolutionizing the established order.
± AD 1800 – AD 1950	The ideal of achieving progress in all types of spheres of society.	Understood in terms of the successes made in various fields (e.g. mechanics, mathematics, geography, astronomy, science).
± 1950 – Today	The ideal of achieving technological and economic progress.	Understood in terms of technological innovation.

IV. RI and the Call for an Alternative Concept of Innovation

Taking the findings of Sects. 2 and 3 into account, it is clear that with the emergence of RI, innovation has entered a turbulent age. On the one hand, by presupposing innovation to be technological, RI can simply be seen as the product of a history in which the ideals of technological and commercial progress have continued to be prioritized. On the other hand, the RI literature repeatedly stresses the political context of today: innovation needs to go beyond

its usual intent of generating commercial value and should instead be concerned with generating the right impact, particularly with regard to the grand challenges of our time, for which we all share responsibility (von Schomberg 2013). Given the indeterminacy of the right impact and the complexity of these grand challenges, it becomes all the more urgent to develop a political discourse of innovation in which the ethical acceptability, sustainability, and societal desirability of innovation processes are ensured in an inclusive and democratic way (Owen et al. 2012; European Commission 2015). In this respect RI promises to be revolutionary. Therefore, to a certain extent, RI reawakens the political origins of innovation; this in striking contrast to what its presupposed concept of innovation suggests.

The question is whether the call for a political discourse of innovation is undermined by the ideals of technological and economic progress inherent in the way innovation is currently at play in the RI literature. To what extent does RI, in order to attain its societal purpose, need to question these ideals and thereby rethink the current – technological – concept of innovation? In what ways could an alternative concept of innovation be more successful in confronting today's grand challenges? In light of these questions, the purpose of this final section is twofold. First, we account for how the presupposed concept of technological innovation affects the feasibility of RI. In this respect, we offer an analysis of the way in which this concept of innovation can be both beneficial and detrimental with regard to the societal purpose of RI. Second, on the basis of this analysis, we philosophically reflect on the ways in which an alternative understanding of innovation could be more fruitful.

On the one hand, the imperative of economic growth inherent in technological innovation is said to be fundamentally at odds with the imperative of solving today's societal and environmental issues. Arguably, this focus on economic growth is the main source of today's increasingly unequal distribution of wealth (cf. Rolston III 2012; Naudé and Nagler 2016), and as "the root cause of many environmental problems" it stands "in direct conflict with sustainability" (Huesemann and Huesemann 2011, p. 256). The latter is confirmed when examining the relatively recent increases in pollution, waste disposal, water shortage, global warming, deforestation, natural resource depletion, loss of biodiversity, and public health issues, increases that can be considered to be the results of technological and economic progress attained through innovation (Huesemann and Huesemann 2011; Purdy 2015).

On the other hand, technological innovation is said to be perfectly compatible with the ideal of solving today's societal and environmental issues. Many technocrats claim that

technological innovation will simply overcome these issues, as it has in the past. This is shown in the history of Venice. Ever since its founding, "[s]aving Venice has meant creating Venice, not once, but many times" (Shellenberger and Norhaus 2011, p. 9). Each recreation of the city would come with "a series of pretentious, costly, and environmentally harmful technological gambles" (Shellenberger and Norhaus 2011, p. 9), which would then be solved by once more recreating the city, and so technological innovation "helped transform a town of humble fisherfolk into the city we know today" (Shellenberger and Norhaus 2011, p. 9). The optimism illustrated here indicates that it is counterproductive to question the concept of technological innovation in frameworks such as RI, because it enables the desirable future that these frameworks ultimately call for.

The ongoing faith in technological innovation is further justified when considering the role it can play in restoring the ecological system of planet earth. In the face of an accelerating pace of environmental destruction, technological innovation can, for instance, aid in the conservation of nature by providing new ways for forests, wet- lands, and diverse species to exist amid a wide range of modern, human landscapes (Kareiva et al. 2011). Similarly, the introduction of green nanotechnology has been shown to enhance environmental sustainability in at least two respects. First, it includes the development of clean technologies that "minimize potential environmental and human health risks associated with the manufacture and use of nanotechnology products" (Shah et al. 2014, p. 157); and second, it encourages the "replacement of existing products with new nano-products that are more environmentally friendly throughout their lifecycle" (Shah et al. 2014, p. 157). Another example of a technological innovation that promises to tackle current environmental issues is the electrolysis of water. Having now reached a commercialized status, the electrolysis of water is considered to be a crucial technology in the production of hydrogen, a transport fuel used in vehicles that have a fuel cell or an internal combustion engine; using hydrogen is likely to overcome the concerns related to greenhouse gasses and other polluting emissions (Badwal et al. 2014). Examples such as these illustrate the success that technological innovation can achieve with regard to confronting the grand challenges of our time, and to a certain extent thus dismiss the need for frameworks such as RI to articulate an alternative concept of innovation.

However, it is in fact in the call to *steer* innovation that the presupposed concept of technological innovation in RI becomes questionable. The emergence of RI and the use of the term 'responsible innovation' suggest that in fact innovation is not always that responsible

(Blok and Lemmens 2015). Due to the negative impact that innovation can have on society and the environment, the aim of RI is to ensure that innovation is ultimately steered into a responsible and desirable direction to avoid the creation and use of harmful technologies and to encourage the introduction of technologies such as the ones described above. The question is whether technological innovation can be steered in the way RI suggests and in what ways an alternative concept of innovation could be more fruitful in this regard.

One of the problems with steering technological innovation is that it requires a mutual agreement concerning the direction it needs to be steered in. While RI to some degree presupposes a consensus with regard to the grand challenges, in practice the various stakeholders involved in processes of technological innovation often differ in their definition of what exactly these challenges are and in their approach to solving them (cf. Kroesen et al. 2015). These differences are mainly due to opposing agendas and motives of, for example, for-profit and nonprofit organizations (Yaziji and Doh 2009). As a result of power imbalances—the engineers who build the technology or the company that funds it naturally tend to have more power than, for instance, the wider public—the differences among stakeholders are not always collectively dealt with and they often end up in conflict (Bryson et al. 2006). In practice, therefore, processes of technological innovation do not easily adhere to the common ground from which the RI literature departs.

Another problem with steering technological innovation is that RI calls for complete transparency among all stakeholders involved in this process. From a business perspective this call for transparency can be said to be naive, because it is undermined by the competitive advantage a new technology needs in order to succeed on the market (Blok and Lemmens 2015). To achieve this competitive advantage, companies rely on information asymmetries, that is, additional knowledge they have about business opportunities that other companies are unaware of. In the context of RI, companies seek such information with regard to finding new solutions for existing and anticipated grand challenges. However, transparency among the involved stakeholders evidently entails a reduction of these information asymmetries, thereby taking away the main source of competitive advantage. In the field of commercialized technologies, therefore, the ideal of achieving a transparent collaboration among all stakeholders involved is simply unrealistic (Blok and Lemmens 2015).

Furthermore, the unexpected outcomes of emerging technologies bring into question the extent to which technological innovation *can* be steered into a responsible and desirable

direction. Even though incorporating the different dimensions of RI in the innovation process may decrease unforeseen societal and environmental consequences, this is not guaranteed (Rammert 1997). During the development of biofuel for example, the involved stakeholders argued that because it is inherently renewable, locally produced, and less polluting, its introduction to the market would promise responsible and desirable outcomes. However, as a result of the increased demand for biofuels, farmers had to grow more crops for biofuel production, which in turn led to an increase in the price of food. An increase in the price of food was not initially anticipated and now brings into question whether the introduction of biofuels was in fact responsible and desirable, especially considering that people in developing countries were negatively affected by this unexpected outcome (Blok and Lemmens 2015). In other words, the ideals of RI cannot be attained insofar as the outcomes of technological innovations cannot be known. Unknown outcomes are in fact a crucial characteristic of technological innovation (Rammert 1997), so the feasibility of RI can be contested in this regard.

The difficulties described above indicate that the presupposed concept of technological innovation needs to be widened; they also call for future research on RI to philosophically reflect on how an alternative concept of innovation could better enable the applicability of its frameworks. To this end, we propose that future research investigates a concept of innovation in which the differences among stakeholders do not hinder the societal purpose of RI and can perhaps even be empowering (cf. Blok 2014). Moreover, this alternative concept of innovation should originate from sources that do not need information asymmetries. Finally, it should overcome the fundamental uncertainty that comes with technological innovation. In doing so successfully, innovation processes would be more ready to be steered in the way RI suggests.

Since frameworks of RI explicitly prioritize political ends, it would be valuable for future research on RI to enquire into a political understanding of innovation. Even though such an understanding was historically given a negative connotation for its disruption of the established order, in today's context it could open up ways of responding to today's grand challenges that move beyond a merely technological and commercial orientation. It is in this direction that Blok (2019) develops a political dimension of innovation in which the direction of the innovation process is essentially determined by a political agenda. In this view, the innovation process is no longer set by commercial ends, but rather by, for example, the Paris

agreement on mitigating global warming and the UN Sustainable Development Goals. This enables a more encompassing understanding of innovation that could also, for instance, draw attention to social innovations that are currently overshadowed by their commercial alternative. Instead of, for example, limiting the discussion of the overconsumption of meat to the possible benefits and implications of in vitro meat, this broader concept of innovation may also include considering *innovative* ways of simply empowering non-meat protein sources and may further enlarge the scope to apply, for instance, user-based innovations, open source and peer-to-peer (p2p) innovation strategies. Hence, by employing a political understanding of innovation, societal and environmental issues would no longer have to solely depend on technological and commercial solutions, thereby enabling RI to primarily respond to its political ideals.

In this final section we have come to realize that even though technological innovation may possess characteristics that hinder innovations from contributing to human welfare and environmental sustainability, these very same characteristics also ensure that innovations enhance such a contribution. Upon closer examination, however, it is particularly in the call to steer innovation that the presupposed concept of technological innovation in RI becomes questionable. The question is no longer what characteristics innovations must have in order to *be* responsible and desirable, but what characteristics innovations must have in order to be *steered* in a responsible and desirable direction. In this respect, we have argued that because processes of technological innovations come with fundamental differences of opinion among the involved stake- holders, information asymmetries, and unpredictable outcomes, the ideal of steering processes of this nature is somewhat naive. On the basis of this insight we have shown how future research on RI can investigate an alternative concept of innovation that better enables the applicability of RI and–departing from our historical analysis–have exemplified this by relating the political origins of innovation to ongoing research that adopts a more encompassing understanding of innovation.

V. Conclusion

The departure point of this paper lies in the observation that even though scholars com- mitted to RI continually attempt to formulate precisely what a political discourse of innovation entails, little thought goes into what innovation means conceptually. Uncritically understood as technological innovation, today it is widely associated with the field of commercialized technologies. The analysis in Section II showed that this conception is reflected throughout the

RI literature, in which the terms ‘innovations,’ ‘technologies,’ and ‘products’ are used interchangeably. This was further confirmed by the examples provided, which among others include synthetic biology, nanotechnology, and ICT.

By examining the different understandings of innovation over time and how they alter according to the dominating worldview of the context in which they emerge, Section III attempted to enable a more comprehensive grasp of the definition of a concept that today is widely considered to be self-evident. In this respect, we learned that innovation did not originate in economic analysis, as is commonly claimed. From antiquity to the Reformation, innovation is seen as a pejorative concept that threatens one of the most prominent ideals of that period: maintaining a stable society. Since innovation may destabilize the established order, it is given a political connotation. Only insofar as the ideal of stability is replaced by the ideal of progress does the concept of innovation receive a more positive connotation. It is not until the more specific ideals of technological and economic progress are introduced that the concept of innovation develops into what we know it to be today: technological innovation.

Based on the findings made in the first two sections, Section IV noted that with the emergence of RI, the concept of innovation has now entered a turbulent age in which it is given a political role, yet at the same time restricted to a technological and commercial context. On the one hand, the tensions between the imperative of economic growth and the imperative of solving today’s grand challenges bring into question whether the ideals of RI can ever be realized insofar as the concept of innovation is presupposed as technological. It is clear that ever since innovation has been understood in terms of technological and economic progress, it has contributed to today’s increasing social inequality and is one of the leading causes of the present environmental crisis. Conversely, the very same concept of innovation that is said to hinder the societal purpose of RI is also said to help achieve it. Technological innovation has been proven to overcome societal and environmental issues in the past, and the introduction of, for instance, green nanotechnology promises to do so in the future. The optimism illustrated here indicates that it is counterproductive to question the concept of technological innovation in frameworks such as RI, because it does in fact enable the desirable future that such frameworks ultimately call for.

Upon further reflection, however, we showed that it is in fact in the call to steer innovation that the presupposed concept of technological innovation in RI becomes questionable. We argued that it is somewhat naive to democratize innovation processes in

which differences among stakeholders are inevitable and information asymmetries a requisite, and whose eventual outcomes are unpredictable. For this reason, we call for future research on RI to explore an alternative concept of innovation—one that does justice to the political origins of innovation and that thereby possesses characteristics that are less susceptible to the flaws diagnosed in technological innovation. A political understanding of innovation does not necessarily have to exclude techno- logical innovation, which to a certain extent has been shown to have the potential to contribute to the societal purpose of RI. However, when the innovation process is essentially set by a political agenda, rather than by commercial ends, it enlarges the scope of innovation in a way that means it is directed to the needs of the world rather than being restricted to those of the market.

Notes

1. Technological innovation and commercialized innovation are generally taken as one interwoven concept that refers to the commercialization of new technologies.
2. Even though this paper specifically explores the presupposed concept of innovation, it is important to note that the RI literature is concerned with both research and innovation. It could, therefore, be interesting for future investigations to explore what role research plays in limiting the concept of innovation to a technological and commercial context.
3. Although this saying was never officially published, it is used across the internet.
4. As a professor and researcher at INRS (Institut national de la recherche scientifique, Montreal, Canada), Benoît Godin was conducting a long-term research project on the intellectual history of innovation, from Antiquity to the present. We acknowledge the extensive findings he has made and consider them as the main source of inspiration for writing Section II.

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CHAPTER 4

Technology in the Age of Innovation:

Responsible Innovation as New Subdomain Within the Philosophy of Technology

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Chapter 4 Technology in the Age of Innovation: Responsible Innovation as New Subdomain Within the Philosophy of Technology

I. Introduction

Dating back to Ancient Greek views on *techne* and travelling through the works of philosophers such as Francis Bacon and Martin Heidegger, the history of Western philosophy unmistakably denotes a rich variety of reflections relating to technology. While this philosophical interest in technology continues to be carried through by a range of contemporary thinkers, ongoing research on technological assessment has paved the way for a new but surely related concept: innovation. Praised as a panacea for resolving all societal issues, and self-evidently understood as *technological* innovation, the concept has become "the emblem of the modern society" (Godin 2008; Nowotny 2008). This is especially reflected in the context of the European Union, where it is considered to play a central role in both strengthening the economy and confronting the current environmental crisis (European Commission 2015).

With global issues such as economic inequality and climate change becoming increasingly urgent, the pressing question of today is how we can steer technological innovation into the "right" direction.[1] To this end, recent frameworks of Responsible Innovation (RI) emphasize the need to ensure the ethical acceptability and societal desirability of emerging technologies in an inclusive and democratic way (Owen et al. 2012, European Commission 2015). A commonly used framework of RI features the importance of four dimensions: anticipation, reflexivity, inclusion, and responsiveness. In this view, innovators and institutions should anticipate the possible outcomes of emerging technologies, reflect on what their moral responsibilities are, and engage with all types of stakeholders including the general public, and all of these in response to the values and changing circumstances of society. Together, these dimensions present several governance mechanisms and management practices that are claimed to enable more responsible innovation (Owen et al. 2012; Stilgoe et al. 2013).

While the RI literature focuses on the governance of innovation processes, little thought goes to what innovation itself means conceptually (Blok and Lemmens 2015; Von Schomberg and Blok 2018). Both EU policy makers and researchers continuously discuss how to enable outcomes of innovation processes to become more desirable and responsible, but rarely raise questions with regard to the *technological nature* of these processes. What understanding of technology does the concept of technological innovation presuppose? To what extent does this

understanding of technology affect the way we innovate today, and consequentially, what implications does it have for the societal purpose of RI? How can the concept of technological innovation be critically assessed from the perspective of the philosophy of technology? These questions call for an investigation in which RI becomes both a subdomain within the philosophy of technology, and a domain in which the philosophy of technology can contribute significantly.

It is against this background that this paper raises the following research question: *To what extent is RI possible in the current age, where the concept of innovation is predominantly presupposed as technological innovation?* As a first step, we elaborate on the rise of technological innovation, both within and beyond the RI literature. In this respect, we learn that even though the concept is widely considered in light of an intrinsic relation between technology and the market, the emergence of RI urges innovation to go beyond the sole intent of generating commercial value (Section II). In light of the philosophy of technology, we then bring into question to what extent the concept of innovation—presupposed as technological innovation—can shift away from its current commercial orientation. On the one hand, we depart from a post- phenomenological perspective to evaluate the possibility of RI in relation to the particular technological innovations discussed in the RI literature. On the other hand, we emphasize the central role innovation plays in the current age and suggest that the presupposed concept of innovation projects a techno-economic paradigm. In doing so, we ultimately argue that in the attempt to steer innovation, frameworks of RI are in fact steered by the techno-economic paradigm inherent in the presupposed concept of innovation. Finally, we account for what implications this has for the societal purpose of RI (Section III).

II. The Rise of Technological Innovation[2]

In this section, we show that while innovation originally had a political meaning it only recently developed into the concept of technological innovation, which essentially prioritizes the ideals of technological and its commercial exploitation. We go on to describe the emergence of RI as an attempt to shift away from the commercial exploitation of innovation, thereby reawaking its political origins. This ultimately brings us to question whether this attempt is feasible in practice, where the concept of technological innovation remains to dominate both within and beyond the RI discourse.

The Political Origins of Innovation

In its broadest sense, to innovate means to introduce changes and new ideas. Changes and new ideas can be introduced in science and technology, but also in other fields, such as management and education. Despite this broad scope, there are very few investigations with regard to what innovation means conceptually (cf. Godin 2008, 2015, 2016; Bontems 2014; Blok and Lemmens 2015; Blok 2019). Instead, almost any study related to innovation both within and beyond the RI literature, self-evidently presupposes the concept of innovation in terms of technological innovation. That is to say, it has become exceptionally common to connect innovation with the field of emerging technologies (Timmermans and Blok 2018).

Interesting to note, however, is that technological innovation is not merely concerned with the creation of new technologies, but ultimately refers to technologies that contribute to the market (Godin 2015). Throughout the last 60 years, mainstream economics has predominantly taken over the discourse of innovation. The concept is now said to first and foremost pertain to the business world, and even is claimed to originate in a tradition of economic analysis (Staudenmaier 1985; Cajaiba-Santana 2013). Consequentially, innovation is currently described as "the development of new ideas into marketable products and processes" (Stoneman 1995, p. 2); its significance lies in delivering value to consumers (Carlson and Wilmot 2006). The commercial dimension of technological innovation is further illustrated by the popular saying of American industrialist J. Paul Getty: "True innovation is coming up with a product that the customer didn't even know they needed." For this reason, technological innovation can also be referred to as commercialized innovation.

The current dominance of technological innovation is further confirmed when considering the common distinction made between incremental innovation and radical innovation. At the level of incremental innovation, one specifically refers to improved technologies, i.e., technologies that have been there before, but that are now transformed to supposedly work more efficient. An example would be the iPhone 8 replacing the iPhone 7. At the level of radical innovation, one speaks of completely new to the world technologies, such as the first integrated navigation system. Noticeably, the latter is claimed to be in the hand of startups and entrepreneurs which set up "the competitive dynamics which *characterize* innovation" (Bessant 2013, p. 5, own emphasis).

Innovation has not always been understood as something technological and commercial. In fact, the concept of innovation originally emerged in Ancient Greece with a

political meaning, where it was essentially understood as "introducing change into the established order" (Godin 2015, p. 5). This is reflected in works such as Plato's *Laws* (7.797b) and Aristotle's *Politics* (10.xii.1316b), in which it refers to either cultural change or changes specifically brought to political constitutions (Cf. Plato 1988; Aristotle 1984). In the fourth century, the concept of innovation made its entry into the Latin vocabulary. Initially, it meant a form of renewing or returning (Ladner 1959). For instance, in a religious context, it implied a return to the purity of the soul (Godin 2015). Centuries later, the concept of innovation was used in a similar vein to refer to the renewal of laws (Machiaveli 1992). However, the concept of innovation predom- inantly continued taking place within a political context as it was mainly defined in terms of revolutionizing the established order. This was the case all the way up to the period from the Reformation to the nineteenth century, where the concept represented radical changes that ruined, troubled, and discontented the State (cf. Burton 1976). For a large part of our history, innovation is thus comprehended as a political concept used to denote anything or anyone that threatens the order and has very little to do with the way we generally understand innovation today.[3]

Nevertheless, in the nineteenth century, the concept of innovation starts to receive a more positive meaning (Bontems 2014; Godin 2015). This is primarily because innovation now steadily enters a context in which progress and utility is celebrated. In response to this new context, innovation becomes an honorable concept (Godin 2015). While in the preceding centuries, the term innovation is mostly found in religious and political pamphlets, it now gradually appears in books, scientific journals, and general magazines. In this upcoming literature, the concept no longer carries a subversive tone, and instead refers to the successes made in mathematics, mechanics, astronomy, geography, and basically all the useful arts and sciences (Cf. Pigott 1792; Robinson 1782). Interestingly, in this period, the concept of innovation does not yet concern any relation between technology and the market. It may denote new technologies such as mining (Blavier 1806) and printing (Comte 1877), but is by no means constrained to them, let alone to their commercial value.

It is only after the rise of the more specific ideals of technological and economic progress that the concept of innovation evolves into our techno-economic understanding of innovation. To be sure, as soon as the domain of mainstream economics becomes more prominent, the field of commercialized technologies is brought into the innovation discourse. Specifically after the Industrial Revolution, the commercial value of new technologies becomes

increasingly recognized. The latter has ultimately led political economists such as Joseph Schumpeter to popularize the concept of technological innovation, according to which innovation becomes commonly associated with techno- logical goods and products, overshadowing the original political character it once had. From this brief history of innovation, we learn that as long as the world is seen and understood as a stable order, innovation is considered a danger to this order and thus widely categorized as a pejorative concept. It is for this reason that Plato for instance despises innovation in music and even in children's toys, as he believes this could lead to the embracement of new habits that eventually cause political instability (Plato 1991). As soon as the ideal of stability of the world makes place for the idea of progress, both in the field of technology and beyond, innovation gradually starts to receive a positive connotation. In this period, a new piece of literature is considered just as much an innovation as a new technology is. The Industrial Revolution and the rise of mainstream economics ultimately led to the current dominance of technological innovation, a concept that intrinsically relates technology with the market. In this respect, the creation of the iPhone or the drone is a typical example of current innovations.[4]

The Emergence of RI

To a certain extent, ongoing research under the heading of RI reawakens the political origins of innovation. While still associating innovation with the field of emerging technologies, the RI discourse urges these technologies to go beyond the sole purpose of creating commercial value. Instead, they should primarily focus on generating the "right" impact, especially with regard to today's grand societal challenges, such as for instance climate change and world poverty (von Schomberg 2013). Given the complexity of these grand challenges and the indeterminacy of the right impact, recent frameworks of RI attempt to shift the focus toward formulating a political discourse of innovation and implementing it in practice (cf. Owen et al. 2013). Other than the four dimensions described in Section I, these frameworks highlight, for example, the importance of democratically determining the purposes of innovation (Owen et al. 2013), and typically argue how placing innovation processes within the values of the European Union will enable outcomes to become ethically acceptable, sustainable, and societally desirable (von Schomberg 2013).

Yet, while the entire RI discourse focuses on conceptualizing and operating the dimensions of "responsible" innovation, the question of innovation itself is rarely raised.

Instead, the concept of technological innovation remains to prevail throughout the literature (Von Schomberg and Blok 2018). For example, in *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*—a central book in the RI literature—the included texts continuously alternate between the words "innovation" and "technological innovation," as if they are self-evidently the same. In discussing the impact of innovation, it is argued that "*technological* innovations are unpredictable" (von Schomberg 2013, p. 55, own emphasis). Similarly, it is claimed that while innovation involves a "process of bringing something new into the world" (Grinbaum and Groves 2013, p. 119), in order to achieve responsible innovation, we have to reflect "on the ethical significance of *technological* innovation" (p. 119, own emphasis).

Beyond the usage of the word technological innovation, the RI literature also adheres to its technological and commercial connotation. This is for instance the case in "A Vision of Responsible Research and Innovation" (2013), written by Rene von Schomberg, who introduced the concept of RI at the level of the European Commission and thereby plays a dominant role in the RI discourse. Here, he places innovation within a distinction that immediately presupposes that innovation is necessarily technological. On the one hand, he discusses mere technical inventions, and specifically refers to introduction of new technologies, such as Bartolomeu's "machine for sailing through the air" (p. 52). On the other hand, von Schomberg discusses modern innovations. Also in this respect the usage of the term technology keeps prevailing. Further- more, while Bartolomeu's machine is referred to as a "mere" technological invention, "modern innovations are distributed through market mechanisms" (von Schomberg 2013, p. 54). To put it differently, modern innovations do not just refer to emerging technologies, but rather to technological *products* that are essentially shaped by the successes they make on the market. This connection between innovation and commercialized technologies is further demonstrated by the particular innovations that von Schomberg discusses, such as genetically modified organisms (GMOs), video-gaming technology, the electronic patient record system (EPRS), nanotechnology, and body- scanning technology. His vision on innovation is reflected in official documents of the European Commission, in which these technologies are considered to be the main innovations to shape the future (cf. Matter 2011).

The presupposed concept of technological innovation is also dominant in EU- funded RI governance projects such as ProGReSS (Coles 2014a) and Res-AGorA (Lindner et al.

2016). To be sure, ProGReSS has delivered reports in which it investigates how research funding can steer innovation toward positive results, mainly with regard to societal desirability. Upon closer examination, these reports unquestioningly account for the societal desirability of technologies that are particularly economically beneficial (Coles 2014b). These specifically include synthetic biology, nanotechnology, and information and communications technology (ICT). Although Res-AGorA strategically differs from ProGReSS, most attention is also dedicated to the "what is responsibility?" aspect of RI. Conversely, the "what is innovation?" aspect is barely explored. Instead, the ethics formulated once again concern economically beneficial technologies. That is to say, they developed the Responsibility Navigator, which is supposed to guide innovation processes through the application of ten principles, most of which are illustrated and placed within the context of market- based technology (Cf. Von Schomberg and Blok 2018).

The above analysis shows that while the concept of innovation is rarely considered as an object of reflection, it is generally presupposed as technological innovation. Noticeably, the term itself implies that not all innovations are technological. In this sense, we have shown that innovation is in fact a very broad concept, and originally contains a fundamentally political connotation. Similarly, the term implies that not all technologies are innovative. In this sense, we have shown that in the current age, in order for a technology to be considered as an innovation it ultimately needs to generate commercial value. In other words, we currently share a techno-economic understanding of the concept of innovation. Even though emerging frameworks of RI now attempt to shift away from this techno-economic understanding of innovation, the concept of technological innovation remains to prevail throughout both the literature and policy documents. This brings into question whether innovation—presupposed as technological innovation—*can* shift away from its current commercial orientation. To what extent is it possible to operationalize the dimensions of RI within a context where innovation is understood in light of an intrinsic relation between technology and the market? For instance, reflecting upon the ethical significance of technologies could be jeopardized by the self-interested pursuit of economic welfare. Similarly, inclusion and deliberation may proceed strategically in function of maximizing one's own profit, while responsiveness may easily amount to window dressing.

III. Technological Innovation and the Possibility of RI: an Investigation for the Philosophy of Technology

In order to adequately evaluate the possibility of achieving RI, in this section we engage with the philosophy of technology to reflect on the concept of technological innovation in two ways. First, we depart from a post-phenomenological perspective to account for the particular technological innovations RI focuses on and reflect to what extent they enable desirable and responsible outcomes. Second, we emphasize the central role innovation plays in the current age and show how the specific techno-economic mode in which the concept of innovation is self-evidently presupposed at the same time projects a techno-economic paradigm, which in turn limits the possibility of RI.

RI and the Focus on Particular Technological Innovations

Throughout the last two centuries, when the philosophy of technology gradually emerged as a distinct discipline, technology was largely considered as a singular overarching process, and philosophically discussed in terms of its relation to, for instance, morality (Jonas 1984), politics (Winner 1980, 1983), and truth (Heidegger 1977). Because these theories do not account for how particular technologies differ from one another in numerous ways, a recent branch of the philosophy of technology asserts that instead of analyzing its relations to philosophical issues other than technology, the philosophy of technology "must make technology a foreground phenomenon and be able to reflectively analyze it in such a way as to illuminate features of the phenomenon of technology itself" (Ihde 1993, p. 38; original emphasis). In light of this view, contemporary philosophers of technology aim to empirically analyze particular artifacts, especially with regard to their concrete usage and the context in which they are used (Verbeek 2005). The popularity of this view is reflected in the theme of the latest Society for Philosophy and Technology conference, which was specifically dedicated to the way in which concrete artifacts work. By narrowing the scope to concrete artifacts, this contemporary view of technology is also characterized as an ontic account of technology (Zwier et al. 2016). Despite what critics say (Cf. Feenberg 2009; Kaplan 2009; Scharff 2012; Smith 2015; Zwier et al. 2016), an ontic account of technology does not mean to disregard the effects technology has on other domains, as long as these effects are studied strictly in relation to the particular technology that causes them, and not attributed to technology as such. In Moralizing

Technology: Understanding and Designing the Morality of Things, Peter-Paul Verbeek provides some compelling examples that illustrate this latter point:

> Speed bumps, to use a favorite example of Bruno Latour, help us make the moral decision not to drive too fast near a school. Ultrasound scans help us to ask and answer moral questions about the lives of unborn children. Energy-saving lightbulbs take over part of our environmental conscience. Coin locks on supermarket pushcarts remind us to return each cart neatly to its place. Turnstiles tell us to buy a ticket before boarding a train. Current developments in information technology show this moral significance more explicitly. With the development of ambient intelligence and persuasive technology, technologies start to interfere openly with our behavior, interacting with people in sophisticated ways and subtly persuading them to change their behavior […]. (Verbeek 2011, pp. 1–2)

In mediating the human–world relation, concrete technologies thus give shape to the moral decisions we daily take. For this reason, Verbeek calls for an ethical framework that conceptualizes the moral significance of such technologies.

Similarly, the RI discourse aims to incorporate an ethical framework into the process of particular innovations. That is to say, as we have seen in the previous section, RI typically focuses on concrete innovations within the field of, for instance, synthetic biology, nano-technology, and ICT. To be sure, the emergence of RI suggests that these innovations are not always that responsible. Due to the potential harmful impact they have on society and the environment, the idea of RI is to ensure that innovation is ultimately steered democratically into a responsible and desirable direction. Even though RI may face some complications with regard to anticipating future outcomes (Grunwald 2014; Nordmann 2014), the technological innovations it focuses on do show to play a significant role in, for example, the conservation of nature. In the face of an accelerating pace of environmental damage, they can for instance provide new ways for wetlands, forests, and diverse species to be in harmony with a wide range of modern, human settings (Kareiva et al. 2011). Similarly, the introduction of green nanotechnology is shown to enhance environmental sustainability in at least two respects. First, it enables clean technologies that "minimize potential environmental and human health risks associated with the manufacture and use of nano- technology products" (Shah et al. 2014, p.

157); and second, it inspires the "replacement of existing products with new nano-products that are more environmentally friendly throughout their lifecycle" (Shah et al. 2014, p. 157). Another example of a particular innovation which promises responsible and desirable outcomes includes the electrolysis of water, which is shown to be vital in generating hydrogen, a transport fuel which is likely to overcome the concerns related to greenhouse gas and other polluting emissions (Badwal et al. 2014). The optimism illustrated here indicates that, at least at the ontic level, the concept of technological innovation enables the desirable future that frameworks of RI call for.

RI in the Age of Innovation

The question is whether we should limit our understanding of technological innovation to an ontic approach. Although the concept certainly refers to its representing innovations, it is also described as the very "emblem of the modern society" (Godin 2008, p. 5), and therefore suggests to be an underlying determinant of the current age. Praised as a panacea for resolving all types of challenges (Godin 2008), it has become an integral part of the way we think and do things today (Este 2013). This is confirmed by the numerous books that emerge in all types of fields, all of which explicitly refer to our age as the age of innovation (cf. Janszen 2000; Araya and Peters 2010; Ingham 2015; Tarkenton 2015; Katsoni and Stratigea 2016; Ben-Haim 2018; Goldberg 2018). Today, innovation is all-pervasive, where innovators like Elon Musk and Steve Jobs are heralded the same way scientists and artists were in previous times. In this respect, the development of innovative products and services is often seen as a major concern at the firm level: not to innovate is to die (Freeman & Soete 1982). This is also the case for institutions such as the Organization for Economic Co-operation and Development and the European Union, both of which consider it self-evident that "most current social, economic and environmental challenges require creative solutions based on innovation" (OECD 2010; cf. European Commission 2010). Noticeably, the European Union launched the Innovation Union, which emphasizes the significance of innovation in increasing European prosperity in terms of stimulating both economic growth and environmental sustainability. For reasons as these, innovation is thus said not only to determine new emerging artifacts and services at an ontic level, but to define our very epoch (Nowotny 2006, 2008; Blok 2019).

If we take this idea into serious consideration, it means that the human–world relation is not only mediated by particular innovations, but also by the specific techno-economic mode

in which we self-evidently presuppose innovation in this age of innovation. On the one hand, particular technological innovations certainly differ from one another in numerous ways, and they thus mediate the human–world relation each in their own way. For example, while a drone changes the way we conduct war, the smartphone changes the way we communicate. On the other hand, the technological innovations that are most prevailing in the literature all tend to share a techno-economic paradigm, i.e., they are techno-economically oriented (Von Schomberg and Blok 2018). While there are of course other forms of innovation, such as social innovation and attitudinal innovation, these are generally less considered in the innovation discourse. This is analogous to a distinction Gilbert Simondon (2017) makes between minor and major technologies. Major technologies are those we mostly discuss, while minor technologies are those we tend to overlook. The point we illustrate here is that the techno-economic nature of the innovations that are dominant in both the innovation discourse and RI discourse can be related to the current age of innovation, in which the human–world relation is ultimately techno-economically mediated.

The techno-economic mediation at stake can also be explained in light of what Heidegger calls Enframing (Heidegger 1977). To be sure, in The Question Concerning Technology, Heidegger claims that technology as Enframing is not itself something technological but entails rather a mode of understanding the world around us and of our relation to it. This mode is to be understood in terms of a calculative ordering according to which we represent, arrange, transform, organize, manipulate, and mobi- lize reality. Under the sway of technology, all things become fungible, disposable, and changeable energy that stands in reserve for whatever purpose we decide upon. For example, the river Rhine comes to be perceived as a source of energy or a tourist attraction, and forests in terms of cubic meters of timber.

> Enframing is the gathering together that belongs to that setting-upon which set upon man and puts him in position to reveal the real, in the mode of ordering, as standing-reserve. (Heidegger 1977, p. 24)

Heidegger further explains that because Enframing presents this mode of calculative ordering as self-evident, it has fatally absorbed and disabled all other possible modes of existence. In

other words, due to Enframing calculative ordering is the only mode in which reality is to be experienced, overshadowing the possibility of any other mode.

In similar vein, we argue that while the concept of innovation in its all-pervasive sense is precisely a way of enabling new possibilities, the dominant mode of calculative ordering constrains us to the self-evidence of technological innovation.[5] Even though innovation is about creating change in the broadest sense possible, and RI is about exceeding the market, the concept of innovation remains presupposed as technological innovation and commercial innovation. As a result, the scope of innovation is limited to the field of commercial or at least commercializable technologies, and tied to an intrinsic relation between technology and the market. This explains why a range of other forms of innovation, such as social innovation (e.g., fair trade) and attitudinal innovation (e.g., lifestyle interventions), are often excluded from the RI discourse. That is to say, these forms of innovation are dominated by their technological and commercial alternative. For example, debates concerning meat overconsumption are often restricted to the potential benefits and implications of in vitro meat, instead of also considering innovative ways of empowering non-meat protein sources.

The ambiguous relation between the ideal of RI (i.e., exceeding the market in order to serve society) and its practice (i.e., implicitly adhering to a techno-economic view on innovation) brings the possibility of RI into question. Even though particular technological innovations are shown to enhance responsible and desirable outcomes, the techno-economic paradigm in which these innovations are embedded is arguably incompatible with the ideal of overcoming today's societal and environmental issues. The imperative of maximizing economic growth is claimed to be the main cause of today's increasingly unequal distribution of wealth (cf. Rolston III 2012; Naudé and Nagler 2016), and as "the root cause of many environmental problems" it stands "in direct conflict with sustainability" (Huesemann and Huesemann 2011, p. 256). This is confirmed by the relatively recent increases in waste disposal, pollution, water shortage, deforestation, global warming, loss of biodiversity, natural resource depletion, and public health issues; increases that can be seen as an effect of the techno-economic paradigm of innovation (Huesemann and Huesemann 2011; Purdy 2015).

One way in which the techno-economic paradigm of innovation affects the possibility of RI is reflected in the power imbalances that take place during the innovation process. That is to say, while RI to a certain extent presupposes an agreement with regard to today's global issues, such as global warming and world poverty, in practice the numerous stakeholders

included in the innovation processes often have different definitions of these issues, and different ways of solving them (cf. Kroesen et al. 2015). These differences are chiefly because of contrasting motives and agendas of, for instance, for-profit and non-profit organizations (Yaziji and Doh 2009). Due to power imbalances—the engineers who create the technology and the companies that finance it tend to have more power than, for example, the wider public—the disparities among stakeholders are not often collectively solved and usually result in conflict (Bryson et al. 2006). As a result, in reality, innovation processes adhere much more to the dominant ideals of technological and economic progress than they do to the common ground from which the RI literature departs.

The techno-economic paradigm of innovation also has implications for achieving the transparency among stakeholders RI calls for. To be sure, this call for transparency is compromised by the competitive advantage a new technology requires in order to flourish on the market (Blok and Lemmens 2015; Brand and Blok 2019). To accomplish this competitive advantage, companies depend on information asymmetries, meaning that they seek for additional knowledge about certain opportunities that other companies are unaware of. In the context of RI, companies search for such information with regard to solving both existing and anticipated global issues. However, transparency among the included stakeholders naturally implies a reduction of these information asymmetries, thus taking away the very foundation of competitive advantage. Therefore, in so far the concept of innovation adheres to a techno-economic paradigm, the idea of enabling transparent collaboration among all stakeholders included in the innovation process is simply naïve (Blok and Lemmens 2015).

Moreover, while the techno-economic paradigm of innovation somewhat takes for granted that outcomes of innovation processes can be calculated and foreseen, in practice they are often shown to be unpredictable. Even though unexpected societal and environ- mental consequences may be reduced when the different dimensions of RI are incorporated in the innovation process, this is not guaranteed (Rammert 1997). For example, during the process of developing biofuel, the included stakeholders concluded that since this type of fuel is locally produced, inherently renewable, and less polluting, its introduction is both responsible and desirable. Nevertheless, as a consequence of the increased demand for biofuels, farmers were forced to cultivate more crops for biofuel production, which in turn led to an increase in the price of food. This increase in the price of food was unexpected and now brings into question if the introduction of biofuels was in fact responsible and desirable, especially given that people

in developing countries were badly affected by this unforeseen outcome (Blok and Lemmens 2015). This example illustrates that the ideals of RI cannot be achieved insofar as outcomes of technological innovations are unknown. Unknown out- comes are in fact a vital characteristic of technological innovation (Rammert 1997), contrary to what the techno-economic paradigm suggests.

Hence, because the innovation processes at stake in the RI discourse adhere to the techno-economic paradigm and, as a result, come with fundamental power imbalances, information asymmetries, and unpredictable outcomes, the ideal of RI to steer such processes becomes problematic.

V. Conclusion

The departure point of this paper lies in the observation that while the current age is marked by the concept of innovation, little thought goes to what innovation means conceptually. Instead, it is self-evidently presupposed as technological innovation, which denotes both a technological and commercial connotation. In Section II, we inquired into the rise of technological innovation and learned that historically the concept has little to do with technology, let alone with the market. Originally, the concept of innovation was political, and essentially referred to changing the political order. Only with the rise of mainstream economics did the concept of innovation become understood in light of an intrinsic relation between technology and the market, particularly in the period of the last 60 years. Conversely, in response to current global issues such as climate change and epidemics related to lifestyle diseases, ongoing research on RI now emphasizes the political role of innovation. That is to say, they call for innovation processes to exceed economic purposes, and to primarily serve societal and political purposes. At the same time, however, we have shown that the concept remains presupposed in terms of technological innovation as it continues to prevail both in the RI literature and in policy documents.

Against this background, in Section III, we engaged with the philosophy of technology to investigate what implications our techno-economic understanding of innovation has for the possibility of RI. In this respect, we provided two reflections. First, at an ontic level and from a post-phenomenological perspective, we accounted for particular technological innovations and for how these mediate the human–world relation each in their own way. In mediating the human–world relation, we demonstrated that these innovations also carry ethical significance.

That is to say, some may result to be more ethically acceptable and societally desirable than others. Accordingly, the purpose of RI is to ensure that innovation processes are steered into a responsible and desirable direction. As such, the technological innovations RI focuses on show to play an important role in confronting, for example, loss of biodiversity and pollution. Second, at an ontological level, we emphasized the central role innovation plays in the current age and demonstrated how the specific techno- economic mode in which the concept of innovation is self-evidently presupposed at the same time projects a techno-economic paradigm. This led us to argue that parallel to Heidegger's view on technology as Enframing, the dominant mode of calculative ordering constrains us to the self-evident techno-economic paradigm of innovation. This disables the possibility of other ways in which we can think of innovation. Accordingly, even if RI attempts to exceed the market, the concept of innovation remains technologically and economically oriented. That is to say, the particular innovations that currently dominate the RI discourse share—despite their differences—a techno-economic paradigm. The impli- cations of the techno-economic paradigm are reflected in the innovation processes, which ultimately come with fundamental power imbalances, information asymmetries, and unpredictable outcomes.

Hence, even though RI provides a critical analysis of innovation at the ontic level (i.e., concerning the introduction and usage of particular innovations), it still lacks a critical analysis at the ontological level (i.e., concerning the techno-economic paradigm of innovation). Therefore, RI needs a fundamental reflection that not only exposes the techno-economic paradigm of innovation—which we did in this paper— but that also explores an alternative concept of innovation which addresses the public good beyond the current privatization wave. The political origins of innovation that we encountered in Section 2, along with the political ends that the RI literature explicitly prioritizes, suggest that we should inquire into a political orientation of innovation. A crucial task of this inquiry would be to account for what such a political orientation of innovation precisely entails at the ontic level, and how it relates to the current techno- economic paradigm of innovation at the ontological level.

Notes

1. This question is also the result of the negative impacts technological innovation has caused in the past, such as nuclear waste (Cf. von Schomberg 2019).
2. This section is largely based on the findings made by von Schomberg and Blok (2018).

3. For a detailed account on the intellectual history of innovation, see Godin (2015). *Innovation contested: The idea of innovation over the centuries*. New York: Routledge.
4. For an overview of the concept of innovation throughout history, see *Chapter 3*, Table 4.
5. While the main focus of this paper is to show how the way we self-evidently presuppose innovation disables the infinite possibilities in which we can account for reality and its uncertainties, in future research we investigate in what way innovation could precisely be about enabling these possibilities.

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CHAPTER 5

It Takes Two to Tango

Towards a Political Concept of Responsible Innovation

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Chapter 5 It Takes Two to Tango: Towards a Political Concept of Responsible Innovation

I. Introduction

The EU policy discourse on Responsible Innovation (RI) has recently been diagnosed with a discrepancy between its strong normative ideals and its concrete implementation in practice (Novitzsky et al. 2020). On the one hand, at the declarative level, policies urge innovation processes to generate societally desirable outcomes, particularly in response to global objectives such as the Sustainable Development Goals (von Schomberg 2019). On the other hand, at the operational level, the integration of RI faces structural tensions with other policy goals, such as scientific excellence and economic value (Rodríguez et al. 2019). As a result, frameworks of RI are exposed to potential instrumentalization, while falling short on the promoted ambitions of the EU (Novitzsky et al. 2020).

To counter this tendency, the academic discourse on RI insists on rigorous innovation governance and typically proposes that to innovate responsibly requires a permanent commitment to be anticipatory, reflective, inclusively deliberative, and responsive (Owen et al. 2013). RI scholars also suggest incorporating human values into design requirements (Van de Poel 2013) and embedding innovation processes in the established treaties of the EU (Von Schomberg 2013). Even so, questions about the politics in and of innovation are often left unaccounted for, despite the longstanding call to democratize innovation processes (Van Oudheusden 2014). Instead, the scope is largely set on *adding* dimensions of responsibility to the widely presupposed concept of technological and commercialized innovation (Blok & Lemmens 2015). The question is whether innovation governance of any kind suffices to operationalize RI insofar its policies and practices are applied and restricted to this techno-economic concept of innovation (Von Schomberg & Blok 2019, Reijers 2020).

Against this background, this paper articulates an orientation shift from a techno-economic concept of innovation towards a political concept of innovation in the RI discourse. As such, we pose the following research question: *What does a political concept of innovation consist of and how does it contribute to the RI discourse?* We consult the work of Hannah Arendt, one of the most influential political philosophers of the twentieth century. In *The Human Condition* she refines the division between the public sphere and the private sphere through articulating the *vita activa*, a tripartite distinction between the activities of labor, work, and action. Our hypothesis is that while a techno-economic concept of innovation primarily

serves the private sphere, the initiative power of the *vita activa* inspires a political concept of innovation that primarily serves the public sphere. In doing so, we contribute to the recent call for research to further explore and transform Arendt's theory and concepts in relation to the phenomenon of RI (Cf. Reijers 2020).

As a first step, we account for *why* the shift towards a political concept of innovation in the discourse on RI is urgent. In this respect, we diagnose the RI discourse with a conceptual ambiguity, struggling to serve both private and public interests. In light of this diagnosis, we distinguish between weak RI, which seeks to govern a techno-economic concept of innovation through an applied set of ethical dimensions; and strong RI, which seeks to conceive a political concept of innovation beyond techno-economic ideology and practice (Section II). Subsequently, we account for *what* this political concept of innovation consists of. Through conducting a generative reading of the *vita activa* we establish a political concept of innovation that enhances the human capacity to speak up and take action, inspires radical novelty, and empowers the public sphere (Section III). Finally, we account for *how* the discourse on RI can operationalize this political concept of innovation. In doing so, we provide a vision of strong RI to be integrated at both substantial and procedural level (Section IV).

II. The Call for a Political Concept of Responsible Innovation

Through articulating six main keys–ethics, societal engagement, gender equality, open science, science education, governance–the EU policy discourse on RI imposes a strong normative view of what constitutes responsibility in innovation processes (European Commission 2020). Even so, the academic discourse on RI demonstrates that, in effect, there remains a lack of clarity of what RI means for research policy and governance (Novitzsky et al. 2020). Among stakeholders, approaches of RI vary between coping with the institutional landscape and pushing to transform it entirely, between implementing practices locally and enforcing objectives globally, and between proposing incremental change and disruptive change (Ludwig & Macnaghten 2019). Moreover, in the very adoption of RI, measures and guidelines are claimed to provide little more than a strategic checklist to continue business-as-usual, potentially leaving the innovation discourse to adopt a mere instrumental understanding of its responsibility to society (Blok & Lemmens 2015, Novitzsky et al. 2020). Consider the 'Hydro-Tech Air Conditioned Shoes', which feature a new filter technology that releases heat and humidity while allowing air to flow in, keeping feet refreshed and clean for long periods of

time. While strictly speaking the shoe company and developers may have ticked off all the RI keys during the process of creating their product, surely this is not the type of contribution RI aims for. The same can be said about the 'Fifth Wheel Parallel Parking Tool', which apart from facilitating parking possibilities does not generate significant societal impact. Skeptics may argue, therefore, that implementing the established RI keys in the innovation process does not necessarily lead to RI, at least not in a revolutionary sense.

At the core, however, the idea of RI is not meant to constitute a tick box exercise. Instead, it is originally presented as a holistic approach, underpinned by a philosophical understanding of responsibility in terms of 'response-ability', that is, the exercising ability to respond (Jonas 1984, Owen et al. 2013). This makes RI non-reciprocal and present-oriented in nature, moving beyond conceptualizations of responsibility that are mainly knowledge based and retrospectively applied after the fact (Grinbaum & Groves 2013). In this view, RI it is not merely about what we do not want innovation to do, but rather about what we do want innovation to do, thus shifting from an ethics of constraints to an ethics of construction (Von Schomberg 2019). In doing so, RI allows for and accommodates the unpredictability of innovation by means of "a collective commitment of care for the future through a responsive stewardship of science and innovation in the present" (Stilgoe et al. 2013, p. 3). On this premise, several RI scholars urge responsibility debates to move beyond consequentialist modes of orientation, focusing on wishful futures rather than on speculative outcomes, thereby enabling more visionary and critical ideas for improving the future (Nordmann 2010, Grunwald 2019). In this respect, RI builds on previous proposals, such as vision assessment (Ferrari et al. 2012), explorative philosophy (Grunwald 2010), and a variety of hermeneutic responses given to the unpredictable nature of emerging technologies (e.g. Van der Burg 2014). Hence, while RI may be vulnerable to questionable tick box implementations, it was originally introduced to express an adaptive and responsive character.

The discrepancy between the ideal of RI and its implementation in practice is arguably the result of a deeper conceptual ambiguity. On the one hand, proponents of RI explicitly call for innovation processes to exceed the privatization wave and serve a political agenda (Von Schomberg 2020). While subject to a variety of perspectives and assessments, it is generally agreed that by engaging governmental bodies, industries, and societal actors within the innovation process, it can be managed in accordance with the values and expectations of society and steered towards a societally desirable direction (Owen et al. 2013). Within the wider EU

context of 'science for society, with society', the hypothesis is that innovation can only respond to the needs and ambitions of society by including all its actors throughout the process. In this respect, RI primarily aims to contribute to the public sphere and promises to be revolutionary, profound, and transformative. On the other hand, the RI discourse tends to lean on a rather conventional techno-economic concept of innovation (Von Schomberg & Blok 2018, 2019). This is reflected in three aspects. First, throughout the RI literature, the vocabulary used to denote the concept of innovation is coined by the terms 'technological innovation' and 'commercialized innovation' (Blok & Lemmens 2015). Second, RI projects focus almost exclusively on economically beneficial technologies, such as synthetic biology, nanotechnology, and ICT (e.g. Coles 2014, Kuhlmann et al. 2015). Third, the broader EU context in which RI operates is characterized by the overarching goal to become an innovation union that turns "great ideas into products and services that will bring growth to our economy and create jobs" (European Commission 2014, p.3). Hence, while the RI discourse may be decidedly progressive and well-intentioned, it faces the conceptual difficulty to overcome a techno-economic concept of innovation.

Even though academic efforts of RI explicitly plead for major innovation governance against mainstream commercial incentive and towards societally desirable outcomes (Owen et al. 2013), the question is whether these efforts can succeed insofar the overall scope is limited to governing a techno-economic concept of innovation. This is not to say that a techno-economic concept of innovation can never serve the public good–examples of recent successes such as green nanotechnology (Cf. Shah et al. 2014) and the electrolysis of water (Cf. Badwal et al. 2014) demonstrate this–but that they in the least limit the possibilities of RI. As we have elsewhere argued in view of the phenomenological tradition–which notes that under the sway of technology, responsibility becomes subject to moral calculus (Satkunanandan 2015)–a techno-economic concept of innovation may absorb the potential of RI to genuinely serve the public good (von Schomberg & Blok 2019). It may, for example, restrict the RI dimensions of anticipation and reflexivity to self-interested pursuits, strategically allow for inclusion and deliberation only to maximize profit, and amount responsiveness to mere window dressing. In this respect, RI primarily attends the private sphere and, to a certain extent, faces the reputation of being conservative, superficial, and a justification for doing business-as-usual.[1]

Against this background, several scholars have insinuated the need for an orientation shift from a techno-economic concept of innovation towards a political concept of innovation

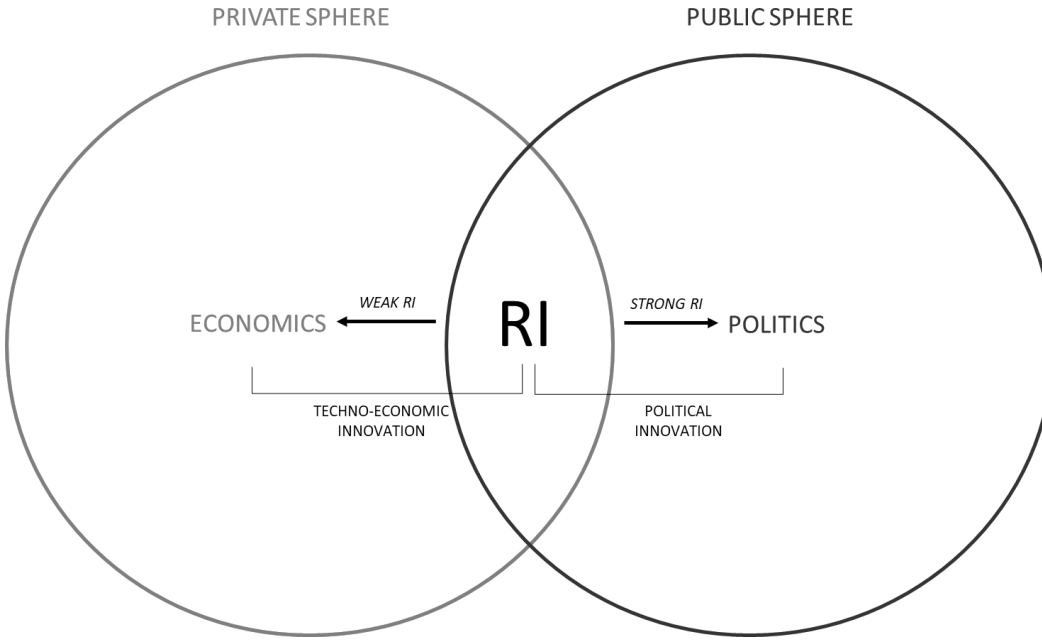
in the discourse on RI (e.g. Van Oudhesueden 2014, Owen & Pansera 2019, Von Schomberg & Blok 2019, Reijers 2020). Especially because frameworks of RI emphasize the *democratization* of innovation processes and aim to 'change the world', they cannot be presented as politically neutral (Van Oudheusden 2014). This is even more so considering that the notion of responsibility itself carries political significance (Reijers 2020). Also with regard to global issues like climate change, RI is shown to be much more complex and political than usually perceived (Stilgoe 2019). All this reenforces the question whether the concept of innovation, particularly in the context of RI, is necessarily bound to market mechanisms.

> Are innovation, and responsible innovation, always destined to be bedfellows of a market-based Schumpeterian model of competitive, creative destruction, or can they–and should they–allow space for other alternatives of innovation and responsibility based on other political beliefs, ways of organizing, ways of distributing power, ways of relating to each other and ways of being; a quality deliberation that favors the confrontation of various arguments and conceptions of the good? (Owen & Pansera 2019, p. 41)

This question provides an opening to reflect on an alternative, political, concept of innovation that disentangles the RI discourse from mainstream economic incentive and genuinely serves the public good.

The above discussion points to an ambiguous position of RI, where the ideal to exceed the market and serve society conflicts with the self-evident adherence to a techno-economic concept of innovation. In light of this diagnosis, we can distinguish between weak RI and strong RI (see figure 1).

Figure 1 The Conceptual Ambiguity of RI



Weak RI denotes an *application* of ethical dimensions to the widely presupposed techno-economic concept of innovation. We consider RI in the form of such an application as weak, because despite good-intentioned efforts to serve the public sphere, its concept of innovation is ultimately oriented towards the private sphere. In contrast, strong RI projects a *transformative* view of the concept of innovation itself; it articulates a political view of innovation that exceeds techno-economic ideology and practice towards genuinely serving the public sphere. As such, strong RI unties itself from the mainstream economic tradition of innovation and does justice to the political ambitions the RI discourse expressed ever since it made its entry into EU policy circles. The two orientations of RI differ with respect to their input, throughput, and output (see table 1).

Table 1 Towards a Vision of Strong RI

The Concept of RI	Weak RI	Strong RI
Input	Seeks to *govern* the techno-economic concept of innovation	Seeks to *transform* the techno-economic concept of innovation
Throughput	Applies RI keys to a techno-economic concept of innovation	Operates a political concept of innovation
Output	Primarily serves the private sphere	Primarily serves the public sphere

Departing from the conceptual ambiguity of RI, this section primarily depicted the techno-economic concept of innovation and exposed its orientation towards the private sphere, thereby pointing to the limitations of weak RI. In turn, the next section is devoted to developing a political concept of innovation oriented towards the public sphere, thereby laying a first steppingstone to establishing a vision of strong RI.

III. Laying the Foundation for a Political Concept of Innovation

In order to develop a political concept of innovation that clearly distinguishes itself from a techno-economic concept of innovation, we require a profound understanding of the relation between the public and private sphere. In *The Human Condition*, Hannah Arendt provides us with precisely that. In particular, her articulation of the *vita activa* enables us to further explore what it means for innovation to primarily serve the public sphere, even if she does not explicitly address the topic of innovation herself. The purpose of this section is twofold. First, after briefly explaining the fundamental categories of the *vita activa*–labor, work, and action–we diagnose the category of work with a duality, responding to both the private interests of labor and the public interests of action. Second, through understanding the duality of work and translating it to what we call 'the duality of innovation', we provide concrete criteria for a political concept of innovation as distinct from a techno-economic concept of innovation. This will eventually serve as the foundation of strong RI, to which we turn in the subsequent section.

It should be noted that our reading of Arendt is generative, meaning that we do not aim to take a specific stance either for or against her work. Our primal intention is to explore possibilities of applying her theory to the dynamic of RI, as recently called for in the literature (Reijers 2020).

The Duality of Work

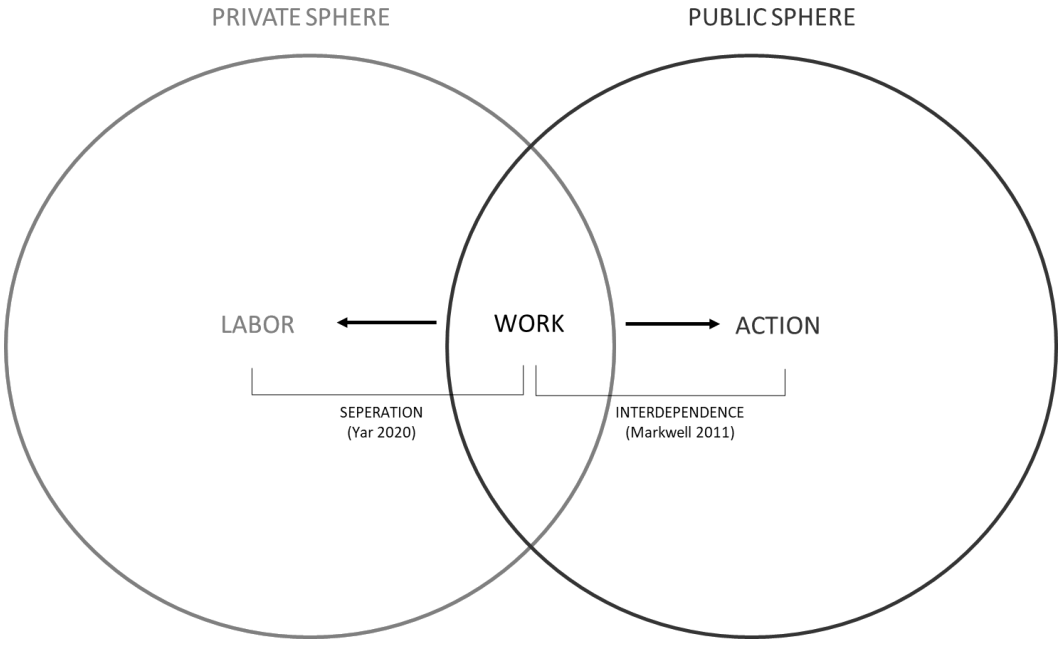
Briefly explained, labor satisfies the vital *necessities* of life and corresponds to the mode in which we survive. Work creates anything of *use* and corresponds to the mode in which we build an artificial world that distinguishes itself from nature. Action means taking *initiative* and corresponds to the mode in which we spontaneously say and do things in *public*. In this respect, action conjugates speech and represents the highest realization of political life, reflecting three central features. First, action is conditioned by plurality. We always act either for or against others. For example, a performance artist acts for its audience, while a revolutionist acts against its oppressor. In both cases action loses its meaning without the presence of a plurality of actors who perceive what it being enacted. Second, action constitutes natality. By virtue of our birth, we take initiative and begin something new. In doing so, we introduce radical novelty in the world. Third, as a result of this radical novelty, action is inherently unpredictable; it carries the capacity of doing something completely unexpected (Arendt 1998). While the position of work in the *vita activa* is arguably more complex, it is clear from Arendt's writings that the three features of action must be understood as counterpoints to the activity of labor. As such, Arendt sharpens the division between the private and public sphere. While the private sphere is concerned with life spent as individuals in the pursuit of self-interest, i.e. as *animal laborans*, the public sphere is concerned with life spent as citizens of a political community, i.e. as *zoon politkon*. The latter is further defined as a common space of appearance in which we actively *appear* to each other through speech and action. In doing so, we ultimately transcend private interests and impact the world beyond the self, that is, the public sphere (Arendt 1977).

The activity of work–which constitutes our life spent as craftsmen, i.e. as *homo faber*–and how it precisely relates to the private and public sphere is best understood in terms of two functional distinctions, respectively, between labor and work–of which Arendt stresses their separation–and between work and action–of which Arendt stresses their interdependence (Markell 2011). Regarding the distinction between labor and work there are three main differences. The first and main difference relates to a classic philosophical distinction between the notions of earth and world. While the former denotes all-natural surroundings, the latter represents human-made constructions. In this respect, Arendt argues that through labor we are essentially earth-bound, while through work we become world-building. In other words, labor is confined to the demands of our animality, biology and nature, while work violates these demands by shaping and transforming them according to our own plans. In contrast to labor,

work is thus a distinctly human activity. Second, precisely because work is controlled by human ends and intentions, it exhibits a certain form of freedom, in contradistinction to labor which is subject to sheer biological necessity. Third, since labor is concerned with satisfying one's own needs, it essentially remains a private matter. Work, on the other hand, contains an inherently public element; it creates an objective and communal world that stands between people and unites them. In doing so, work provides the conditions for the existence of a political community, where citizens can come together as members of that communal world to participate in speech and action. This last point brings us to the interdependence of work and action, which can easily be illustrated by the example of a table. A table is a worldly object which resulted from the activity of work. At the same time, a table enables a physical space in which people appear to each other. The object of a table thus provides a space for plurality to flourish, which in turn is the necessary condition for action.

Despite what our reading of Arendt suggests, work cannot be clearly set apart from labor, for its mediative character towards the public sphere is equally so towards the private sphere (Reijers 2020). In this respect, we identify the activity of work with a duality. On the one hand, as illustrated in the example of a table, work enjoys political significance and can be used for public purposes, such as parliamentary debates and federal court cases. On the other hand, to stick to the same example, the table can be made to sell for profit. Also in its usage, a table may accommodate private purposes such as bookkeeping and administration. A more contemporary example is illustrated by the smartphone, which is said to both facilitate and hinder public engagement (Cf. Böhmer et al. 2013). The duality at stake is also reflected in the way we commonly understand the notion of work, used to denote our daily jobs; we may do our job to earn a living, to contribute societally, and oftentimes for the sake of both (Morse & Weiss 1955). Hence, while the private and public sphere are constituted by labor and action, respectively, work can be understood as a means to accommodate either one of the two (see figure 2).[2]

Figure 2 The Duality of Work in the Vita Activa



The Duality of Innovation

The duality of work in the *vita activa* inspires us to identify the concept of innovation with a similar duality. On the one hand, as noted in Section 2, innovation is predominantly driven by a techno-economic orientation and widely presupposed in terms of technological and commercialized innovation. As claimed in the tradition of economic analysis, innovation is characterized by its technological dynamics and primarily directed at delivering value to consumers (Carlson and Wilmot 2006). As such, a techno-economic concept of innovation is based on rule-following logic and efficient means-end patterns (Blok 2021), particularly in response to the private pursuits of labor. Arendt, along with the phenomenological tradition, attributed this calculative logic to the threat of technology, ultimately warning for a victory of *animal laborans* over *zoon politikon* (Passerin 2019, Reijers 2020).

On the other hand, however, the conceptual origins of innovation suggest that innovation has little to do with technology, let alone with the market. Instead, for a large part of history, the concept of innovation had a fundamentally political meaning and was used as a pejorative to denote any change that threatened the established order (Godin 2015). Plato, for

example, accused the innovator of seeking to renew the eternal and a priori determined values of truth, beauty, and justice (Blok 2018). Moreover, throughout the literature on innovation studies, the concept of innovation is defined in terms of radical novelty–it changes 'the rules of the game'–and thus differs from a classic conceptualization of technology, which much rather adheres to the rule-governed logic described above. With the introduction of the printing press, for instance, Johannes Gutenberg launched a technology which not only served a specific end, but which in effect led to the reformation, undermined the authority of the Catholic church, gave birth to the modern sciences, enabled radically new industries, and even transformed the shape of our brains (Naughton 2019). Remarkably, nobody in 1450–which is around when Gutenberg's press was invented–could have predicted that printing would transform the world over the centuries to come. In this respect, it brings about an element of unpredictability, in striking contrast to how technology is classically conceptualized in terms of what we know and are always already familiar with (Heidegger 1977).

Against this background, we may posit a political concept of innovation that enhances the human capacity to speak up and take action, inspires radical novelty, and empowers the public sphere. Contrary to a techno-economic concept of innovation, which focusses much more readily on the further development of marketable technology trends–e.g. Iphone 8 making place for Iphone X–and in this sense is renovative rather than innovative, a political concept of innovation constitutes the worldly significance of, for example, the steam engine, the compass, and the lightbulb.

In the expressive sense of 'it takes two to Tango', a political concept of innovation inspired by the *vita activa* thus resides in the *interdependence* between work and action, for the mediative nature of the former enables the initiative potential of the latter. As such, a political concept of innovation constitutes an artificial world in which speech and action are brought to flourish; through facilitating both a physical (or virtual) infrastructure and a symbolic space of appearance, citizens are activated to engage with one another. This in turn provides the RI discourse with an alternative perspective, shifting its focus away from integrating ethical keys into a techno-economic concept of innovation, towards in effect operating a political concept of innovation. The question–to which we will turn in the next section–is how the RI discourse is to do so.

IV. A Vision of Strong RI

In light of the foregoing, we define strong RI as the operation of a political concept of innovation that primarily serves the public sphere, through which the human capacity for speech and action is actualized in a way that unleashes a plurality of perspectives, values, and possibilities. At the substantial level of RI this means that artifacts and services should get citizens to open up, speak their mind, and take initiative. Similarly, at the procedural level of RI, this means that innovation processes should expand their engagement with representative stakeholders to the direct involvement of citizens and allow for plurality to flourish. In the following, we will (1) account for three cornerstones in the actualization of speech and action; (2) show how these cornerstones translate into the operation of strong RI; and (3) illustrate what such an operation looks like at both the substantial and procedural level of innovation.

The first cornerstone constitutes *plurality*. Concretely, this means that the actualization of speech and action amounts to both a singular and a plural undertaking. For if to act means to open oneself up through words and deeds, it also means to make an appearance in public and engage with a plurality of others and their respective perspectives, values, and interests. This connection between the singular and the plural is perhaps best captured by what Jean-Luc Nancy calls the "singular plural of Being" which notes that "Being cannot be anything but being-with-one-another, circulating in the *with* and as the *with* of this singularly plural coexistence" (Nancy 2000, original emphasis, p. 3). In other words, to be ourselves we have to be with others. As such, the assertion of selfhood is not summoned to a collective identity, but rather integrated in a web of plurality. It is by virtue of this interwovenness between the singular and the plural that the individual can act and relate to others in ways that are unique and distinctive, guarding his or her opinion against the opinion of the mass. To this end, the first cornerstone articulates a plural mode of engagement, which in the context of strong RI bases innovation on a direct contact with citizens, welcoming and even encouraging their differences. In doing so, strong RI substantiates the wider claim that innovation should not only be *for* society, but also *with* society. While this claim is itself not new, this cornerstone provides us with a philosophical justification on the basis of political grounds. In this respect, it points to the need for public engagement rather than stakeholder engagement in innovation processes. In practice, citizens are often represented by stakeholders and only incorporated towards the end of the innovation process. This narrows the focus down to the private interests of the respective stakeholders, particularly in function of receiving their approval. In contrast, by

engaging with the public early-on, strong RI prevents generic deals and instead allows for situational solutions; no one-size-fits-all approach, but one in which public interests are also determined at micro-level, e.g. by taking into account the regional culture and socio-economic circumstances.

The second cornerstone constitutes *openness*. To be sure, the RI literature emphasizes that we should open up our reflections to one another (Owen et al. 2013). While this 'opening up' tends to be conceptualized either in terms of mutual responsiveness (Cf. Von Schomberg 2013) or constructive conflict (Cf. Blok 2014), the very 'openness' in which we actually can and do open up forms a primary condition for the actualization of speech and action. Therefore, beyond the question of *how* we should open up, the question is how innovation can lighten up a space which ensures *that* we open up. In what way can RI enable a space for citizens *to* open up, that is, to speak and to act? Against this background, strong RI safeguards both a literal and symbolic openness in which people are unafraid and even excited to freely engage with one another. A potential successful example can be illustrated by the Catalyst project, which in collaboration with the NEMO Science Museum in Amsterdam proposes an experimental platform of art and science fiction that stimulates citizens to envision and form an opinion on the city of the future. Such an approach also aligns ongoing initiatives of 'direct democracy'. In France, for instance, citizen councils are organized to publicly discuss the topic of climate change. Under the sway of strong RI, similar councils could be organized to tackle global challenges, including those that are 'politically' polarized like climate change. Precisely because public engagement stimulates different opinions, addresses situational priorities, and may quickly intervene in case of undesirable developments, it ultimately generates political support, even in a polarized climate.

The third cornerstone constitutes *performative speech acts*. In this, speech is not limited to describe a state of affairs, but in effect does or performs something (Blok 2017). This conjugation between speech and action can be explained in three respects. First, speech serves as a means to formulate the significance of our actions as well as those of others, e.g. by praising or condemning the emergence of Artificial Intelligence (AI). Second, the sincerity of speech is often evaluated by the corresponding action, e.g. when advocates of solar energy fail or succeed to live up to their promise. Third, speech serves to recognize the inherent infelicity of action, e.g. through a code of conduct (Cf. Blok 2017). On the basis of these three premises, strong RI links responsibility in innovation directly with the performativity of the actors

involved. RI discussions on innovations such as genetic modification and nuclear energy tend to be so abstract that they often result in the exclusion of the perspective of the producers, as well as those of citizens who employ these innovations. An inspiring example in this regard is the Debian Project of Linux, the free and open software alternative to closed and commercial computer systems. As explained by Andrew Maynard and Elizabeth Garbee (2019), Debian enables both developers and users to participate in and contribute to the computer processes and programs that they work with on daily basis. This Linux distribution has its own constitution, social contract, and policy documents, none of which are regulated or mandated by external policies or organizations. Instead, "the members of the Debian community take responsibility upon themselves to manage their activities in this way, and democratically create a structure that is deeply embedded in their shared values of transparency, open access, creating robust and dependable code, and contributing positively to the broader Linux community" (Maynard and Garbee 2019, p. 498). In this vein, strong RI emphasizes the action perspective of actors and their responsibility in innovation practices. This bridges the micro-level with the macro-level and at the same time reduces the feeling of powerlessness among citizens when debates on new developments emerge.

The operation of a political concept of innovation, i.e. strong RI, actualizes speech and action in accordance with the three above cornerstones. This means that strong RI is (1) principally a plural undertaking which guards individual opinion from collective opinion; (2) enables a physical (or virtual) and symbolic openness that genuinely activates citizenry; and (3) engages with performative speech acts. As such, strong RI can be operated at both the substantial and procedural level of innovation. To be sure, the literature on RI clearly distinguishes between these two levels. On the one hand, a substantial approach of RI focusses primarily on the innovation *artefact* or *service* and how it is to generate responsible outcomes, e.g. through integrating norms and values into the design (van der Hoven 2013). In the context of strong RI, this means that innovation artefacts and services should aim for the actualization of speech and action. Parallel to the Debian Project of Linux, the EU policy for Open Science seeks to introduce collaborative technologies that recognize and reward the participation of citizens and end users. In a similar vein, the Belgian government recently introduced an open platform for the public to engage in a debate on the topic of deactivating two nuclear plants.

On the other hand, a procedural approach of RI focuses primarily on the innovation *process* and how it is to be managed responsibly. To this end, particular attention is dedicated

to reaching shared strategies and objectives through stakeholder engagement (Gould 2012). However, as noted earlier, such an approach often results in narrow configurations of RI where deliberation is limited to a small range of mostly internal stakeholders and where "second-order reflexivity and the political are almost entirely beyond scope, or at least deeply tacit" (Owen & Pansera 2019, p. 41). Alternatively, under the sway of operating a political concept of innovation, strong RI takes a pluralistic and non-reductive approach of the innovation process, i.e. in accordance with the three cornerstones of actualizing speech and action. It is pluralistic in the sense that it extends the involvement of stakeholders with merely complementary disparities to the variety of values and interests of the wider public; and it is non-reductive in the sense that it does not reduce such involvement to 'common stakes', but instead aims to provide individuals with an openness for them to articulate their own stance and judgement, according to their own interests and value frames (van Huijstee et al. 2007). Moreover, strong RI realizes that inclusion does not de facto lead to societally desirables outcomes, meaning it commits to the promise of creating a better future, but acknowledges the possible infelicity in doing so. The aforementioned catalyst project serves as a good example of integrating citizens in the innovation process. Other examples include the New European Bauhaus and the implementation of the Green Deal, which stimulate conversations beyond usual circles, allowing for citizens to deliver insights concerning the most urgent needs and challenges in architecture and urban planning. To this end, the European Commission has launched a website and is currently exploring other possible tools dedicated to co-design and of co-creation.[3]

The operation of strong RI ultimately constitutes a web of human relations, where each thread is weaved through the actualization of speech and action. A positive implication of strong RI is that it prioritizes the choice, freedom, and uniqueness of the individual. In doing so, it encourages unconventional approaches that break free from the techno-economic tradition of innovation, as well as from other organizational, disciplinary, and bureaucratic boundaries. While we urge future research to further explore the relation between the singular and the plural, as well as the limitations of speech and action, the point we wish to make here is that in itself this relation constitutes a more meaningful understanding of collective responsibility in innovation processes that exceeds techno-economic ideology and opens up the possibilities of innovation.

V. Conclusion

In this paper we responded to the emerging call for an orientation shift from a techno-economic concept of innovation towards a political concept of innovation. In Section 2 we showed that the urgency for this shift is grounded in a conceptual ambiguity of RI, where the ambition to serve public interests is undermined by a techno-economic concept of innovation. Even though today's global issues urge innovation to go beyond the sole purpose of generating commercial impact–thereby paving the way for RI–innovation remains very much framed within a techno-economic context–thereby limiting the possibility of RI. For this reason, the call for a political concept of innovation has been made both explicit and urgent in the recent literature. This call suggests that RI does not simply entail an application of the 'R' to the 'I'–limiting its contribution to the private sphere–but constitutes the very transformation of the 'I'–fundamentally serving the public sphere.

To this end, in Section 3, we developed a political concept of innovation inspired by the *vita activa* of Hannah Arendt. We argued that, as such, the concept of innovation reflects a mediative character, facilitating *both* the private and the public sphere. In the same way the activity of work serves as a means to satisfy labor (private) and enable action (public), the concept of innovation is subject to a techno-economic orientation (private) and a political orientation (public). In light of the expressive sense of 'it takes two to Tango', we concluded that a political concept of innovation constitutes the interdependence between work and action. Through creating an artificial world in which citizens actively engage with one another, a political concept of innovation supports speech and action, inspires radical novelty, and empowers the public sphere. Departing from this insight, we opened an alternative path for the RI discourse, shifting its focus away from merely integrating ethical keys into a techno-economic concept of innovation, towards in effect operating a political concept of innovation.

To a certain extent our articulation of a political concept of innovation may also be understood as a *techno-political* concept of innovation. To be sure, Arendt–along with the phenomenological tradition–warned for the threat of technology, in particular for its inherently calculative logic. While we share the concern that this calculative logic limits the possibility of RI, we attribute this logic to the ways of the market much rather than to those of technology. In this respect, Gutenberg's press provided us with a compelling example of a technology that primarily impacted the public sphere. Therefore, under the sway of a political concept of innovation, technology is not necessarily summoned to economic requirements. Nonetheless,

a techno-political concept of innovation still excludes the possibility for other forms of innovation, such as social innovation (Howaldt et al. 2018), frugal innovation (Srinivas & Pandey 2019), and educational innovation (Freire 1970) which may equally enhance speech and action, inspire radical novelty, and empower the public sphere. For this reason, the all-encompassing sense of a political concept of innovation, which includes but is not limited to technology, better fits the purpose of RI.

In Section 4 we accounted for the operation of a political concept of innovation in the RI discourse; an operation we defined as strong RI. As such, we argued that strong RI primarily serves the public sphere through *actualizing* the human capacity for speech and action in a way that unleashes a plurality of perspectives, values, and possibilities. We considered three cornerstones in the actualization of speech and action through which we denoted that strong RI (1) is principally a plural undertaking which guards individual opinion from collective opinion; (2) enables a physical (or virtual) and symbolic openness that genuinely activates citizenry; and (3) engages with performative speech. At the substantial level of RI this means that artifacts and services should get citizens to open up, speak their mind, and take initiative. Similarly, at the procedural level of RI, this means that innovation processes should expand their engagement with representative stakeholders to the direct involvement of citizens and allow for plurality to flourish.

As such, strong RI politicizes the discourse on RI precisely in the way it was originally envisioned, that is, by making innovation a fundamentally political matter (Owen et al. 2013). In this view, politics is not merely an extension of RI but is itself the condition of RI; it is what enables innovation to genuinely serve the public good.

Notes

1. In a recent workshop on the challenges of RI, held in Leiden University (2019), speakers discussed "the mainstream challenge of RI" in which the discourse must decide whether to continue business-as-usual or to take a radical stance against it. In this respect, they pointed to both the conservative force and revolutionary potential of RI. For a summary report of the workshop see: https://app.box.com/s/z1uzybq083u1c3bs18iun7wi5r019maq
2. Note that, contrary to our analysis and that of Reijers (2020), a more general reading of Arendt suggests that action is by and in itself the *diferentia specifica* of the human

condition and must be considered in opposition to labor and work altogether (Passerin 2019).

3. https://europa.eu/new-european-bauhaus/index_en.

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CHAPTER 6

Discussion and Conclusions

Chapter 6 Discussion and Conclusions

This thesis took on the challenge to philosophically reflect on the nature of innovation in the emerging context of Responsible Innovation (RI). In this concluding chapter I will first briefly recap the main research objectives that came with this challenge and bring together the key findings of each chapter. On the basis of these findings, I will then discuss the main contributions of this thesis, account for the limitations it faces, and provide some recommendations for future research to explore. This brings me in a position to reflect on a range of broader insights, particularly in relation to (1) the philosophy of innovation; and (2) the ethics of socially disruptive technologies. I will conclude this chapter with some final remarks.

I. Summary of Findings

In the introduction I departed from the observation that while the RI discourse dedicates tremendous effort to developing governance frameworks to steer innovation processes towards societally desirable outcomes, little thought goes to what innovation itself means conceptually. At a descriptive level, the question was what concept of innovation is presupposed as self-evident and what implications this has for the ambition to achieve RI. At a normative level, the question was how the concept of innovation should be understood in order to genuinely serve the societal purpose of RI. In this respect, I distinguished between weak RI and strong RI, proposing two corresponding propositions:

P1. Weak RI seeks to govern a techno-economic concept of innovation through an applied set of ethical keys.

P2. Strong RI seeks to transform a techno-economic concept of innovation and constitutes a shift towards a fundamentally political concept of innovation.

On the basis of these overarching propositions, I formulated four research objectives, one for each chapter, respectively. In the following I will briefly recap the main objective and findings of each chapter.

Objective 1: To understand the emergence of RI and the main challenges it faces.

The first objective was to introduce the concept of RI and account for some of its main challenges. To do so, *chapter 2* explored how RI came to receive a prominent position in the discourse on science and technology. In this, I showed that RI resulted from a longer history of efforts to incorporate ethical dimensions in new and emerging technologies, such as Technology Assessment (TA) and Science and Technology Studies (STS). While similar to its precursors in prioritizing ethical concerns, one point in which RI clearly distinguishes itself is that it does not merely focus on what innovation *cannot* do, but also on what innovation *should* do, thus shifting from an ethics of constraints to an ethics of construction. I went on to show that such an attempt comes with an epistemic challenge (i.e. we cannot always know the outcomes of innovation), a political challenge (i.e. people have different values and perspectives when it comes to what innovation should do), and a conceptual challenge (i.e. the concept of innovation is widely presupposed as techno-economic which inhibits the societal ideal of RI).

Objective 2: To analyze and break open the concept of innovation in RI.

The second objective was to provide an extensive analysis of how the concept of innovation is generally understood in both research and policy documents of RI, and to critically account for whether this is de facto what it means to innovate. On the one hand, *chapter 3* demonstrated that for a large part the RI discourse presupposes the concept of innovation in terms of an intrinsic link between technology and the market, as coined by the term technological innovation and interchangeably used with the term commercialized innovation (what I have also come to call a techno-economic concept of innovation). On the other hand, the chapter reflected on the history of innovation to show that the concept of innovation was in fact politically oriented and had little to do with how we understand innovation today. While acknowledging the ways in which a techno-economic concept of innovation can and does bring about societally desirable outcomes, I argued that it is in fact in the attempt to *steer* innovation that this presupposed concept of innovation becomes questionable. To this end, I provided some initial directions for future research to explore an alternative concept of innovation; one that does justice to its political origins.

Objective 3: To assess the feasibility of RI from a perspective of the philosophy of technology.
The third objective was to engage with the philosophy of technology to assess whether RI is possible insofar it presupposes a techno-economic concept of innovation. To this end, *chapter 4* established RI as a new subdomain of the philosophy of technology. In doing so, I noted that RI incorporates a rather non-essentialist view of innovation. I showed that while RI has a tendency to account for particular innovations (i.e. at the ontic level), it oversees the techno-economic pattern all these innovations seemingly share (i.e. at the ontological level). Parallel to Martin Heidegger's view on technology as Enframing, I argued that despite intentions to prioritize the societal purpose of innovation, the RI discourse ultimately remains constrained to the calculative ideology inherent in a techno-economic concept of innovation.

Objective 4: To operationalize a political concept of innovation in RI.
The fourth objective was to constitute a shift from a techno-economic concept of innovation towards a political concept of innovation in the RI discourse (i.e. from weak RI to strong RI). To this end, *chapter 5* found inspiration in the work of Hannah Arendt to establish a political concept of innovation that actualizes the human capacity for speech and action, inspires radical novelty, and empowers the public sphere. In doing so, I concluded that strong RI (1) is principally a plural undertaking which guards individual opinion from collective opinion; (2) enables a physical (or virtual) and symbolic openness that genuinely activates citizenry; and (3) stimulates performative speech. At the substantial level of RI this means that artifacts and services should get citizens to open up, speak their mind, and take initiative. Similarly, at the procedural level of RI, this means that innovation processes should expand their engagement with representative stakeholders to the direct involvement of citizens and allow for plurality to flourish.

II. Main Conclusions: Contributions, Limitations, and Recommendations
By meeting the four research objectives, it is now time to reflect on the main contributions and limitations of this thesis.

A first and perhaps more evident contribution is that the thesis breaks open the concept of innovation in RI. Noticeably, throughout conferences and workshops of RI, the conceptual question recurs: what is responsible innovation? This thesis essentially invites us to take a step back and ask: What does it mean to innovate? And how does reflecting on this question

contribute to the question on how to innovate responsibly? Such an investigation is especially timely in an age where innovation is said to be the primary mission of both policy and research, but where at the same its meaning is taken for granted. By drawing attention to the concept of innovation, I comply with efforts such as Blok & Lemmens (2015) and Timmermans & Blok (2018) to help raise self-awareness of the RI community about presuppositions and their barriers to reaching the societal ideal. Important to note here is that my contribution does not so much reside in my concern with the techno-economic ideology of innovation as such – a concern which RI in fact already expressed when it first emerged – but more so in my critique to the idea that we can somehow overpower this ideology through governance and regulation. This is where the philosophical distinction between the ontic and the ontological has proven to be fruitful. At an ontic level, the RI literature is rich in critical approaches to innovation in fields ranging from agriculture and medicine to nanotechnology and robotics. Geoengineering (Stilgoe et al. 2013) and synthetic biology (Stemerding 2019) are good examples of where the adoption of RI has been effective. However, at the ontological level RI remains deeply entangled with a techno-economic concept of innovation. In pointing to this ontological dimension I essentially provide an explanation for the ongoing instrumentalization of the RI discourse, where the recently established keys are turning RI into a tick-box exercise, to the dismay of its founding fathers (Owen et al. 2021).

At the same time, the rehabilitation of an ontological dimension in RI provides the philosophy of technology with a new perspective. To be sure, contemporary philosophers of technology have taken distance from ontological views of technology, arguing that each technology mediates the human-world relation in its own way (Verbeek 2005). But there is a much more encompassing ring to the sound of innovation. When we speak of innovation, we do not merely refer to *this* or *that*. We see it as virtue, a driving force for success, and the solution to all societal problems. For today's *Homo Innovatus* not to innovate means to die (Freeman & Soete 1982). Therefore, under the sway of innovation – as *the* ontological category of our age – technology does not only mediate but is itself mediated. In other words, while acknowledging the ontic differences among technologies – e.g. a drone and a laptop are very different both in purpose and use, as well as in the way they mediate the human-world relation – these technologies are nonetheless ontologically embedded in our age of innovation. To a certain extent, I reawaken the spirit of a more classical account of the philosophy of technology which also saw an underpinning force at play in the emergence of new technologies. However,

unlike such a classical account, I take distance from the pessimistic idea that this underpinning force is bound to pure calculation with little hope left humanity. Instead, precisely because the meaning of innovation is much broader and more political than the tradition of economic analysis may suggest, I see the possibility for technology to be ontologically embedded in the public sphere.

This brings me to the next contribution of this thesis: establishing a political concept of innovation in the RI discourse. In doing so, I substantiate one of the foundational claims of RI, namely that in order for innovation to be *for* society, it needs to be *with* society. To be sure, while RI aims to include society in innovation processes, discussions on political questions concerning, for instance, which actors to include and how they are expected to co-create outcomes remain scarce throughout the literature (Van Oudheusden 2014). Through articulating a political concept of RI, I respond to this lacuna and essentially provide a vision of (1) what it actually means to include society in innovation processes; (2) why it is important to do so; and (3) how this can be operationalized (see Table 1).

Table 1 Strong RI: Overview (for a more detailed account see *chapter 5*)

Explanation: What?	**Justification: Why?**	**Operation: How?**
Both at substantial and procedural level, strong RI aims for the actualization of individual speech and action. It gets citizens (beyond representative stakeholders) to open up, speak their mind, and take initiative.	The actualization of speech and action enables the human capacity to begin something completely new and unexpected, thereby exceeding private interests towards genuinely serving public interests.	The operation of strong RI requires: (1) A plurality of values and perspectives; (2) A physical (or virtual) and symbolic openness that invites and activates plurality; (3) Performative speech.

This vision aligns the target goals of Horizon Europe, the new EU Framework Program for Research and Innovation that runs from 2020 to 2027, which calls for a mission-driven approach that continues to feature big-picture research targeted at delivering societally desirable outcomes. In this view, "missions must be bold, activating innovation across sectors, across actors and across disciplines. They must also enable bottom-up solutions and experimentation" (European Commission 2018, p.2). Strong RI contributes to laying a conceptual foundation for this mission-oriented approach and ultimately enhances the 'boldness' Horizon Europe calls for.

At this stage, strong RI is mostly conceptually founded and could still benefit from further empirical analysis. In *chapter 5* I referred to the Debian Project of Linux as a potential example of an innovation that actualizes the speech and action of both its developers and users. Through participating in and contributing to the computer processes and programs, both users and developers collectively create their own constitution, social contract, and policy documents, none of which are regulated or mandated by external policies or organizations. Additionally, I showed how ongoing initiatives of 'direct democracy' such as citizen councils could stimulate opinions and address situational priorities on polarized topics like climate change. While examples as these are promising, they still require a more in-depth assessment. To what extent do they really succeed to actualize individual speech and action? And is this effectively creating a better a future for all? Future research still needs to develop a performance measurement system (Cf. Neely et al. 1995) that uses key indicators to monitor how innovation processes and artefacts effectively enable citizenry, and to what extent doing so helps tackling the so-called grand challenges of our time.

Also at the conceptual level, the basic assumption that in order for RI to genuinely serve society it needs to exceed economic incentives could benefit from further critical analysis. From a neoliberal perspective, for instance, it could be argued that economic and societal purposes do not conflict with one another, and that market competition even serves as a driving force for tackling global issues. For example, catalytic converters are improving air quality significantly, while engineered microbes are successfully producing biodegradable plastics. An important nuance here, however, is that while these may not be examples of strong RI in the strict sense of enhancing speech and action, they may still very well be forms of responsible innovations. In this respect, the distinction between weak RI and strong RI is essentially made to denote the (lack of) politics in RI. A political concept of innovation can help face the complexity and epistemic uncertainty of the future, without undoing the societal potential of techno-economic developments.

Moreover, the operation of strong RI could be posed with the particular challenge to find a balance between under-inclusion and over-inclusion. While this thesis mostly points to the problem of under-inclusion in RI, there are also potential socio-ethical risks with over-inclusion, especially when people foster dishonest and even terrorizing intentions (Popa & Blok, forthcoming). In this respect, it will be a crucial step to discuss and establish criteria for

speech and action in a way that enhances plurality and genuinely helps to reveal each other's blind spots and assumptions, while maintaining respect for each other's differences.

III. Broader Insights

On the basis of the findings and conclusions made by this thesis, in the following I provide two brief reflections on the philosophy of innovation and the ethics of socially disruptive technologies, respectively.

Philosophy of Innovation

The historical analysis of innovation by Benoit Godin sheds light on the large conceptual space of innovation, emphasizing that "innovation in literature can corrupt or perfect taste; in religion, excite or calm troubles; in politics, save or ruin a nation" (Godin 2015, p. 166). This history of innovation ultimately paves the way for a philosophy of innovation and brings into question what innovation really is. Throughout its different meanings, contexts, and usages, what is *true* innovation? Precisely because the concept of innovation structures the way we think and do things today, philosophical reflection of this kind is both timely and urgent (Este 2013). Although Godin explicitly refuses to engage with such reflection, he does suggest that two characteristics of innovation are determinant, 'the quest for freedom' and 'action', respectively. While a philosophy of innovation is still in its infancy and its different dimensions are only in the initial stages of their development (Blok 2021), these characteristics could be reiterated to further explore its political dimension. To a certain extent, this thesis contributes to doing so through articulating a shift from a techno-economic concept of innovation to a political concept of innovation. On the one hand, a techno-economic concept of innovation disables the possibilities of innovation in its broadest sense, excluding other forms of innovation such as social innovation (e.g. fair trade) and attitudinal or behavioral innovation (e.g. lifestyle interventions). In this respect, the quest for freedom and space for action inherent in innovation are summoned to pure calculation. On the other hand, the operation of a political concept of innovation is all about the actualization of action. Through action, in turn, individuals experience the freedom to reveal who they really are and what they actually stand for.

Ethics of Socially Disruptive Technologies

Socially Disruptive Technologies (SDTs), such as artificial intelligence and robotics, promise to radically change the way we live. Notwithstanding their potential to tackle global issues, these technologies raise several socio-ethical concerns. A common concern, for instance, is that the automatization of society will lead to significant unemployment. More fundamentally, SDTs intervene with our human autonomy and interdependence, while at the political level they challenge foundational concepts, such as justice and democracy. From the perspective of strong RI, the question is how these technologies ultimately affect the human capacity for speech and action, and whether they allow for plurality to flourish. In this view, the algorithms of social media, for example, could be criticized for only connecting people from their own bubble with similar interests, thus limiting the possibility for a plurality of values and perspectives, while attributing speech an action with a rather superficial role. The same holds for the online spreading of misinformation and disinformation, which in a recent report of the *State of the World's Girls* (2021) demonstrates to restrict girl's activism worldwide. One out of four girls feel less confident to share their views and one out of five girls stop engaging in politics or current affairs altogether.

A particular challenge emerges when SDTs are used to collect data of citizens at an unprecedented scale. In *The Age of Surveillance Capitalism*, Shoshana Zuboff (2019) sees these SDTs as an extension of capitalism, arguing that that they are created by big-tech corporations who seek to predict and preconfigure human behavior for the sake of profit. Google, for example, was originally introduced as a public service for people to search information, but its users are now in turn being searched and extracted information from. Not only is this information then traded with other markets, but also used to manipulate future behavior. Parallel to the way in which psychologist B. F. Skinner famously developed methods of operant conditioning to modify and control the behaviour in living organisms, private enterprise is now manipulating human action at global scale.

> Industrial capitalism transformed nature's raw materials into commodities, and surveillance capitalism lays its claims to the stuff of human nature for a new commodity invention. Now it is human nature that is scraped, torn, and taken for another century's market project. […]. The remarkable questions here concern the facts that our lives are rendered as behavioral data in the first place; that ignorance

> is a condition of this ubiquitous rendition; that decision rights vanish before one even knows that there is a decision to make; that there are consequences to this diminishment of rights that we can neither see nor foretell; that there is no exit, no voice, and no loyalty, only helplessness, resignation, and psychic numbing; and that encryption is the only positive action left to discuss when we sit around the dinner table and casually ponder how to hide from the forces that hide from us. (Zuboff 2019, p. 94)

In this respect, SDTs are posing a threat to the existence of a public sphere, for the human capacity to spontaneously say and do things is reduced to a bare minimum.

Nevertheless, the question is whether Zuboff's critique is directed to the emergence of SDTs as such or rather to its capitalist extension (Morozof 2019). To be sure, while capitalism may no longer thrive without the use of SDTs, SDTs may still serve purposes beyond capitalism. For example, blockchain technology could potentially provide citizens with an intelligent system that enables them to instantly engage with politicians and governmental decisions (Krasadakis 2020). It could establish an always-on performance dashboard that allows the wider public to track the contributions of governments and politicians against their promises and political commitment. It could also enable citizens to instantly share their feedback on governmental actions and decisions, efficiently composed and summarized through the use of analytical techniques and artificial intelligence. In this sense, SDTs carry the potential to empower the public sphere, enabling citizens to participate in politics at any place and any time.

In discussing the ethics of SDTs, a key take-away of this thesis is to focus on how these technologies precisely relate to the human capacity of spontaneously saying and doing things in public. In this, it will be important to assess if and how STDs can create a space that genuinely activates citizenry, while allowing for plurality to flourish.

IV. Final Remarks

This thesis departed from the observation that while the concept of innovation defines our age, it is predominantly presupposed in terms of the commercial value it generates. Even though the emergence of RI aspires to initiate a shift in the innovation discourse, away from mainstream economic interest towards societally desirable outcomes, this aspiration is shown

problematic when the overall focus is limited to governance and regulation. What is really needed is a political concept of innovation that is fundamentally embedded in the public sphere. While the political significance of innovation is already reflected in historical inventions like the washing machine, which freed women from the shackles of laundry and ultimately contributed to the equality of men and women, strong RI essentially reiterates this significance though philosophically exploring what it means to include society at both the substantial and procedural level of innovation.

The spirit of this exploration is perhaps best captured in the following concluding note. During a recent RI workshop, a representative of an organization called 'UK Innovation' explained how his team is in charge of funding over 3000 companies. The challenge is that while they only aim to fund companies that explicitly engage in RI, there is no concrete guidance as to how these companies are to do so and thus no concrete guidance for them to evaluate these companies accordingly. He then used the metaphor of an orchestra to illustrate the importance of guidance and harmony in order to deliver a good piece of music, in the same way guidance and harmony are crucial in coordinating 3000 companies to deliver responsible innovation. But if the ambitions of RI are taken seriously and understood in light of a profound, philosophical if you will, understanding of innovation on the one hand, and politics on the other, then a political concept of innovation is not simply the result of a harmonized process grounded in a defined set of rules. To stick to this metaphor, it is not just about making new music; it is, as Plato defined innovation – ironically using the same metaphor – about making a *new way* of music. Strong RI does not entice the musician to simply join the music and continue business as usual; it entices the musician to spontaneously play a radically new tune.

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Summary

The concept of innovation defines our age. It fuels the global economy, promises a sustainable future, and stands at the heart of our interconnected society. On the one hand, the concept of innovation is widely presupposed in terms of the commercial value it generates. As claimed in the tradition of economic analysis, innovation is characterized by its competitive dynamics and primarily directed at developing marketable products and services. On the other hand, the reality of today's global issues, such as climate change and food security, urges innovation to generate societal value beyond mainstream economic incentive. To this end, the EU policy discourse has paved the way for Responsible Innovation (RI). The core idea here is to steer innovation processes towards societally desirable outcomes, specifically in response to the 'grand challenges' of our time. Under the sway of 'science with and for society', the hypothesis is that innovation can only respond to the needs and ambitions of society by including all its actors throughout the process.

However, while much effort is dedicated to governing innovation, little thought goes to what innovation itself means conceptually. What understanding of innovation underpins the framework of RI? What implications, if any, does this have for the ambition to achieve RI? These are important questions to raise as they enable critical reflection on the relation between responsibility and innovation, broadly speaking. Does the 'R' in RI entail an application of ethical keys to an already existing concept of innovation, or does it require us to rethink the concept of innovation altogether?

After providing a general introduction in chapter 1 on the context of the dissertation and its main research objectives, chapter 2 shows how RI emerged from a longer history of efforts to incorporate ethical dimensions in new and emerging technologies, such as Technology Assessment (TA) and Science and Technology Studies (STS). While similar to its precursors in prioritizing ethical concerns, RI clearly distinguishes itself by shifting from an ethics of constraints to an ethics of construction. The chapter continues to show that such an approach comes with an epistemic challenge (i.e. the outcomes of innovation cannot be known in advance), a political challenge (i.e. people have different values and perspectives when it comes to what innovation should do), and a conceptual challenge (i.e. the economic ideal of innovation inhibits the societal ideal of RI).

Through an extensive analysis of policy documents and academic literature, chapter 3 breaks open the concept of innovation in the RI discourse. Firstly, it demonstrates that the RI discourse tends to presuppose a techno-economic concept of innovation, as coined by the terms 'technological innovation' and 'commercialized innovation'. Secondly, it provides a historical analysis to show that the concept of innovation was originally politically oriented and had little to do with the way in which it is commonly understood today. Thirdly, it discusses the implications of a techno-economic concept of innovation for achieving the ideal of RI and brings into question whether the political origins of innovation may inspire an alternative route.

Chapter 4 engages with the philosophy of technology to assess the feasibility of RI at both an ontic and ontological level. While innovation at the ontic level refers to concrete innovative artefacts, innovation at the ontological level refers to the mode through which these artefacts are seen, understood, and created. At the ontic level, RI is shown to play a significant role in steering emerging technologies towards societally desirable outcomes. Even so, at the ontological level, the question is whether the ideal of RI is feasible insofar its scope is limited to governing a techno-economic concept of innovation. Parallel to Martin Heidegger's view of technology as Enframing, this chapter denotes that in trying to govern a techno-economic concept of innovation, the RI discourse remains subject to its dominance. This in turn explains why, at the operational level, RI is often employed for mere strategic and instrumental purposes, while falling short on its promoted ambitions.

Chapter 5 articulates an orientation shift from a techno-economic concept of innovation towards a political concept of innovation in the RI discourse. To this end, the chapter distinguishes between weak RI, which seeks to govern a techno-economic concept of innovation through an applied set of ethical dimensions; and strong RI, which seeks to conceive a political concept of innovation beyond techno-economic ideology and practice. Inspired by the work of Hannah Arendt, the chapter establishes a political concept of innovation that actualizes the human capacity for speech and action, inspires radical novelty, and empowers the public sphere. In doing so, the chapter concludes that strong RI (1) is principally a plural undertaking which guards individual opinion from collective opinion; (2) enables a physical (or virtual) and symbolic openness that genuinely activates citizenry; and (3) stimulates performative speech.

The final chapter, chapter 6, briefly recaps the main research objectives and takes stock of the insights gained. It concludes that the contribution of this dissertation does not reside in

the concern with the techno-economic ideology of innovation as such – a concern which RI in fact already expressed when it first emerged – but more so in the ontological critique to the idea that this ideology can somehow be overpowered through governance and regulation. The rehabilitation of an ontological dimension in RI in turn provides a new perspective to the philosophy of technology, which over the years has taken a course away from ontological viewpoints. Moreover, the chapter elaborates on how a political concept of innovation adds depth to the foundational claims of RI. Based on these conclusions, the chapter reflects on a range of broader insights, particularly in relation to the philosophy of innovation and the ethics of socially disruptive technologies.

In sum, this dissertation politicizes the RI discourse precisely in the way it was originally envisioned, that is, through conceptualizing innovation as a fundamentally political matter. In this view, politics is not merely an extension of RI but is itself the condition of RI; it is what enables innovation to genuinely serve the public good.

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Lucien von Schomberg
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Wageningen School of Social Sciences

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
"Towards a Techno-Political Concept of Innovation"	Philosophy of Human-Technology Relations Conference (PHTR)	2020	1
Research Visit	Social Sciences and Humanities Research Council of Canada (SSHRC)	2020	3
"Towards a Phenomenology of the Quadruple Helix"	European Triple Helix Congress on Responsible Innovation and Entrepreneurship (ETHAC)	2019	1
Research Visit	Institut National de la Recherche Scientifique (INRS)	2019	1
Research Visit	Arizona State University (ASU)	2019	2
"Technology in the Age of Innovation"	Society of New and Emerging Technologies Conference (S.NET)	2018	1
"Society of Philosophy and Technology Conference"	Society of Philosophy and Technology Conference (SPT)	2017	1
Research Proposal	Wageningen University & Research (WUR)	2017	6
WASS Introduction Course	WASS	2017	1
B) General research related competences			
Study Group PHI (Paper discussions, state of the art literature, presenting research)	PHI (WUR)	2016-2021	4
Study Group Philosophy of Innovation/ Philosophy of Technology	PHI (WUR)	2016-2021	2
Organization of public lecture and workshop: Benoit Godin & the idea of innovation	WASS	2017	1
Accreditation of Prior Learning (APL): - Philosophy of Responsible Research and Innovation (OZSW) - Technology, Society, Environment (KUL) - Ethical Theories and the Moral Life (KUL) - Philosophy of Education and Teaching (KUL) - Modernity and its Discontents (KUL) - Themes in Metaphysics (KUL) - Philosophy of Religion (KUL) - Common Seminar (KUL)	OZSW/KUL	2014-2016	12
C) Career related competences/personal development			
Teaching: - Philosophy and Ethics of Management, Economics, and Consumer Behaviour - Ethiek, Gezondheid en Maatschappij - Analyse van een Probleemveld (Voeding & consument, Migratie) - Ethical & Societal Aspects of Plant Biotechnology	CPT (WUR)	2017 - 2021	4
Total			**40**

*One credit according to ECTS is on average equivalent to 28 hours of study load

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In 2015, Lucien graduated with distinction in philosophy from the KU Leuven (Belgium). He specialized in continental philosophy with notable interest in existential phenomenology and traditional metaphysics. This led to a PhD project in the field of responsible innovation at Wageningen University (Netherlands). The results of this project are presented in his doctoral dissertation, entitled *Raising the Sail of Innovation: Philosophical Explorations on Responsible Innovation*. In 2019, Lucien went on research visits to Arizona State University (United States) and the Institut National de la Recherche Scientifique (Canada). In 2020, he worked as an international research consultant for the Social Sciences and Humanities Research Council of Canada (SSHRC) to explore the challenges of interdisciplinarity. Since 2017, Lucien has been teaching on topics related to philosophy, innovation, and entrepreneurship. In addition to his academic career, Lucien is an UEFA-Advanced licensed football coach and scientist with more than ten years of international coaching experience.

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Colophon

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