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What Is Innovation? Laying the Ground for a Philosophy of Innovation

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Abstract: In this article, I reflect on the nature of innovation to lay the groundwork for a philosophy of innovation. First, I contrast the contemporary techno-economic paradigm of innovation with the work of Joseph Schumpeter. It becomes clear that Schumpeter's work provides good reasons to question the techno-economic paradigm of innovation. Second, I contrast 'innovation' with 'technology' and identify five differences between the two concepts. Third, I reflect on the process-outcome dimension and the ontic-ontological dimension of innovation to develop four characteristics of the phenomenon of innovation. These four characteristics move beyond the techno-economic paradigm of innovation and highlight, first, the importance of its process dimension understood as ontogenesis, second, the outcome of innovation, and third, the importance of the ontological dimension of innovation, which is considered adjacent to its fourth characteristic, i.e., the ontic level of the outcome of innovation. After drawing conclusions, a research agenda for future research is provided.

Key words: innovation, ontogenesis, philosophy of technology, technology, Schumpeter

1. Introduction

In our current society, we are overwhelmed by new innovative products and services on a daily basis, ranging from consumer products like smart consumables to nano- and bio-technologies that mitigate climate change; from novel business models like Uber to the social media enhancement of political engagement. Policymakers foster innovation as well. In 2017, the European Commission released a statement arguing that we "need to do much better at turning our research into new and better services and products if we are to remain competitive in the global

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marketplace and improve the quality of life in Europe" (European Commission 2017). It is safe to say that our society is characterized by a fascination with and quest for innovation (Nowotny 2006). This fascination is further characterized by a so-called 'pro-innovation bias,' whereby "[r]esearchers have implicitly assumed that to adopt innovations is desirable behaviour (rational) and to reject innovations is less desirable (irrational)" (Rogers 1962, cited in Godin 2015, 235–36). In this view, innovation is uncritically regarded as a good thing (Rogers 1976) and self-evidently taken as a *panacea* for a wide range of socio-economic problems, ranging from the financial crisis to climate change, and from public health issues to welfare in developing countries (Godin 2015). For institutions like the Organization for Economic Cooperation and Development (OECD) and the European Commission (EC), it is self-evident that "most current social, economic and environmental challenges require creative solutions based on innovation and technological advance" (OECD 2010, 30; cf. European Commission 2010).

At the same time, the notion of innovation itself seems to be taken for granted in these policy documents, as well as in scientific literature (Godin 2015). In management and economics textbooks, innovation is often defined as "the first commercial application or production of a new process or product" (Freeman and Soete 1997, 1). We are familiar with dichotomies like incremental versus disruptive innovation (Christensen 1997), or closed versus open innovation (Chessbrough 2003, 2006)—but what does the notion of innovation itself mean? While the Cambridge dictionary defines innovation very broadly as a "means to introduce changes and new ideas" which originally concerned *novelties* in the broadest sense of the word (including imitation, invention, change), it is nowadays self-evidently understood as the *commercialization* of *technological* inventions (cf. 2.1).

In this article, I reflect on the nature of innovation in order to contribute to the development of a philosophy of innovation. Philosophical reflection on the concept of innovation is important because it is an emblematic notion that characterizes our time (Godin 2008). Why did innovation become so important by the end of the 20th century that it became emblematic? Why is innovation self-evidently associated with technology and commercialization? What does it mean that the ideal of innovation is nowadays extended to all aspects of social life, ranging from innovation in healthcare to innovation in politics? And, perhaps more fundamentally, to what extent can innovation be understood as a category of human existence and the world in which we live? Shouldn't we ask: *why* innovation? In light of these questions, it is unclear whether the self-evident understanding of innovation remains appropriate. Without a critical reflection on this self-evident

understanding of innovation, philosophy of innovation, Science and Technology Studies (STS), and innovation studies remain restricted by the techno-economic paradigm of innovation (Schomberg and Blok 2018), while neglecting their essential task to develop new theories to answer these questions.

In this article, I employ the philosophical method of explorative confrontation to examine the concept of innovation and develop a critical understanding of innovation in contrast with technology (Blok 2020). Our approach here is explorative because it moves toward a deeper understanding and interpretation of scholarship about innovation, in this case the analysis and examples provided by Joseph Schumpeter, an influential economic thinker whose work exemplifies many of the elements typical of the contemporary notion of innovation. My approach is confrontational because I analyse and disrupt the preconceptions held by Schumpeter to develop a philosophical understanding of innovation.[1]

Although many authors before and after Schumpeter have contributed to today's understanding of innovation (Godin 2015), my focus on Schumpeter in this article is justified as my main aim is not so much to provide a historical account of the emergence of innovation, but to contribute to the development of new theory. Schumpeter's work helps explain why innovation is normally understood from within a techno-economic paradigm, while at the same time providing good reasons to question the self-evidence of this conceptualization. Like many others, Schumpeter associates innovation with technology, but his notion of creative destruction enables me to question a unilaterally progressive understanding of technological innovation. Drawing upon Schumpeter's conceptualization of innovation, I am able to theorize about the concept beyond its self-evident association with commercialization and technology.[2]

Because philosophical reflection on innovation is still in its infancy—in fact, neither the philosophy of technology nor philosophy in general theorize about innovation—I do not pretend to develop a full philosophy of innovation in this article. Instead, I lay the groundwork for such a philosophy by making four contributions. First, I critically analyse the self-evidence of the techno-economic paradigm of innovation to raise the question: what is innovation (2.1)? Second, because innovation is self-evidently associated with technology and economy, I turn to Joseph Schumpeter (2.2). Third, I contrast innovation with technology in order to open up the concept of innovation for philosophical reflection (2.3). There are two reasons for this approach. On the one hand, because Schumpeter self-evidently associates innovation with technology as well, a reflection on technological innovation seems to be a good access point to reflect on innovation.

On the other hand, because the philosophical underpinning of innovation remains unclear, while philosophy of technology is an advanced field of study, a reflection on technological innovation seems to be a good access point to reflect on innovation. By contrasting innovation with technology, it will turn out however that it is at least questionable to employ 'technology' to find an answer to our question. For this reason, I leave the techno-economic paradigm behind and reflect on two other dimensions of innovation in section two: the process-outcome dimension and the ontic-ontological dimension of innovation. These dimensions enable us to develop four characteristics of the phenomenon of innovation. Finally, I draw conclusions and provide a research agenda for future research in the emerging subdomain of philosophy of innovation, which resides at the intersection of philosophy of technology and philosophy of (techno)science.

2. Opening Up the Taken-for-Granted Concept of Innovation

2.1. The Self-Evident Notion of Innovation in Contemporary Reflections on Innovation

In a recent study, Benoit Godin analysed the history of the innovation concept. Although the concept of innovation has existed throughout history and has concerned *novelties* in the broadest sense of the word—including imitation, invention, creative imagination, and change—it has recently become restricted to *technological* innovation (Godin 2015; Bontems 2014; Blok and Lemmens 2015). What is more, innovation is now not only associated with the exploration of new technologies, but also with the commercial exploitation of these new technologies (Schomberg and Blok 2018).

A first characteristic of this techno-economic paradigm of innovation can be found in scientific literature on the phenomenon of innovation.[3] Edward S. Phelps defines a successful innovation in terms of its ability to find a "demand among users sufficient to warrant putting the innovation into regular production" (Phelps 2009, 68). Phelps analyses the emergence of innovation in terms of the interaction between 'flow supply' of new ideas coming from entrepreneurs and 'flow demand' from financiers (Phelps 2009, 49); in his work, the economic paradigm of innovation becomes clear, while the concept of innovation itself remains underarticulated. Similarly, Eric von Hippel discusses the shift from manufacturer-centric innovation to user-centred innovation that threatens the innovation model that have been the mainstay of commerce for hundreds of years (von Hippel 2005, 1); once again, the economic paradigm of innovation becomes clear, while the concept of

innovation itself remains implicit. The same holds for classical dichotomies in innovation literature, like incremental versus disruptive innovation (Christensen 1997), or closed versus open innovation (Chessbrough 2003, 2006). While it is not clear what the notion of innovation itself means, it often remains taken for granted in this literature.

A second characteristic of the techno-economic paradigm of innovation can be found in management and economics of innovation textbooks. In these textbooks, innovation is defined as "the first commercial application or production of a new process or product" (Freeman and Soete 1997, 1). And although innovation management literature acknowledges that innovation can also exist in the form of new services, it self-evidently associates innovation with a *technological* invention—the technology behind Facebook's or Amazon's services, for example,which enables the company to provide new services like social media platforms and online bookstores. In his textbook on innovation, Smith for instance argues:

> Hence innovation embraces both a technological and a creative dimension, that we normally refer to as invention, together with a commercial dimension that involves the exploitation of the invention to turn it from a model or prototype into something that is available in the market for consumers to purchase. This latter aspect is much less heroic and less glamorous then invention, but it is crucial. Without it an invention is little more than a great idea, and all too often this is an element of innovation that is neglected, with disappointed consumers the result. Only when both aspects have been effectively handled does one have an innovation. (Smith 2006, 6)

Even if we accept the 'innovation imperative' that is dominant in engineering and business schools (Bessant and Tidd 2007), and even if we embrace the OECD's and the European Commission's definition of innovation in the *Oslo Manual*—"the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD 2005)—it remains unclear what the philosophical underpinnings of this notion are.

2.2. Schumpeter: One of the Founding Fathers of Innovation as Technological And Commercial Innovation[4]

If the concept of innovation remains underarticulated in contemporary literature while a techno-economic paradigm dominates our understanding of innovation, the question remains where this dominant conceptualization comes from. One of the founding fathers of our understanding of innovation and its intrinsic relation

to technology and economy is the economist Joseph Schumpeter (1883–1950) (Bessant and Tidd 2007).[5] According to Schumpeter, the "capitalist enterprise" and "technological progress" are "essentially one and the same thing" (Schumpeter 1943, 110). The entrepreneur is always seeking new business opportunities. By doing things differently than others, i.e., by introducing innovative technologies into his business practices, the entrepreneur enhances and secures his competitive advantage over competitors. Because competitors will try to copy the entrepreneur's innovation to secure the market for themselves, and because large firms have an advantage over small firms, according to Schumpeter, the entrepreneur has to continually explore new innovative business ideas, marketing strategies, etc. According to Schumpeter (1943), this cycle, in which entrepreneurs explore and exploit innovations to achieve a temporary monopoly, which are then copied by large firms and necessitate new innovations by the entrepreneur etc., is what drives the economy.

For Schumpeter, innovation not only concerns an invention at the product or service level but is also connected with what he calls 'economic waves'. Following initial work by Nikolai Kondratieff, Schumpeter studies long economic waves that are driven by clusters of industries and can be associated with technological shifts—for instance the wave starting around 1845 associated with steam power and innovations in the railway industry, or the wave starting around 1900 associated with electricity and innovations like the internal combustion engine (Schumpeter 1983). Hence, for Schumpeter, it is *technological* innovation that plays a key role in economic development.

Schumpeter's conceptualization of innovation resonates with the self-evident understanding of technological and commercial innovation found in the abovementioned OECD and EC frameworks. And yet, Schumpeter diverges from our common understanding of innovation when he talks about *waves* and not about an endless economic progress. According to Schumpeter, entrepreneurs disrupt the

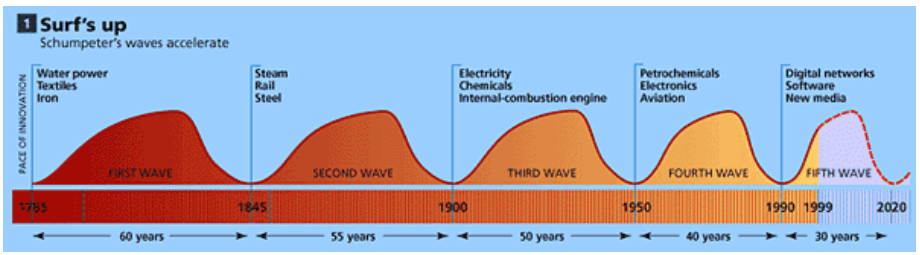

Fig. 1. Schumpeter's business cycles (source: The Economist 1999)

status quo or economic equilibrium with their innovations. These disruptive innovations will lead to economic growth (upswing), which then end in decline when a new economic equilibrium is reached in which large firms dominate, and the role of the entrepreneur diminishes. This periodic economic decline or depression is explained by two factors: 1) the capitalist concentration of power and capital by large firms and corporate groups, in which no place is left for entrepreneurial behaviour; 2) the emergence of an intellectual class that on the one hand emerges because of economic growth but on the other hand holds social-democratic values that are hostile to capitalism. Although we have not (yet) experienced such a decline in our present economy, we can recognize Schumpeter's ideas in our current society, where competition is crushed by technology giants like Google and Amazon, and where it becomes difficult for new entrepreneurs to enter the market while social democratic movements against the Transatlantic Trade and Investment Partnership (TTIP), for instance, are hostile to capitalism. This intrinsic tendency towards power concentration by large corporates is inherent in capitalism. For this reason, Schumpeter is pessimistic about the abilities of capitalism to serve long term economic progress. According to him, the negative consequences of power concentration can only be broken by innovations that disrupt the existing status quo of the market and prevents the collapse of the capitalist system.

The role of innovation in the upswing of economic cycles becomes clear in Schumpeter's notion of creative destruction. According to Schumpeter:

> Capitalism . . . is by nature a form or method of economic change and not only never is but never can be stationary. . . . The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates. . . . The opening up of new markets, foreign or domestic, and the organizational development from the craft shop and factory to such concerns as U.S. Steel illustrate the same process of industrial mutation . . . that incessantly revolutionizes the economic structure *from within*, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in. (Schumpeter 1943, 82–83)

The innovation of the diesel engine in locomotives, for instance, was not just the creation of a new technology but also the destruction of the existing industry in steam engines, just like the innovation of the compact disc destroyed the indus-

try of cassette tapes and LPs and has now been replaced by MP3 and streaming services. Schumpeter identifies five forces of creative destruction: product innovation, innovation in the production process, creation of new markets, discovering a new source of raw materials, and developing new organizational structures (Schumpeter 1943).[6]

This brief consultation of the origin of our taken-for-granted understanding of innovation as technological and commercial innovation shows that Schumpeter can legitimately be seen as one of the founding fathers of our current understanding of innovation. At the same time, our initial reflections show a clear difference between Schumpeter's conceptualization of innovation and the contemporary taken-for-granted notion. While innovation is nowadays seen as contribution to economic growth *per se*, and as a *panacea* for all kinds of societal challenges, Schumpeter's notion of economic *waves* and creative *destruction* already enables us to question the unilateral progressive and constructive connotation of the concept.

Even if we do not agree completely with Schumpeter's diagnosis—the idea that large firms are better able to foster innovation, for instance, is challenged in the literature—the idea that economic decline follows every upswing of the economic cycle due to the creation of new technologies makes clear that innovation may be a necessary, but not sufficient, condition for economic growth; innovation may account for the upswing of the economic cycle but innovation is at the same time in need of additional and maybe even non-economic interventions to prevent its decline. We may even argue that innovation, despite its contribution to the upswing of the economic cycle, is itself non-economical, to the extent that innovation *limits* the concentration of power and capital in the capitalist economy, which would collapse without its temporary disruption by innovations. If innovation prevents the collapse of the capitalist system, then we can formally conclude that innovation itself doesn't belong to the capitalist economic system but constitutes its limit. Furthermore, the idea that every upswing of the economic cycle involves the construction of new and innovative solutions *and* the destruction of the existing markets, industries and firms, i.e., the idea that the positive impact of innovation is accompanied by negative impacts elsewhere, makes clear that innovation may be a necessary but not sufficient condition for the solution of the societal challenges we face today; innovations that address societal challenges are accompanied with negative impacts elsewhere, and therefore raise new societal challenges. This intrinsic *Faustian* or dark aspect of innovation is largely ignored in the policy documents dedicated to innovation (Blok and Lemmens 2015). In

other words, our brief reflection on Schumpeter's notion of innovation brackets the presupposed notion of innovation as economically progressive *per se*, as well as its conceptualization as a solution for societal challenges. This raises the question about the extra-economic conditions that must be fulfilled if innovation is to contribute to economic growth and to the solution of societal problems. An overview of the differences between the self-evident understanding of innovation and its origin in Schumpeter's work can be found in table 1.

Table 1: Differences between the common understanding of innovation and its origin in Schumpeter's work.

Contemporary self-evident understanding of innovation		Schumpeter's concept of Innovation
1) Newness (product, process, marketing method, organizational method, workplace organization (OECD)), ranging from new to the firm to new to the world	=	1) New to the World (good, process, market, source of supply, industrial organization)
2) *Technological* Innovation	=	2) *Technological* Innovation
3) Serves economic progress *per se*	≠	3) Serves economic cycles with temporary progression *and* depression
4) Human actor (businessman) as subject of innovation	=	4) Human actor (entrepreneur) as subject of innovation
5) Conceived as good in itself and as solution for societal challenges	≠	5) Faustian aspect of all Innovation acknowledged

These differences problematize the self-evidence of the techno-economic paradigm of innovation and raise the question: what is innovation?

2.3. Technology versus Innovation

Because Schumpeter connects innovation with technology as well, the notion of technology could provide a potential further point of access for our reflection on the notion of innovation.[7] Furthermore, because the philosophy of innovation is in its infancy while philosophy of technology is an advanced field of study, our reflection could benefit from findings in the domain of philosophy of technology by applying them in the context of innovation.

Surprisingly enough, however, philosophers of technology do not seem to be interested in the notion of innovation at all. Classical philosophers of technology like Martin Heidegger never reflected on the notion of innovation, while contemporary philosophers of technology like Don Ihde and Peter-Paul Verbeek use the term sporadically and only in connection with technology (Ihde1979, 1990; Verbeek 2005, 2011). There is sufficient reason to dissociate innovation from technology. For Heidegger, technology is associated with a type of knowledge—

a *sich auskennen* or a "know-how in taking care, manipulating and producing" (Heidegger 1979, 16)—which is contrasted with instrumental and anthropological conceptualizations of technology (Heidegger 1977). However, disruptive innovations like the internet or the combustion engine are rather associated with the *un*-known, those things with which we are unfamiliar because they disrupt what is known and concerns something *new* to the world. In other words, contrary to Heidegger's notion of technology as that which we *know* and that with which we are always already familiar, innovation ruptures this technological familiarity. Innovations are not based on what is known, but emerge from what is un-known, as they are *new* to the world.[8] Another example concerns Gilbert Simondon's conceptualization of technology. While for Simondon economic considerations do not intervene directly in technological progress (Simondon 2017, 76), innovation seems to be inseparable from economy. And while Simondon focusses mainly on the invention as *creation* and evolution of a new technological object (the creation of the first internal combustion engine for instance), innovation can also relate to the first *adoption* of this new object in the market of users (Tarde 1903), or the whole process from creation to market adoption (cf. Bontems 2014). There seems to be therefore sufficient reason to suspend our self-evident association of technology and innovation, and to philosophically reflect on the notion of innovation itself, i.e., beyond its conceptual identification with technology.

We therefore return to Schumpeter's notion of innovation in this section to further articulate innovation in contrast with technology. Although Schumpeter never thought about the difference between technology and innovation, his work on innovation provides a starting point for our philosophical reflections on the concept of innovation in contrast with technology. Innovation can be understood both as a process—i.e., the process of innovation—and as the result of this process—i.e., the innovative product or service as an outcome of the process. Although Schumpeter ultimately maintains that the innovative product or service provides a competitive advantage, his reflections on innovation primarily focus on the process of innovation; creative destruction is not a characteristic of the innovative product or service, but of the innovation process.

Here, the first possible difference between technology and innovation emerges. The word technology has a primarily substantive meaning; it concerns an object that we can encounter in the world. This explains why contemporary reflections on technology often find their point of departure in concrete artefacts: new technologies like drones or robots that are outcomes of the innovation process (Ihde 1979, 1990; Verbeek 2005, 2011). Innovation, on the contrary, has both a

substantive and verbal meaning and is primarily thought of in the verbal sense of the word, which is to say as *process*.[9] This does not imply that technology cannot be thought of as a process. We can think for instance of the work of Gilbert Simondon, who is primarily interested in the individuation process of technology (Simondon 2017). But we can say that while technology tends to be taken as an artefact according to the substantive meaning of the word, the verbal meaning of innovation makes it impossible to omit a reflection on the process of its emergence and further development.

A second possible difference between technology and innovation now emerges. While all technology can be considered an outcome of an innovation process—all technology originates from an innovation process somewhere in history—not all innovation processes lead to technologies. Schumpeter's discussion of the creation of new markets and the development of new types of organizational structures make this clear, as do contemporary notions like social or political innovations. The possible second difference between technology and innovation is therefore that all technology originates from an act of innovation, while the act of innovation may result in outcomes beyond technology (e.g., social innovation).

Here, a third possible difference between technology and innovation emerges, namely between intrinsic and extrinsic determinants. Classical philosophers of technology like Heidegger and Simondon focus on the *intrinsic* conditions of technology. While Heidegger argues that technology is a particular way of unconcealing truth, Simondon focusses on the tendency to concretization of technical structures:

> A certain number of extrinsic causes no doubt exist, in particular those which tend to produce the standardization of spare parts and organs. Nevertheless, these extrinsic causes are not more powerful than those that tend toward the multiplication of types, appropriated for an infinite variety of needs. If technical objects do evolve toward a small number of specific types then this is by virtue of an internal necessity and not as a consequence of economic influences or practical requirements; it is not the production-line that produces standardization, but rather intrinsic standardization that allows for the production-line to exist. (Simondon 2017, 29)[10]

In postphenomenology, we can observe a focus on the intrinsic determinants of artefacts themselves and the way they mediate the world (Verbeek 2005). This does not imply that technology cannot be considered extrinsically conditioned—we can think for instance of Feenberg's or Kaplan's criticism that postphenom-

enology focusses on the mediation of artefacts without taking the political and economic dimensions of its emergence and use into account (Feenberg 2009; Kaplan 2009), or our own criticism that contemporary philosophy of technology does not take the Earth as an ontic-ontological condition for the possibility of technology into account (Blok 2017; Zwier and Blok 2017). Rather, it implies that technology is primarily taken as intrinsically determined; at the same time, Schumpeter's embedding of innovation in market needs and economic waves makes it impossible to discard a further reflection on the extrinsic determinants of innovation processes.

A fourth possible difference between technology and innovation emerges if we consider Schumpeter's idea that innovations change 'the rules of the game'. Innovations like the steam engine are definitely instances of the innovation of a new entity—the first engine for instance—but their creative and destructive aspect primarily consists of the fact that they destroy the old economic equilibrium—the world that is associated with water in which the water mill was embedded (e.g., the textile industry)—and create a new world order which can be associated with steam (e.g., the railway industry)(see section 2). This ability of innovation to destroy the old rules of the game and create new rules can be contrasted with the conceptualization of technology (*technique*) as rational rule-following behaviour according to efficient means-end patterns. Jacques Ellul for instance argues: "In our technological society, technique is the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity" (Ellul 1964, xxv). Rather than following the rules of a rule-governed system, innovation *destroys* the existing rules and *creates* new rules of the system.

Taking the findings of this section together, we propose five differences between technology and innovation in table 2.

Based on this first round of reflections on preliminary differences between technology and innovation, we cannot draw conclusions about the nature of innovation yet. By contrasting innovation and technology in this section, we intended to a) question the identification of innovation and technology in the concept of *technological innovation;* b) raise awareness of the differences between technology and innovation; and c) open-up the concept of innovation for philosophical reflections. Furthermore, even if we reject some of the aforementioned distinctions made between technology and innovation, for instance because Feenberg's philosophy of *technology* is in fact able to analyse the political-economic dimensions of technology, we would argue that the particular nature and context of innova-

Table 2. Possible Differences between Technology and Innovation

Technology	Innovation
1) Product level as point of departure (tool, machine, artefact) (for instance Mumford)	1) Process level as point of departure (creative destruction)
2) All technology is the product of innovation	2) Innovation doesn't necessarily produce new technology (for instance social innovation)
3) Focus on intrinsic orientation (for instance Simondon, postphenomenology)	3) Focus on extrinsic orientation (for instance economic embeddedness)
4) Technology as rule-governed system (for instance Ellul)	4) Innovation as rule-creating and rule-destructing system
5) The known and familiar as point of departure (for instance Heidegger)	5) The un-known and un-familiar as point of departure (focus on the New)

tion strictly necessitates taking these differences into account and can therefore also provide a new perspective that can stimulate further debates in philosophy of technology.

3. Towards a Philosophy of Innovation

In this section, we continue our reflections by focussing on the concept of innovation itself, without reference to technology. We discuss a) the innovation process and outcome dimension, and b) the ontic and ontological dimension of innovation, from which we develop four characteristics of the phenomenon of innovation. These dimensions turn out to have several implications for our understanding of the novelty and temporality of innovation, as well as of the role of human involvement in the innovation process.

3.1. The Process and Outcome Dimension of Innovation

A first characteristic of innovation can be found if we oppose the innovation process itself to the outcome of the process. The word innovation has two meanings. On the one hand, it has a substantive meaning, e.g., the iPhone as an outcome or end-product. On the other, it has a verbal meaning, e.g., the innovation process that results in the iPhone as outcome. Because innovation is not only an outcome but also a process, it is something that can and should be managed. Stage gate models and technology readiness levels for example, enable the management of the innovation process in such a way that leads to the best possible outcomes.

If we consider the outcome of the innovation process as a concrete *individual* object or artefact, the innovation process itself can be conceived as the *pre*-individual. The innovation process *before* its individuation in a concrete innovation

outcome can be conceptualized as the *ontogenesis* of this outcome. The ontogenetic *process* of innovation cannot be understood out of its outcome because then the process of innovation is conceptualized based on its outcome, i.e., the pre-individual is understood in terms of the individual that comes out of it and not in terms of the process itself. This is precisely the problem with many typologies of innovation in the literature: distinctions like incremental versus radical innovation (Freeman and Soete 1997) or architectural versus modular innovations (Henderson and Clark 1990) miss the ontogenetic process of innovation because they take the outcome of the innovation process—concrete individual products or services, their components, or the compositions of these components—as the point of departure. This focus on the innovation outcome may be explained by what is called the 'culture of things' or material culture. According to Godin, "[t]he origin of this culture goes back to the Renaissance: due to commercial exchanges, exploration and travel, natural and artificial objects have been what is valued in arts, science, and real life" (Godin 2008, 21). But if innovation concerns both the process and the outcome of the process, a philosophical reflection can no longer be isolated to outcomes, but must come to terms with the process as a distinct and integral part of innovation. If we locate the point of departure of our reflections in the outcome of the innovation process, we miss the *operation* that constitutes this innovative outcome; we miss innovation as an ontogenetic process.

Therefore, we should no longer think the ontogenetic process out of an *individual* innovation outcome that is created while it destroys a previous *individual* outcome, but on the contrary, it should be understood at the level of of the process of creation and destruction itself, i.e., at the *pre-individual* level. In this view, we assume a fundamental difference between outcome and process, between individual and pre-individual, thereby making the case that innovation as process cannot be reduced to innovation as outcome—which is to say that process and outcome are divided by a fundamental difference. We should not, however, take this move as an invitation to disregard the innovation outcome—it is highly questionable whether we can understand innovation processes without considering their outcomes, as these outcomes only account for spatio-temporal differences in their manifestation (see 3.2)—but rather as a call to acknowledge both outcome and ontogenetic process as two fundamental aspects of innovation.

3.2. The Ontic and Ontological Dimension of Innovation

At the level of the innovation outcome, a second difference emerges if we consider that Schumpeter is not interested in the creative destruction of an individual arte-

fact, but is looking for patterns that undergird the emergence of economic waves associated with water, steam, electricity etc. (see fig. 1). What is destroyed by the innovation of streaming services is not so much the CD in the literal sense—there are still CDs in the world—but the way value is created and captured via markets in the economic order associated with digital networks like the internet.[11] What is destroyed is not so much an artefact, but the political-economic order that is associated with it, for instance, water and the way in which the water mill and the accompanying textile industry was embedded, which in turn gave rise to a new political-economic order associated with steam (railway industry for instance)(see fig. 1).

We see here that innovation operates at two levels of outcomes. The innovation of streaming services concerns both the ontogenesis of these services at an ontic level and the ontogenesis of the political-economic order of the world associated with digital networks at the ontological level. Traditionally, a philosophical distinction is made between the ontic level of beings in the world and the ontological level of the essence or nature of these beings. This ontological level of the nature of beings, which is associated with the *idea*, *eidos* or form of beings, does not concern the ontic level of beings themselves but the measure or structure in light of which these beings appear and are understood. To the extent that innovation not only concerns new artefacts but also the structures within which these artefacts appear and are understood as *ordered*, we think that the distinction between the ontic- and the ontological may be helpful to understanding the phenomenon of innovation. In the current age, the ontological level of innovation concerns the ontogenesis of a world order associated with digital networks. In this world order, the streaming services can emerge, can be applied in various software applications and social media, and can be adopted and used by humans.[12] This distinction between the ontic and ontological level of the innovation outcome provides a new perspective on Schumpeter's conceptualization of innovation as creative destruction. Innovations like the internal combustion engine are innovations at the ontic level, but their destructive character consists in the fact that they destroy the economic equilibrium or world *order* associated with a particular set of innovations, in this case innovations associated with the world of steam. Simultaneously, the innovation of the internal combustion engine at an ontic level gives rise primarily to a new world order associated with electricity. Innovation as creative destruction, therefore, not only concerns things in the world, but also affects the world *order* in which these things appear and can be understood (Blok forthcoming). It is at this ontological level that innovation can be said to change the 'rules of the game.'[13]

The idea that innovation intervenes at the ontological level of the world *order* is already prefigured in the work of Francis Bacon (1561–1626), in which he argues that innovations "have altered the whole face and state of things right across the globe" (cited in Godin 2015, 182).[14] We propose, therefore, a dual conceptualisation of the innovation outcome: innovation primarily operates at the ontological level of categories that constitute and establish a world *order*, and simultaneously operates at the ontic level within this world where it engenders novel things or innovative outcomes.

Although the advantage of a dual notion of innovation is that it explains how innovation can be said to be both a being that is 'new to the world' and a process that changes 'the rules of the game', it is not necessary to accept the content of Schumpeter's categories (water, steam, electricity). A philosopher like Walter Benjamin would rather emphasize other disruptions like the innovation of printing, photography, and film, while philosophers like Bernard Stiegler would point to innovations associated with digitalization. Be that as it may, what we learn from our reflection on Schumpeter's notion of creative destruction, is that innovation primarily involves the creation of ontological categories that constitute a world *order* (the digital world for instance), in addition to producing innovation outcomes at an ontic level. At the same time, the ontic and ontological levels of innovation turn out to be interconnected and interdependent. On the one hand, the innovation of the internal combustion engine at the ontic level is dependent on a world order associated with electricity. On the other hand, this world of electricity at an ontological level emerges only *as* a world order in case of the innovation of the internal combustion engine that destroys the world of steam. The innovation of the world of electricity is ontologically first, but not necessarily in the temporal sense of the word.

The interdependency of the innovation outcome at the ontic and ontological levels already provides good reasons to reject any unilateral focus on either the ontological level or the ontic level of innovation. For a unilateral focus on the ontological level of innovation, we can think of a Heideggerian approach that highlights the importance of the ontological level of the innovation of a world order while neglecting the ontic level of innovations like the internet, social media etc. For a unilateral focus on the ontic level of innovation, we can think of of a postphenomenological approach that highlights how the innovation of Google Glass for instance mediates the world we experience. Roughly speaking, while Heidegger argues in "The Question Concerning Technology" that this ontological level of technology cannot be found at the level of screws and bolts of an artefact,

Verbeek would argue that there is no ontological level beyond the screws and bolts of the artefact (Verbeek 2005). In fact, our reflections on the innovation outcome compel us to rehabilitate the ontic-ontological difference that was rejected by post-modernist philosophy—e.g., Ihde's idea that there is no Heideggerian 'essence' of technology beyond the many technologies (Ihde 2010)—at least in case we want to reflect on the phenomenon of innovation. Because our primary goal in this article is to lay the groundwork for a philosophy of innovation without claiming to be able to provide such a full-fledged philosophy at this stage, we leave the question how the ontic and ontological level of the outcome of innovation are related to each other, as well as the question of which contemporary innovation outcomes provide indications of the destruction of the contemporary dominant world order and prefigure the creation of an upcoming world order, up for future research.

In table three, we summarize the findings of our reflection on possible dimensions of the concept of innovation. We first distinguished between the process and outcome dimension of innovation and then between the ontic and ontological dimension of innovation. These dimensions provide two axes that enable us to distinguish four characteristics of innovation, namely: innovation as innovation outcome at the ontic level, e.g., the innovation of streaming services; innovation as innovation outcome at the ontological level, e.g., the political-economic order of the world associated with digital networks in our current age; innovation as innovation process at the ontic level, e.g., the process by which streaming services evolve out of predecessors (LPs, CDs) and the existing retail market for CDs is destroyed; and finally innovation as innovation process at the ontological level, e.g., the process by which the digital world evolves out of the world of petrochemicals and electricity (see fig. 1). A full understanding of the phenomenon of innovation includes these four characteristics of innovation.

Table 3: four characteristics of the phenomenon of innovation

Innovation Outcome (Ontic Level)	Innovation Outcome (Ontological Level)
Innovation Process (Ontic Level)	Innovation Process (Ontological Level)

4. Conclusions

In this article, we laid the ground for a philosophy of innovation. We did this in four steps. First, we critically analysed the self-evidence of the techno-economic paradigm of innovation to raise the question: what is innovation? Second, because

innovation is self-evidently associated with technology and economy, we contrasted the contemporary conceptualization of innovation as technological and commercial innovation with Schumpeter's work. Although we saw that Schumpeter indeed can be seen as a founding father of the contemporary techno-economic paradigm of innovation, we also provided two reasons to reject the self-evidence of the techno-economic paradigm. Schumpeter's notion of economic waves and creative destruction makes it questionable whether innovation can be seen as economic progress *per se*, and as a *panacea* for societal challenges (see table 1).

Third, to open up the concept of innovation for philosophical reflection, we contrasted innovation and technology to find an answer to the question *what innovation is*. We identified five differences between technology and innovation that makes it at least questionable to employ 'technology' to find an answer to our question (see table 2). Fourth, we performed a critical hermeneutic reflection on innovation based on the analysis and examples of Schumpeter in order to develop and articulate a philosophical understanding of the phenomenon of innovation. By reflecting on the process-outcome dimension and the ontic-ontological dimension of innovation, we developed four characteristics of the phenomenon of innovation (table 3). These four characteristics move beyond the techno-economic paradigm and highlight the importance of understanding the process dimension of innovation as ontogenesis (next to the innovation outcome that is usually emphasized), of locating the ontological dimension of innovation next to the ontic level of the innovation outcome.

So what? Philosophical reflection on basic concepts like innovation is important, because these concepts structure the way in which we understand the world around us. If, for example, we understand innovation as technological innovation which is primarily executed by engineers in private R&D departments and laboratories, then we miss a whole set of contemporary phenomena that can be associated with system innovation (e.g., agro-ecological innovations), social innovations (e.g., political innovations like online petition websites), or attitudinal innovations (e.g., prevention or lifestyle interventions), as well as the parts of innovation processes that can be associated with the diffusion of innovations. Philosophical reflection on innovation can also help us to assess whether new phenomena still fall under the same concept or not. An example is the new paradigm of (bio)technological developments and engineering practices associated with *biomimicry*, i.e., with the imitation of natural processes in technological design (Blok and Gremmen 2016). Finally, philosophical reflection can help us to develop a critical attitude towards the self-evident use of the concept of innovation, to highlight contradictions and

tensions in its use, and to raise questions regarding the limitations of its use and the conditions of *responsible* innovation. Is innovation good *per se* (Rogers 1976) or should we reflect on its consequences in relation to the problems it seeks to solve, the risks involved, as well as the potential negative side-effects?

We do not claim to have answered these questions in a definitive way with our reflections on innovation in this article. One could argue, for instance, that the selection of sources has biased our analysis, and that a philosophical reflection on other sources could have resulted in slightly different characteristics of innovation. Although we think that Schumpeter is in fact one of the founding fathers of the contemporary understanding of innovation and is also seen this way by many innovation and STS scholars, and therefore, that his selection as a source for this study is legitimate, we cannot claim to have developed a full philosophy of innovation yet. With our reflections on the concept of innovation, we have laid the groundwork for such a philosophy by providing four building blocks that can guide future research in this emerging subdomain at the intersection of philosophy of technology and philosophy of (techno)science. To fully develop such a philosophy of innovation, future research must consider the implications of the phenomenon for our understanding of the novelty, the temporality and the role of human involvement in innovation practices. Furthermore, the following research questions have still to be answered:

— What is the content of the innovation outcomes at an ontological level that constitute our contemporary world order?

— Which emerging innovation outcomes at an ontic level provide indications of the destruction of the contemporary dominant world order and prefigure the creation of an upcoming new world order?

— How are the innovation outcomes at ontic and ontological level related to each other, if a unilateral focus on either the primacy of the ontological level or the ontic level is no longer appropriate?

— Which conceptualization of time underlies the temporal dimension of innovation as ontogenetic process?

— How can we conceptualize the novelty involved in innovation?

— How can we conceive the co-creativity of human being at the pre-individual level of the ontogenetic process?

— How are the two roles of human being as co-creator and as adopter of innovation related to each other?

— Why did the philosophical tradition not reflect on innovation, contrary to other fields of study like psychology, sociology and economics?

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Notes

1. In this respect, we don't start with the delineation of the set of phenomena labelled as innovations but take the set of examples provided by Schumpeter and others. The explorative confrontational approach enables us to develop general characteristics of the phenomenon of innovation based on our critical interpretation of these examples provided by Schumpeter.

2. In this, we follow the strategy of eminent scholars in related fields of research who draw upon one single but important author to oppose the dominant understanding of theoretical concepts and to develop new theory (Tsoukas and Cummings 1997; Komporozos-Athanasiou and Fotaki 2015).

3. If we argue that most scientific literature on innovation assumes the techno-economic paradigm without explicit reflexion on the concept of innovation itself, this is not necessarily meant in a critical manner. A classical division of labour between philosophy and science is that philosophy reflects on the nature of basic concepts in the sciences—what is nature, what is human being, what is innovation—while the sciences propose hypotheses that add further information about these subjects, and that are principally testable. Seen from this perspective, it is not the task of scholars in management and economics of innovation to reflect on the phenomenon of innovation itself.

4. Parts of this sub-section were published earlier in Blok (forthcoming).

5. Schumpeter was not the only author who provided an understanding of innovation, and there are many other authors before and after him who contributed to our contemporary understanding of the concept. Godin (2015) for instance convincingly showed that Schumpeter is not the only founding father and that the dominant view of Schumpeter's role in the conceptualization of innovation emerged in the 1970s due to the work of Chris Freeman and others. Although the historical role of Schumpeter in the development of the concept is still open for discussion, we limit ourselves to philosophical reflection on the concept of innovation in this article. To this end, it is

sufficient to acknowledge that Schumpeter is *one* of the founding fathers of our contemporary conceptuality.

6. The connection between innovation and technology is ambiguous in Schumpeter's work, because the examples of opening new markets and of new types of industrial organization as forces of creative destruction show that innovation is not necessarily associated with technological inventions. In his book on business cycles, Schumpeter writes: "Innovation is possible without anything we should identify as invention and invention does not necessarily induce innovation" (Schumpeter 1939, 84). Nonetheless, he argues that technological innovation is the driver of creative destruction, the creation of new market needs, and destruction of existing markets (Schumpeter 1943, 81–86). This conceptualization also shows why Godin is mistaken in his assessment of Schumpeter, when he writes that the five forces concern only the *application* of a new product or process in a firm, and do not imply the *commercialisation* of this product or service in the market (Godin 2015, 267). It may be interesting to disconnect innovation as application and as commercialisation this way (Godin 2019), but this is definitely not what Schumpeter had in mind.

7. In this section, we philosophically reflect on possible differences between technology and innovation, based on the concept of technology as it is understood in the tradition of philosophy of technology. We mainly leave aside the history of the definition of technology in this reflection. For this, see the eminent studies by Schatzberg (2018) and Godin (2019).

8. The formal distinction between technology and innovation based on an opposition between the known (technology) and the unknown (innovation), requires further reflection in general, and on the relation between innovation and newness in particular. This is, however, beyond the scope of this article.

9. Godin argues that innovation is often referred to by using a verb in ancient Greece, for instance, and that the substantive use of the word is rather rare (Godin 2015, 31).

10. Simondon is at least ambiguous in this focus on intrinsic conditions of technological development, because he elsewhere seems to take extrinsic—economic—conditions into account as well (Simondon 2017, 159–62). The further discussion about the relation between intrinsic and extrinsic determinants of technological development in Simondon is beyond the scope of this article.

11. Although it is clear that economists like Schumpeter focus on the impact of innovation on the economic order and assume that the articulation of a new world order is often established via markets, we can learn from the history of innovation that the economic orientation of the contemporary notion of innovation is not self-evident and should be extended to include the political-economic domain (Blok forthcoming).

12. Likewise, the emergence of the steam engine changed the human-technology relation as a whole: "The factory uses true technical individuals, whereas, in the work-

shop, it is man who lends his individuality to the accomplishment of technical actions" (Simondon 2017, 131). See the rest of this section for further details how this ontic and ontological level of innovation has to be understood.

13. Strictly speaking, probably without knowing it, Schumpeter himself called for this ontological level of innovation, to the extent that creative destruction is not limited to the economic sphere, but concerns the processual principle that explains the upswing and decline of economic cycles. As such a principle underlies economic cycles, the principle itself is not primarily economical but ontological. The pattern of creative destruction that Schumpeter is looking for, we could argue, is an ontological pattern underlying all innovation processes and their outcomes, which is at the same time independent of this outcome. On the one hand, this pattern may be inductively derived from individual innovation processes; on the other hand, it moves beyond the individual innovation process and constitutes economic waves.

14. Elsewhere, I have traced this differentiation between the ontic and the ontological level of innovation in the history of innovation in the work of Xenophon, Plato, Machiavelli and Bacon (Blok forthcoming).

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