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INNOVATION AND THE PROBLEM OF VALUES
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Abstract
Innovation is presented as the solution to address grand societal challenges. Taking this new policy motto seriously requires to renew the dominant imaginary of innovation defined by a series of attributes -technology centeredness, market relatedness, competition, entrepreneurialism, diffusion, exclusivity and creative destruction- and above all by the belief that innovation is always good.
To contribute to such an endeavour, this paper starts with the discussion of five innovation myths. This allows us to identify a set of "handles" that could contribute to a re-opening. The presentation of the three literature streams (Democratising innovation, Responsible innovation, Transformative change) that currently feed the innovation renewal allows consideration of explorations in academia as well as in public policy. A re-imagination and re-invention of innovation is underway, and this dynamic is constituted of different actors from different traditions but still has some limitations.

INTRODUCTION

In 1932, in the wake of the great depression, a New York real estate broker, Bernard London, published his essay Ending the Depression Through Planned Obsolescence which introduced the concept of 'planned obsolescence'.
"People generally, in a frightened and hysterical mood, are using everything that they own longer than was their custom before the depression. In the earlier period of prosperity, the American people did not wait until the last possible bit of use had been extracted from every commodity. They replaced old articles with new for reasons of fashion and up-to-datedness. They gave up old homes and old automobiles long before they were worn out, merely because they were obsolete. Perhaps, prior to the panic, people were too extravagant; if so, they have now gone to the other extreme and have become retrenchment-mad. People everywhere are today disobeying the law of obsolescence. They are using their old cars, their old tires, their old radios and their old clothing much longer than statisticians had expected."

As a solution to the economic crisis, London recommended that government should apply management and planning to undoing obsolete jobs from the past. Government should "assign a lease of life to shoes and homes and machines, to all products of manufacture (…) when they are first created." After their allotted time has expired, these things will legally be "dead" and would be controlled and destroyed in the case of widespread unemployment (Slade 2009). London's idea of planned obsolescence has become a reality but with an important variation. Government rules and controls are not needed; obsolescence is constructed technically through a set of practical elements that artificially reduce product lifetimes. The example of smartphones -with Apple taken to court accused of reducing the technical capacity of older versions of its star product, the iPhone - is a mere drop in the ocean. The practice of planned obsolescence has become widespread in the consumer society. Innovation is considered the goal because historically, innovation was considered always as been good. However, the limitations of our planet are forcing us to consider seriously the damage wrought by an economic system based on planned obsolescence, and to challenge the underpinning socio-technical logic. We can no longer view innovation as always good. Innovation does not systematically result in creative destruction. It can, contrary to Schumpeter's central thesis, be a destructive creation (Soete 2013).
Such reflections have become central in an age when innovation is seen as the solution to grand societal challenges such as climate change, world food security, natural resources depletion, an ageing society, etc. Hence, this paper's main objective to reflect critically on the concept of innovation in order to contribute to its reinvention. This paper continues a research strand that originated many years earlier on the way innovation is understood, and on the shortcomings of current innovation policies.
In a recent paper (Joly 2017), I argue that the 'master narrative' or innovation imaginary is defined by the attributes of technology centeredness, market relatedness, competition, entrepreneurialism, diffusion, exclusivity and creative destruction. I use the concepts of "models of innovation" to characterize different ways of innovating explored and experimented with by many actors. Models of innovation are conceptual frameworks that provide a stylised representation of how innovation is generated. These frameworks both describe the reality 'out there,' and act as lenses to view and interpret this reality, and when shared widely they play a performative role (Joly et al. 2010). They guide how collectively, we see and order the world through its histories and its futures, and in this respect these models constitute a central part of what Sheila Jasanoff calls sociotechnical imaginaries (Jasanoff, Kim 2015). Models of innovation include not only economic impact and competitiveness but

also the distribution of power and agency, collective learning, social relations, etc. They are value-laden and they embed a dimension of the social order; hence, they are also models of society. Finally, models of innovation involve not only discourses but also institutional devices, organisations, routines. The policies formulated follow these innovation models, although often unconsciously. The identification and description of alternative models of innovation are used to demonstrate that it is possible to think outside the box and to address innovation beyond a competitiveness framework.

This paper deals with the same issues but in a different and complementary way. The aim is to explore why the understanding of innovation is associated so closely to this master narrative, and to highlight different initiatives and research streams that challenge this entrenched imaginary. First, I discuss five deeply-rooted innovation myths which are the pillars of the sociotechnical imaginaries of innovation. Critical reflection on these myths is an important step in the questioning of this imaginary and opening up innovation. The analysis in this paper provides a set of handles[1] for reimagining innovation. In the second part of the paper, I adopt a different perspective focused on three streams of literature offering alternative visions of innovation. These visions of innovation have important policy implications, and although they may be marginal, could be of great interest to certain key institutions.

The problem of values is the common thread running through this paper. In Joly (2017), I used the concept of a moral economy since it refers to two dimensions that condition innovation models: an organised system (constituted of rules, material devices, ways of knowing, discourses, actors) that displays some regularities (the term "economy"); a set of affect-saturated values that stand and function in well-defined relation to one another, and that legitimise action (the term "moral"). The main idea is that there is a strong link between the way we value the outcomes of our actions, the way we know, and the way we act. Hence, raising the problem of values, valuing and valuation (Dewey 2013) is an important way to re-open innovation.

CHALLENGING SOME DEEPLY-ROOTED INNOVATION MYTHS

In a long term research project "The idea of innovation," devoted to the intellectual and conceptual history of innovation, Benoit Godin poses three important questions:

"First, why has innovation acquired such a central place in our society or, put differently, where precisely does the idea of innovation come from? Second, why is innovation spontaneously understood as technological innovation? Third, why is the idea of innovation often restricted to commercialized innovation?"

(http://www.csiic.ca/en/the-idea-of-innovation/)

My discussion of the innovation myths is in line with his second and third questions but goes beyond them. It is aimed also at identifying and debating a set of strongly entrenched beliefs that constitute the pillars of the socio-technical imaginary of innovation. Of course, there are different ways to identify and present these myths. Here, I chose to be sufficiently comprehensive to take account of the different unquestioned beliefs that anchor the imaginary of innovation.

"Myth 1- Trickle down innovation" allows discussion of the strong association between innovation and the competitiveness frame, and the idea that the maximisation of economic value through innovation is the solution to all kinds of problems. Market mechanisms are of course important but if innovation is to be the solution to all challenges, we need to consider other values as well as economic value, and take the multi-dimensionality and directionality of innovation seriously.

"Myth 2 – The linear model of innovation" which has been much discussed in the literature. It remains fixed, and discussion of it reveals the diversity among innovation models and sources of innovation

"Myth 3 – Innovation is driven by (new) technologies" is a central belief discussed in the various contributions in this book. We would include also the obsession with novelty, and suggest the need to shift from a culture of novelty and disruption to the heuristic of continuity, recycling and incremental improvement.

"Myth 4 – The technology selected is always the best" which introduces the idea of path-dependency and lock-in effects that characterize socio-technical trajectories. Socio-technical transitions constitute a major problem barely considered by innovation policy, and especially when what is at stake is the discontinuation of a socio-technical system (what we call out-novation).

"Myth 5 – Innovation as creative destruction" is the master myth alluded to in the introduction. If we consider that innovation is not always good, there is an urgent need to reflect on technical democracy as new power/knowledge configurations.

Myth 1 – Trickle-down innovation

The myth of trickle down innovation is borrowed from the myth of trickle-down economics, i.e. the idea that what the rich enjoy today will benefit the poor tomorrow (Bozeman, Sarewitz 2011). The core assumption is that reducing taxes on businesses and high income stimulates investment in the short term, and benefits society at large in the long term. The myth of trickle-down economics is challenged

[1] I use this term to mean support points or grips that allow to grasp, displace, di-assemble, re-assemble. I owe this expression to Douglas Robinson.

by empirical evidence which shows that since the 1980s (and the implementation of neo-liberal policies that led to tax cuts for high earners) the degree of inequality has increased sharply (Piketty, 2013).
The myth of trickle down innovation refers to the belief that the creation of wealth through innovation will not only benefit the impoverished but also will solve the major societal problems, including environmental. There is a widespread belief that investment in research and innovation is the best way to address grand challenges.
The European Commission is an emblematic example of this policy discourse. Since 2010, innovation has been seen as the solution to major societal challenges (climate change, depletion of fossil fuel resources, ageing societies, etc.), and is expected to boost competitiveness, maintain employment and protect our social models.

"As public deficits increase and as our labor force begins to shrink, what will be the basis for Europe's future competitiveness? How will we create new growth and jobs? How will we get Europe's economy back on track? How will we tackle growing societal challenges like climate change, energy supply, the scarcity of resources and the impact of demographic changes? How will we improve health and security and sustainably provide water and high-quality, affordable food? The only answer is innovation, which is at the core of the Europe 2020 Strategy »
(Horizon 2020, Innovation Union, emphasis added)

The strength of the trickle-down innovation myth rests on several entrenched beliefs. First, technological fix, i.e. the idea that technology will provide the solutions to the problems confronting us, and that if these solutions bring new problems (damage related to use of the new technology), further technological progress will provide new solutions. Geoengineering is a representative example of the belief that technology can address any problem we might face.
The second imaginary is that resources are fungible, and hence, in some way unlimited. Economic growth and wealth will provide the resources needed to produce new knowledge and new technologies to address society's problems. The fact that Malthus's prophecy of doom has not come true reinforces the belief that technology and innovative capacity continually push back the boundaries to the planet.
The strength of this myth lies also in the fact that it does not challenge our way of life or the current distribution of resources and social relations. For instance[2], genetically modified organisms (GMOs) have been portrayed as the solution to the food security problem whereas foresight exercises demonstrate that a shift from animal to plant protein would allow us to 'feed the world' without increasing agricultural production (Paillard et al. 2014). Similarly, geoengineering is touted as the technical solution to climate change and does not necessitate a change to our way of life.
This myth can be challenged on different premises. In this volume, Dominique Pestre shows that the green economy has not led to a significant reduction in the pressure exerted by human activity on natural resources. This may be explained –inter alia- by the rebound effect, i.e. the reduction (due to behavioral or other systemic responses) in the expected gains from new technologies that enable more efficient use of resources. Also, the scientific evidence is increasingly alarming; for instance , the Alliance of World Scientists[3]' "warning to humanity" signed by more than 15,000 scientists.
"To prevent widespread misery and catastrophic biodiversity loss, humanity must practice a more environmentally sustainable alternative to business as usual. This prescription was well articulated by the world's leading scientists 25 years ago, but in most respects, we have not heeded their warning. Soon it will be too late to shift course away from our failing trajectory, and time is running out. We must recognize, in our day- to-day lives and in our governing institutions, that Earth with all its life is our only home."
(Ripple et al. 2017)

If we are to challenge the myth of trickle-down innovation we must learn to consider that innovation involves more than competitiveness. Innovation defined as future society in the making, goes beyond this framing. Accordingly, the value of innovation is not limited to economic value. As Stirling (2009) suggests, we need to take account of the multi-dimensionality of innovation, and hence, both the directionality and distributional effects of innovation. New generations of approaches to measuring the of impact of research beyond economic impact are crucial (Bozeman, Sarewitz 2010 , Joly et al. 2015) for opening up the valuation process and hopefully, providing new instruments for implementing directionality.

Myth 2 – The linear model of innovation [4]

The so-called linear model postulates that innovation starts with basic research, and is followed by applied research and development, and finally production and diffusion. It defines the roles of various actors and the division of labor, and offers a diagnosis of what is happening and what should be improved. The origin of this model can be attributed to Joseph Schumpeter and Vannevar Bush (Godin 2015)[5]. Schumpeter made a clear distinction between invention and innovation, two processes that correspond to different motivations, competences and norms. Entrepreneurs are innovators; they have the ability to bring radical change by designing new products, and implementing new processes of production or new organisations. They are motivated by the potential economic benefits that are conditioned by the temporary monopoly associated to their advance

[2] U.S. president George H.W. Bush famously declared: "The American way of life is not up for negotiation".

[3] http://scientistswarning.forestry.oregonstate.edu/

[4] This section draws on Joly (2017).

[5] For an interesting discussion of the myth of the linear model, see Edgerton (2004).

in the diffusion of innovation. Bush's report Science: the Endless Frontier (1945) also is seen as a pillar of the linear model. By pursuing research in the "purest realms of science" scientists can build the foundations for new products and processes to deliver health, full employment and military security for the nation. Hence, public funding of basic research is vital for social progress and economic growth:

"Advances in science when put to practical use mean more jobs, higher wages, shorter hours, more abundant crops, more leisure for recreation, for study, for learning how to live the deadening drudgery which has been the burden of the common man for past ages. Advances in science will also bring higher standards of living, will lead to the prevention or cure of diseases, will promote conservation of our limited resources, and will assure means of defense against aggression" (p. 10). "Without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world" (p. 11). (quoted in Godin 2006: 644)

History of technology and innovation studies have for long challenged the model of innovation from various directions. Nathan Rosenberg (1982) argues convincingly that technology is not merely the application of scientific knowledge. It is itself a body of knowledge about certain classes of events and activities[6]. In the academic milieu, innovation generally is considered an interactive process. The chain-link model proposed by Kline and Rosenberg (1986) may be seen as a kind of consensual representation. Interactions are the crucial element in the process; knowledge is diverse (scientific knowledge, technological knowledge, action knowledge, etc.); scientific knowledge very often is produced as the answer to a practical problem; technological tools and infrastructure condition the agenda of research. This emphasis on the role of interactions leads innovation studies to broaden the analytical scope and to take account of the innovation systems in which they are embedded (Fagerberg, Verspagen 2009). The research agenda involves different dimensions corresponding to the diversity and complexity of the innovation processes and the interactions between levels, from isolated innovation to changes to the techno-economic trajectory.

However, despite a broadening of the notion of innovation in academia, institutions responsible for innovation policy continue to tend to adopt the definition of innovation proposed in the 1960s. To illustrate the lasting influence of the linear model, one could cite the European Union's Lisbon Agenda, the objective of 3% of GDP invested in research, and the shaping of the knowledge economy. This vision has led to implicit or explicit assertions that "Science is the solution, society the problem". Society is expected to become more entrepreneurial, to become more accepting of and enthusiastic about new technology. It can be seen as the 21st century version of the Chicago World Exhibition's catchphrase that "society has to conform".

Hence, although it has been challenged for long, the myth of the linear model of innovation remains sticky. Re-imagining innovation requires one to know about and to acknowledge the diversity of innovation models. Thus, the importance in current debate on "social innovation", on its definition, its characterization, its identification and its integration in national and international statistic systems. Depending on this improved knowledge and acknowledgement, better appraisal of the different sources of innovation would provide new insights for innovation policy.

Myth 3 – Innovation is driven by (new) technologies

Although the definition of innovation often is broad and not limited to technological innovation (see for instance the definition in the Oslo Manual[7]), in the public arena, the term innovation generally is associated to technology. This is reflected in some of the most famous rankings of innovation, for instance Thomson Reuters which focuses on patents as a proxy for the capacity to innovate[8] . Some of these rankings have the ambition to implement a more comprehensive view, thus integrating a wide variety of sources of innovation including the human factor and entrepreneurship (see for instance, the Global Innovation Index[9]). However, the association with technology, and specifically new technologies remains very strong. It would be hard to imagine an Innovation Forum that did not stage nanotechnologies, digital technologies, big data in biology, etc.

The close association between innovation and technology is related to the technological fix discussed above. The technological solution avoids researching solutions that would imply societal changes. Also, there is also a bias toward new technologies. The solutions will be found in new technology, not improvements to old ones. The historian of technology David Edgerton shows that this bias toward novelty is deep rooted. In the Shock of the Old (Edgerton 2006), Edgerton demonstrates that historians of technology generally study technologies in their emergent stage and rarely look at technologies in use. Take for instance, the example of the Green Revolution. The imaginary of the Green Revolution is associated to genetics and the diffusion of so-called high yielding varieties (HYV) which earned Norman Borlaugh his Nobel Peace Prize. However, recent research on the Green Revolution

[6] Among the various examples he gives, the discovery of thermodynamics is probably among the most emblematic: "Sadi Carnot's remarkable accomplishment in creating the science of thermodynamics was an attempt of the attempt, a half century or so after Watt's great innovation, to understand what determined the efficiency of steam engines" (Rosenberg 1982: 142).

[7] Oslo Manual : "An innovation is the implementation of a new or significantly improved product (good or service), A product innovation is the introduction of a good or service. A process innovation is the implementation of a new or significantly improved production or delivery method." (OECD, 2005).

[8] http://top100innovators.clarivate.com/content/methodology

[9] https://www.globalinnovationindex.org/.

in India demonstrates that the increase in wheat production had little to do with HYV (Subramanian 2015). Rather, it was driven by rapid expansion of irrigation, facilitated not by Nehru's big dams but by small, privately-owned, traditional groundwater pumps. By highlighting the key role played by one of the oldest agricultural techniques (irrigation) in what was assumed to be a revolution based on new technologies, this research challenges the dominant view of innovation.

Paying attention to technology in use, to incremental improvement and to maintenance calls for a Copernican revolution in innovation studies. It forces scholars –even as Edgerton argues, historians - to shift from the fascination with novelty to the heuristic of continuity (Joly, 2015). This leads to thinking about innovation in a new way. In reflecting on the reception given to The Shock of the Old, David Edgerton makes this clear:

"Although it has been interpreted as arguing for the study of use over invention/innovation, or for the small rather than the big, or for extending studies of users and consumers, or to shift attention from the rich to the poor it is a call to rethink invention/ innovation as well as use –to rethink the big as well as the small, production as well as consumption, and the rich world as well as the poor world."
(Edgerton 2010, p.685)

Currently, a range of experiences run in this direction which materializes in the proliferation of new expressions such as: frugal innovation, grassroots innovation, reverse innovation or innovation from the bottom of the pyramid (Prahalad 2005). This goes along with a new geography (the "South" as a key source of innovation), and a new cosmology (the "users" at the core) of innovation. Hence, there is a need not only to acknowledge the non-technical sources of innovation but also to shift from a culture of novelty and disruption to a culture of incrementalism, recycling and maintenance.

Myth 4 – The technology selected is always the best[10]

The belief that technological competitions are, like sports competitions, processes that allow selection of "the best", is strongly anchored. Since the 1980s, the sociology of innovation, and the economics of technical change have been grounded on a very different assumption, namely that a technique is not used widely because it is intrinsically better but that it becomes the best because it is widely used.

For scholars who adopt a constructivist approach to technology (e.g. social construction of technology -SCOT Bijker et al. 1987) the idea that technologies are not selected because they are most effective is obvious. The adoption of this idea by economists has been more difficult, and the work of Brian Arthur and Paul David, economists working at the Santa Fe Institute and Stanford University that helped to revise the myth of selection of best techniques by the market (Arthur 1989, David 1986). The key is the concept of increasing returns from adoption. If we assume that the efficiency of a technology is positively related to the number of users, then competition among technologies can produce surprising effects such as the exclusion of intrinsically superior techniques, or even lock-in to technologies with low intrinsic value. Under this hypothesis, competition models show that small events (Arthur) or historical accident (David) can give an initial advantage to one technology; cumulative effects do the rest.

Several examples are cited regularly. For example, the QWERTY typewriter (and now computer) keyboard is a legacy of a design that took account of physical constraints (transmission by means of bars) to achieve greater efficiency which has proved impossible to displace although according to ergonomics other keyboard designs are more efficient (the CLIO keyboard seems to be the best). Another exemplar from the nuclear field is the diffusion of light water reactors despite the claim of many specialists that gas cooling would have proved more efficient had as many resources been devoted to its development as were invested in light water reactors. The assumption of increasing returns to adoptions runs counter to the previous general assumption in economics. For the specialist, it can be explained empirically by five complementary phenomena: (i) strong learning by doing processes; (ii) network externalities; (iii) economies of production scale; (iv) informational increasing returns; and (v) technological complementarities. These features are applicable to most current and emerging technologies.

Taking account of the diversity of technological pathways is one of the important implications of this work. In the presence of high increasing returns, the exclusion of alternative techniques can be too rapid and too broad. It may be necessary to enact policy to incentivise the exploration of a range of options (Callon 1994, Stirling 2008). Also, it will be necessary to imagine how to withdraw socio-technical elements (Goulet and Vinck 2012) which would indicate learning how to govern outnovation processes.

Myth 5 – Innovation as creative destruction

Innovation as creative destruction can be considered the master myth which dictates that the destruction of existing elements is necessary for the creation of new ones. This myth is associated to Joseph Schumpeter who conceptualised innovation and the role of the entrepreneur as the drivers of economic development.

"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.

[10] This section draws on Joly (2016).

Steel illustrate the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one."
(Schumpeter 1942, pp.82-83).

That the birth of something new is conditioned by the destruction of something that exists is an old idea. Reinert and Reinert (2006) remind us that the Greeks inherited the myth of Phoenix from the bird Bennu in Egyptian mythology, symbolising the rising sun.
"Bennu or Phoenix was consumed to ashes, but out of the ashes grew a new Phoenix which, in time, repeated the 500 year cycle. In medieval Christian writings Phoenix was a symbol of the Resurrection of Christ, in itself a prime example of creative destruction."

The vision of creative destruction leads to a particular view of history in which the arrow of progress is associated to cyclicality. On the one hand, as with the Phoenix and its 500-year cycles, creative destruction leads to cyclical rather than linear historical patterns: take Schumpeter's 'clustering of innovations' as the basic cause of long economic (Kondratieff) cycles. On the other hand, new cycles are associated to new core technologies which are supposed to be better than the old ones. The steam engine and railroads were replaced by electricity, the internal combustion engine, oil and chemistry, which are being replaced by electronics and informatics, biotechnology, etc. New cycles bring economic and social progress (Perez 2002, Freeman & Louca 2001).

Hence, the myth of creative destruction is associated to the idea that innovation is always good. In this frame, actors who contest innovation are laggards. Against this, sociology and the history of technology show that controversies and contestations have played an important role in the innovation process (see inter alia Callon 1981, Rip 1986 and contributions in the Third Part of this volume). The concerns over the potential (economic, social and environmental) damage caused by new technologies led to the institutionalisation of technology assessment, first in the US with the establishment in 1972 of the Office of Technology Assessment, and then in most European countries in the 1980s and 1990s. However, de facto, technology assessment operates as a tool for improving and fostering technological change, not controlling it (Collingridge 1980, Joly 2015).
Contemporary debate on planned obsolescence constitutes an interesting way to challenge the myth of creative destruction. In a paper entitled "Is innovation always good?" Luc Soete, one of the leading economists of innovation, warns that contrary to mainstream beliefs, the creative part of innovation does not necessarily outweigh its destructive aspects (Soete 2013). Soete shows how innovations in consumer goods have led our societies to "a conspicuous consumption path of innovation-led 'destructive creation' growth" (Soete 2013, p.136).

"Easy and cheap ways in which existing usage value can be destroyed are, for example, through product design and restrictive aftermarket practices, and in the extreme case through so-called 'planned obsolescence' purposely limiting the life-span of particular consumer goods. (…) Probably the most extreme and widespread case would be new product design, for instance in fashion clothing or shoes, destroying existing output, but there are of course many other forms and sorts of restrictive aftermarket practices that can be found in many ICT-related sectors, such as software writers limiting backward compatibility, or electronic goods manufacturers ceasing to supply essential after-sales services or spare parts for older products, not to mention smart phones, mobiles, iPods, or iPads. It is actually surprising in how many areas processes of 'destructive creation' exist that hinder prolonged usage and induce customers to migrate continuously to newer models."
(Soete 2013, p.138)

The concept of planned obsolescence referred to in the introduction to this chapter, originated at the beginning of the XXth Century. Historians of technology have shown how planned obsolescence became a systematic pattern in the production and consumption of goods (Slade, 2009). Heinz Wisman, a French philosopher, takes an extensive view of planned obsolescence and argues that it is the result of a desire-based economy invented in the late XIXth Century, a time when innovation was decoupled from progress, and novelty became the goal (Wisman 2015). Post WWII, the making of the consumer society and the invention of marketing considerably amplified this desire-based economy at the cost of depleted natural and also psychic and cognitive resources (Cohen, Todd, 2015).
Contestation of planned obsolescence is growing in the public arena also. Take France as an example. The French Law on Energy Transition (Law 2015-992) introduced the crime of planned obsolescence defined as "the set of techniques by which a manufacturer aims to deliberately shorten the lifetime of a product to increase its replacement rate". I*n 2017, the Halte à l'Obsolescence Programmée* – HOP or Stop Planned Obsolescence program,- filed a complaint against Apple after the company admitted to intentionally slowing the operation of its iPhones as they age. HOP had already filed a legal complaint against the printer manufacturers Canon, HP, Brother and Epson, claiming that their devices forced users to change their ink cartridges before they were empty.
If we take for granted that innovation is not always good –which is itself a strong stance, what are the implications of this position? This returns us to the problem of control of technology. David Collingridge referred to the dilemma of knowledge/control: the impacts of technologies which are still flexible are unknown whereas technologies whose impacts are well known have irreversible effects (Collingridge 1980). In this perspective, diversity is crucial for limiting irreversibility. This leads to consideration of how the balance of power and the related knowledge

Table 1. Handles for the re-imagining of innovation

Innovation and its myths	Handles for re-imagining innovation
Myth 1 – The idea of trickle down innovation	- Innovation beyond the competitiveness framework - Distributional effects and directionality of innovation
Myth 2 – The linear model of innovation	- Diversity of models of innovation - Different sources of innovation
Myth 3 – Innovation is driven by (new) technologies	- Acknowledging non-technical sources of innovation - Culture of maintenance and recycling vs. culture of novelty and disruption
Myth 4 – The technology selected is always the best	- Taking care of diversity - Learning to govern transitions and out-novation processes
Myth 5 – Innovation as creative destruction	- Issue of directionality: Instruments to steer innovation - Technical democracy as a new power/ power configuration

field, might increase the capacity to act. This question is explored under the heading "technical democracy" (for instance Callon et al. 2011), and considers inter alia the role of counter-expertise, transparency, public participation, and different legal innovations such the precautionary principle.

Wrap up 1. Challenging the myths, re-imagining innovation

Discussion of the innovation myths led to the identification of a series of "handles". By this I mean elements that allow something to be grasped, displaced, turned around, reframed or reassembled. The list of handles for re-imagining innovation is presented in table 1.

RE-INVENTING INNOVATION AND INNOVATION POLICIES – AN OVERVIEW OF RECENT RE-OPENINGS

We now change perspective and consider literature streams that currently are feeding the renewal of innovation. Our analysis is centered mainly on academic works. However, there is strong involvement of coproduction processes (Jasanoff, 2004). The first strand of work "Democratizing innovation" owes much to the actors that explore and experiment with alternative ways to innovate from the centralized delegated model. However, it owes much also to academic research that has attracted public attention, and made local experiments transportable and generalizable to an extent.

The second and third streams involve the top down, and have close ties to European Commission initiatives, although both investigations are widespread. The "Responsible innovation" stream is related strongly to the perceived need to re-align science and society, triggered by strong contestation of new technologies. The European Commission Framework Programmes are important spaces for coproduction involving STS scholars among others. The third stream of work on "Transformative change" emerged from the strong convergence of academic research devoted to sustainable transitions, and the recasting of innovation policy around grand challenges. The appointment of Mariana Mazzucato as special advisor to Commissioner Moedas on mission driven science and innovation is an illustration of such convergence[11].

Democratising innovation

The traditional view of innovation based on a strong division of labor between innovators (e.g. the Schumpeterian entrepreneur) and passive users is increasingly being challenged. The literature on bottom up innovation, user centered innovation, distributed innovation, community based innovation, etc. is burgeoning.

Eric Von Hippel, Professor of Management of Innovation at MIT, was one of the pioneers of this renewal. Working on innovation in very different areas, he demonstrated that the sources of innovation vary across situations, and that in sectors such as scientific instrumentation and semiconductors, users (usually companies rather than individuals) are the main source of innovation (Von Hippel 1988). Innovation is based on neither technology push nor

[11] Professor of Economics at University College London, she is an advocate of the role of the redefinition of the role of the State in innovation policy.
https://marianamazzucato.com/uncategorized/mariana-mazzucato-appointed-as-special-advisor-for-mission-driven-science-and-innovation-to-eu-commissioner-for-research-carlos-moedas/

demand pull; it is the result of interactions among actors with complementary knowledge. Users are no longer seen as only using; they learn by using, and in some situations they co-innovate. This means also that users learn from each other, and that innovators can learn from users. In his 1988 book, Von Hippel introduces the concept of distributed innovation. Innovation is distributed if the process is fed from various sources, for instance user-produced prototypes and experiments. Importantly, Von Hippel observed that the exploitation of this diversity is not natural but depends on the ability of firms to recognise these sources of innovation, and to develop forms of organisation and management tools to exploit them. He claimed that this had major implications for the management of innovation as well as for innovation policy (system level analysis and policy, property rights, support for users, etc.).

In his more recent *Democratizing Innovation*, Von Hippel (2004) goes beyond a firm-centric analysis to consider numerous actors including creative communities. Distributed innovation challenges a structural feature of the social division of labour, the separation between users and consumers. Von Hippel identifies two engines of distributed innovation. First, in the delegated model of innovation, standardised products are the rule. Large manufacturers design products to meet the needs of a large market segment to induce purchase by and capture significant profits from a large number of customers. Distributed innovation allows the diversification of product design to respond to the diversity of user needs. Second, the contribution of users is growing as a result of continuing advances in computing and communications capabilities, and digitalisation of many areas.

The example of OSS (open source software) – and the wider development of open access information technology tools – is often used to illustrate the distributed model of innovation, and to show that one of the motives of its promoters is to redistribute agency, knowledge and power. In other words, a normative model of society is also being performed. A key feature is the invention of *collective property rights* through the creation of the general public licence (GPL or copyleft): the right to use the product at no cost, the right to modify it, and the right to distribute modified or unmodified versions at no cost. Even when incorporated in commercial tools, software protected by a GPL is not proprietary.

There are other examples, ranging from the involvement of patient associations in medical research (Rabeharisoa, Callon 2004), the role of users in the design of software (Pollock et al. 2016), participatory plant breeding research experiments and exchanges of experience in French 'peasant networks' (Bonneuil et al. 2006), and bottom-up innovations in low-input agriculture (Wiskerke, Van der Ploeg 2004)[12] . In addition, the recent cases of the 3D printer and the Reprap model show how technical devices (information technologies coupled with new manufacturing devices) can reinforce the capacity of individuals to make (or hack) technology. Such technological transformations have some sociological drivers as illustrated by the burgeoning of communities of makers, and new sites where the creation of technology is actively distributed (FabLabs, Living Labs, Hackers' Spaces, etc.). In a distributed network, everyone is supposed to contribute and to learn from each other. These peer-to-peer networks are commonplace in computing and information technology. They allow communities to share information and knowledge. The implications of peer-to-peer go well beyond computer systems, and some scholars predict that in the information age it is the basis for a new socio-political constitution (Benkler 2006).

The model of distributed innovation is seldom institutionalised. For example, the H2020 programme implements "multi-actor approaches" (MAA) as a joint initiative of DG Agri and DG Research & Technology.

"(…) projects must focus on real problems or opportunities that farmers, foresters or others who need a solution ("end-users") are facing. It also means that partners with complementary types of knowledge – scientific, practical and other – must join forces in the project activities from beginning to end. As a result, MAA projects are able to develop innovative solutions which are more ready to be applied in practice and cover real needs. This brochure presents the benefits of the MAA, includes some examples of existing H2020 projects and explains where to find project results."

(https://ec.europa.eu/eip/agriculture/en/publications/eip-agri-brochure-horizon-2020-multi-actor)

One of the key barriers to the wider mainstreaming of distributed innovation is generalisation, i.e. the shift from the first circle of users/co-innovators to a wider circle of users. Generalisation is crucial for achieving wider impact. Scholars often describe this process using the concept of 'scaling', seldom distinguishing between scaling up (more of the same) and scaling out (different uses of the innovation). Generalisation can be achieved by several (complementary) mechanisms: circulation of technical objects, technical standards, construction of markets, creation of intermediary organisations, or sharing of practice and knowledge among peers. Generalisation may be understood also as a process of mainstreaming or institutionalisation, i.e. a process through which a new set of (formal and informal) rules, tried out in local situations, stabilise and condition the activities of many actors.

We can sketch the set of values associated to the stream "democratising innovation". Of course, more research is needed to ground this on strong base. Democracy is indeed a central point. However, since it is an essentially contested concept (Gallie, 1955), it needs to be qualified. Looking at the literature and previous experience, I suggest that the meaning intended is strong democracy (Barber 1984) in which communities are the main drivers. This stance towards democracy is developed in Callon et al. (2009) which focuses on concerned groups. It is accompanied by the values of empowerment and autonomy. Democratising innovation runs counter

[12] For a recent comprehensive analysis of the role of users and distributed innovation, cf. Hyssalo et al. (eds.) 2016.

to the central/delegated model of innovation. This also is related to actors' curiosity, to valuing local experience, tinkering, making and hacking (well illustrated by the DiY movement).

Responsible innovation

The issue of research responsibility is not new. On the one hand, scientific responsibility has a long history of much debate within and around the scientific community, and institutionalised forms such as ethics committees, or guidelines and rules to prevent misconduct and misbehavior. On the other hand, the expression 'responsible innovation' (Guston, 2004), or related expressions such as 'responsible development', date back to the late 1990s and appeared as a response to a series of crises (the GMO crisis being the most memorable) (Owen et al. 2012). In contrast, the responsible research and innovation (RRI) frame, promoted by the European Commission since 2011 is more recent.
One of the most-cited definitions comes from René von Schomberg (2011: 9), a scientific officer at the DG Research, and one of the notable promoters of the concept:
"Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)."

The definition of RRI adopted in official European Commission documents reads as follows.
"The grand societal challenges that lie before us will have a far better chance of being tackled if all societal actors are fully engaged in the co-construction of innovative solutions, products and services.
Responsible Research and Innovation means that societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society. RRI is an ambitious challenge for the creation of a Research and Innovation policy driven by the needs of society and engaging all societal actors via inclusive participatory approaches."
(Directorate-General for Research and Innovation, 2012: 2)

The official European Commission document goes on to refer to the six main elements of RRI: engagement, gender equality, science education, ethics, open-access, and governance. These can be considered as constituting the building blocks of the guidelines for the implementation of RRI in European Commission research programs. To broaden the scope, we conducted textual analysis of the RRI literature (Tancoigne et al. forthcoming). RRI discourses are remarkably convergent, and have three distinctive features. First, they are about research and innovation outputs and goals, and take serious account of the desire to steer research and innovation towards solving societal problems, especially so-called 'grand challenges'. Second, RRI discourse refers to inclusive and participative forms of governance which clearly differentiates it from discourses premised on scientists' self-regulation of science. Third, the meaning of responsibility embedded in RRI is prospective rather than retrospective, moral rather than legal, and collective rather than individual.

Programmatic papers by influential scholars in the field of RRI elaborate on this. According to Owen et al. (2012) there are three main features of RRI that to an extent overlap the European Commission Framework:
- Democratic governance of the purposes of research and innovation and their orientation toward the «right impacts».
- Responsiveness, emphasising the integration and institutionalisation of established approaches of anticipation, reflection and deliberation in and around research and innovation, influencing the direction of these and associated policies.
- Framing of responsibility in the context of research and innovation as collective activities with uncertain and unpredictable consequences.
According to Stilgoe et al. (2013), RRI has four dimensions: (i) anticipation, (ii) reflexivity, (iii) inclusion, and (iv) responsiveness.

The future actual impact of RRI is much discussed. The possibility of responsible greening should not be excluded since the RRI frame is voluntary and highly flexible. It can be considered a strategic tool for maintaining corporate licenses to operate. Indeed, it need not be taken at face value but seen as a discursive space that contributes to re-imagining innovation.

What is valued in the stream of responsible innovation is the alignment of science and society as a major lever for addressing grand challenges. This is related to the focus on new technologies and their contestation. This alignment is supposed to emerge through dialogue, anticipation and reflexivity. Responsibility is understood as care for the future which is framed as threats to be avoided. Openness is the core value.
Transformative change
This third stream is related also to the coproduction of public policy and academic research. On the policy side, the grand challenges discourse has become pervasive, both in Europe where it is a central political motto, and in other parts of the world. To address grand challenges such as climate change, world food security, natural resources depletion, ageing societies, etc. doing more of the same is no longer an option. It is necessary to do it differently, and hence, to promote a deep transformation.
This echoes academic research which for more than 20 years has focused on socio-technical (sustainable) transitions (Rip and Kemp 1998, Geels 2002, Geels, Schot 2007). Drawing on the lessons from analyses that highlight the path-dependent character of technological trajectories (Cf. Myth 4 – the

technology selected is always the best), researchers have conceptualised transitions as dynamic processes that allow socio-technical systems to be unlocked and which re-open possibilities. Such dynamic processes are considered to be multilevel involving a combination of transformation forces coming from the bottom (niche exploration), from the top (influence of the environment) but also from the socio-technical system itself (socio-technical regime) as the result of endogenous changes (weakening of core technology, change in consumers' preferences, new incumbent strategies, changed expectations, etc.). This is a very sketchy account of a complex and vibrant research stream but it suffices to demonstrate its core position: (i) due to strong environmental, social and economic limits, there is a need for sustainable transition; (ii) the changes are both technological and social (socio-technical); (iii) due to uncertainty, complexity and ambiguity, transitions cannot be governed by simple command and control processes.
As shown in a paper by Johan Schot and Ed Steinmueller from SPRU, such a frame strongly shapes innovation and leads to the redesign of innovation policy (Schot, Steinmueller 2016). The core question is: "How to use science and technology policy for meeting social needs and addressing societal challenges?" (Schot, Steinmueller 2016, p. 5). In a transformative change perspective, this question leads to a focus on the way innovation policy can achieve system-wide transformation of the food, energy, material, mobility, healthcare and communication socio-technical systems. It is such wide transformations – not competitiveness or other targets - that constitute the core of innovation policy. This requires thinking that goes far beyond the traditional innovation policy tools based on support for R&D and prioritisation of specific research avenues.
Innovation policy as a process within a transformative change perspective involves the opening up of the possibilities for evolution through support from experimentations that go beyond –and often challenge- the incumbent frame.

"Innovation policy should support constant 'tinkering' and the re-making of socio-technical systems as well as the development of new services and organisational models to meet social and economic challenges.

(…) Innovation policy is not about setting priorities, but about improving the process of opening up to a wide range of choices(…)Innovation policy should allow for deep learning, challenges to dominant views, and nurturing a greater diversity of options. It should enable experimentation with options beyond those emerging within the narrow boundaries set by incumbent institutions (...)"

(Schot, Steinmueller 2016, p.21)

(Transformative change) "is not principally a model of science and technology regulation. Instead, it focuses on innovation as a search process, guided by social and environmental objectives, informed by experience and the learning that accompanies that experience, and a willingness to revisit existing arrangements to de-routinize existing them so as to address societal challenges."

(Schot, Steinmueller 2016, p.18)

In terms of governance, what is crucial is that transformative changes involve tensions and conflicts, and challenge the interests of incumbent groups often occupying dominant positions. Schot and Steinmueller consider that what are needed are new institutional arrangements and governance structures that bridge governments, markets and civil society. They suggest also, that public deliberation could shape collective expectations and strengthen commitment to the search for new solutions that might challenge current interests. In their view, transformative change involves democratising control over innovation production and diffusion.
Such a framework is tentative, and its ability to achieve its goals remains to be demonstrated. Concern over the diversity and directionality of innovation beyond the competitiveness framework- and the need to think of technical democracy as new power/knowledge configurations- are rightly pointed out. However, the effectiveness has still to be tested. Is it possible to govern outnovation of major socio-technical trajectories such as pesticide use in agriculture? The weak part of the framework is the design of a hybrid governance arrangement. This prevents consideration of the specific role of public authorities. Against this, Mazzucato (2015) suggests that it is necessary to consider this seriously, and to look at the broader implications for mission oriented investments of not just fixing market or system failures but actively shaping and creating markets.
What is valued in the transformative change stream is the ability to govern and perform socio-technical transitions. The democratic values are important in so far that they contribute to successful unlocking of trajectories that are not sustainable. Since the emerging socio-technical systems are unknown, experimentation and technological diversity are both valued highly. Communities are not important per se but depending on whether they contribute to the needed transitions through local experimentation that potentially is generalised.

Wrap-up 2 – Streams that feed innovation renewal and handles for reimagining innovation

Indeed, the different streams that currently feed innovation renewal draw on very different intellectual traditions. They do not share a common understanding of democracy or progress, and do not consider innovation processes on a main level. What is valued in each stream and the related valuation process also differs.
Table 2 provides a tentative combination of the literature streams and the set of handles identified in section 1. This qualitative appraisal is not meant to compare the respective performance of these streams but to look at how they fit with our idea of re-imagining innovation. "Democratizing innovation" and "Transformative change" have the best fit. The least good fit is the need to shift from a culture of novelty and disruption to a culture of maintenance

Table 2. Three streams and a set of handles

Innovation and its myths	Handles for re-imagining innovation	Democratizing innovation	Responsible innovation	Transformative change
Myth 1 – The idea of trickle down innovation	- Innovation beyond the competitiveness framework	++	+	+++
	- Distributional effects and directionality of innovation	+	++	+++
Myth 2 – The linear model of innovation	- Diversity of models of innovation	+++	+	+++
	- Different sources of innovation	+++	+	++
Myth 3 – Innovation is driven by (new) technologies	- Acknowledge non-technical sources of innovation	++	++	++
	- Culture of maintenance and recycling vs. culture of novelty and disruption	+/-	+	+
Myth 4 – The technology selected is always the best	- Taking care of diversity	+++	+	+++
	- Learning to govern transitions and out-novation processes	+	+	+++
Myth 5 – Innovation as creative destruction	- Issue of directionality: Instruments to steer innovation	+	++	+++
	- Technical democracy as a new power/ knowledge configuration	+++	+	++

and recycling.

Of course, one can argue that although drawing on different traditions, these streams are compatible, and hence, it is more productive to consider their complementarity than their competition.

CONCLUSION

Since the 2017 presidential elections, the mood for innovation in France has been renewed. The inclination of President Macron for new technology and start-ups is well known.

«L'esprit start-up, c'est le courage, c'est l'audace, c'est l'agilité (…) Nous devons devenir en cinq ans la nation des start-up. C'est une transformation profonde». [133]

Emmanuel Macron, avril 2017

This can be understood in several ways including the ironic reference in French media to what the "Macronist newspeak".

"Avec sa 'team ambiance', sa stratégie 'civic tech' de conquête du pouvoir basée sur des 'helpers' et des «CEO», le président élu Emmanuel Macron a «disrupté» dans la campagne par sa veine «startupper».

(La novlangue macroniste, Marianne, 12/5/2017)

This paper is definitively not a critique of current day-to-day policy. Instead, reference to the French context is meant to show that the sociotechnical imaginary of innovation is not constructed as a straw man to serve my rhetorical strategy. This imaginary is deeply entrenched. I have argued that it prevents the needed transformation to the way we imagine and govern innovation. The dual approach in this paper is aimed at opening up this imaginary in order to renew innovation. Demonstrating the innovation myths as debatable is a first important step which makes visible the deep beliefs that condition the imaginary. It allows us to identify a set of handles that could contribute to a re-opening. The presentation of the three literature streams that currently feed the innovation renewal allows consideration of explorations in academia as well as in public policy. This shows that a re-imagination and re-invention of innovation is underway, and that the dynamic is constituted of different actors from different traditions.

Although these streams share a need for diversity and directionality of innovation, they hardly challenge

133 "Start-up spirit is courage, daring, agility. (...) We must become the nation of start-ups within five years. It is a profound transformation."

the fashion for novelty. This is not surprising if we consider that as suggested in section 1, this would mean a Copernican revolution in innovation studies. However, the shift to –or to put it more gently the balance with- a heuristic of continuity, maintenance, repair and recycling will be necessary to reconcile innovation and progress (Wisman 2015).
Our final observation focuses on the issue of technical democracy. Our high scores may be misleading. They express the huge concern over the issue, not the effectiveness of the proposed measures. This is surely the weakest area in current explorations in these research streams.

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