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# STS and Post-truth, Wearable Sensors, Sustainable Transitions, Nanoindustry, Datafication and Big Data from Below

*ASCII Shell Forkbomb* (2002) by Jaromil

This forkbomb is a kind of poetic virus. If its visually attractive line of only thirteen characters is entered into the command line of a Unix system and the enter key is pressed, within seconds the computer will crash because the devious little program commands it to make multiple copies of itself, setting off a chain reaction and thus quickly exhausting the system's resources. In considering a source code as literature, I am depicting viruses as *poésie maudite*, *giambi* against those selling the Net as a safe area for a bourgeois society. The relations, forces and laws governing the digital domain differ from those in the natural. The digital domain produces a form of chaos – sometimes uncomfortable because unusual, although fertile – to surf thru: in that chaos viruses are spontaneous compositions, lyrical in causing imperfections in machines made to serve and in representing the rebellion of our digital serfs.

https://jaromil.dyne.org/journal/forkbomb.html

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# TECNOSCIENZA

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***Cover*** *ASCII Shell Forkbomb* (2002) by Jaromil

## *Essays*



## *Crossing Boundaries*



## *Scenarios*

# Book Reviews

# Wearable Sensors

## Exploring EU Policy Narratives by Engaging the Extended Peer Community

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**Abstract:** Wearable sensors that allow communicating patient's state of health to their physicians without the need for their physical presence, are offered with grand promises to both patients, doctors and other communities. This paper looks at how this technological promise is influencing policy making in the EU about future healthcare. In particular, we use knowledge assessment concepts to examine the pedigree of claims and assumptions in e-health related EU policy documents, deepening the examination of the narratives with engagement of relevant actors, i.e. those that are part of the extended peer community. We found that even if the proposal of e-health is attractive to many, there are many disconnects about both bodies of knowledge and the apparently disjointed imaginaries about the role of these technologies to address different challenges in the healthcare sector.

**Keywords:** E-health policy; European Union; knowledge assessment; wearable sensors; techno-scientific imaginaries.

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## 1. Introduction

Wearable sensors (WS) are a core element of wearable technologies and devices[1]. WS allow activity and physiological monitoring, and as such they are used in a wide spectrum of health-related aspects by many people. They are already widely used for fitness and health-as-leisure purposes (Piwek et al. 2016), but the growing attention is primarily due to their

potential applications in the area of healthcare monitoring, the focus of this paper. The literature suggests and describes the usage of these sensors in medical contexts, for example, rehabilitation (Bonato 2005), eldercare (Milligan et al. 2011), the treatment of people with chronic medical conditions (Siddiqui et al. 2018) and the use of big (sensors') data for personalised healthcare (Chawla and Davis 2013). The possibility to remotely monitor a patient's health while collecting the patient's data over a long-time span nurtures the expectation that WS shall enable a more complete medical analysis and a less cost intensive healthcare.

The promises that these sensors come with are visible in the narratives entrenching discourse and action of market, media, academia and policy. People increasingly use WS, as tools for self-improvement and self-enhancement. The moto of the Quantified Self movement[2] is "self-knowledge through numbers". Therefore, we can say that WS may be seen as "an extension of human senses" (Vesnic-Alujevic et al. 2016). They also provide a feeling of more control over one's life (Lupton 2014b).

Optimistic imaginaries of key actors, especially those of policy makers and industry about the potential and applications of WS to deal with healthcare matters drive the development of these technologies. Yet, WS growing usage in everyday life activities are blurring the existing boundaries of medical and more mundane well-being practices, posing challenges to our received notions of 'health', medical practice, healthcare policy and the ethics that sustain these. Indeed, as Lupton (2014a, 1347) pointed out, the discussions on digital health, of which WS are a part of, rarely address broader implications of these technologies on the meanings of health and illness or on the medical practice and doctor and patient relationships. Furthermore, a variety of ethical issues, namely social inclusion and social justice as well as, data ownership need to be still thoroughly investigated (Rich and Miah 2017).

With the use of WS, individuals' everyday practices generate data. The transformation of activities into data is first enabled through the collection of few body signals by different types of sensors and then processed algorithmically, and communicated to different parties. This is what Mayer-Schoenberger and Cukier (2013) called *datafication* of individuals' lives. While the quantity of (big) data collected in such ways is indeed enormous, their quality is questionable (Cai and Zhu 2015), and more importantly, the sense that different agents make with them needs critical interrogation (Van Dijck 2014). The "data-driven lifestyle" (Lupton 2014b) and the emerging narrative about big data as the latest resource to reveal 'truths' about us, our behaviour, our needs and expectations could turn out to be the next deception.

The potential to integrate personal data with clinical data and the blurring line between the use of wearables for fitness or medical purposes is raising ethical concerns, paving the way for a need for specific regula-

tion. Governments and the European Union (EU) institutions have become involved in several ways. For example, the EC has published documents, classifying WS for medical purposes (MEDDEV 2.1/6 July 2016) trying to propose data collection regulation on health and fitness apps (EC SWD(2014) 135 final 10.04.2014).

In our study we are interested in understanding how different types of knowledge inform and influence policy making in this sector, because while looking at different discourses, we observed that policy narratives did not seem to address different challenges to the promises of this type of technology in addressing healthcare issues, voiced by different actors. We applied what Funtowicz (2006) described as 'knowledge assessment methodologies'; in particular, we investigate whose and which knowledge (scientific or non-scientific) on WS technology informs policy making, in the EU context. Our main research questions are: 'Who' informs policy making in the domain of wearable sensors at the European Commission? Whose and what knowledge is reflected in the policy papers and the EC narrative on WS technology use for healthcare?

While looking at WS policy we found that the notion of techno-scientific imaginary (Jasanoff and Kim 2009) to situate the EU policy narratives is critical to understand the role of actors and institutions in their development. Our departing point is EU policy making in this domain directly or indirectly referring to WS; the analysis of those narratives helped with situating WS in the wider context of current imaginaries of innovation, helping also with identifying relevant actors. We used the notion of *pedigree*, which is a key concept of 'knowledge assessment' to analyse knowledge claims, assumptions and framings appearing in relevant EU documents. The pedigree analysis is further attuned with in-depth interviews to identified actors. The paper offers a discussion about the production and circulation of knowledge that sustains current policy making in Europe with regards to WS usage in healthcare.

## 2. Conceptual Background: Imaginaries and Knowledge Assessment

Felt and Wynne (2007) argue that all key reference points in science and governance, such as the purposes of research, ethical issues and public concerns, are objects of collective imagination. Jasanoff and Kim (2009) have described techno-scientific imaginaries when they studied energy policies in the USA through the exploration of the *imaginaries* that guided past energy policies in that country. This concept explains how visions about possible futures are produced as "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects" (Jasanoff and Kim 2009, 120). Hence, it is important to investigate whose and what im-

aginaries are entertaining techno-scientific narratives and developments and who drives the process of collective imagination. In other words, whose values are being enacted? What and how is knowledge produced to ground these visions of the future? How is knowledge circulated?

Visions of future healthcare practices in EU policy circles and wider sectors of society are informed and enacted by various actors. How these actors are involved in the process of knowledge production (and contestation), how they interact, and how knowledge circulates and how it influences decision-making helps with situating dominant healthcare innovation narratives in Europe. In this context, we are referring to all the parties, those that produce "scientific knowledge", but also those holding political, experiential and practical knowledge.

It is important to understand how policy relevant knowledge is generated (Porteous 2016). 'Knowledge assessment' (KA) as defined by Funtowicz deals with "evaluating of knowledge inputs in decision-making processes" (Funtowicz 2006, 139). In this context, knowledge is not simply understood as 'scientific' knowledge, but also includes other types of knowledge produced outside the academic sphere. An important goal of knowledge assessment is to identify and involve relevant actors in a given debate about policy relevant science, which Funtowicz and Ravetz (1991, 6-7) called the 'extended peer community' – a concept from post-normal science – i.e. a community "consisting not merely of persons with some form or other of institutional accreditation, but rather of all those with a desire to participate in the resolution of the issue" and produce 'extended facts'. In the case of healthcare WS, the extended peer community can consist of doctors, patients, researchers, developers, policy makers, industry, users (e.g. specific communities such as the quantified-self movement –http://quantifiedself.com/) or other individuals with an interest or concern about these devices and their applications.

## 3. Wearable Sensors in the EU Policy

The current narratives on WS can be linked to a more general perspective on science and technology in the EU. At the core of the EU 2020 strategy lies the so called 'Innovation Union', which heralds research and innovation as a means to bring more products to the market, with an imaginary of salvation of EU economy. Amongst its underlying assumptions, the innovation narrative promises that innovation will create jobs and improve quality of life (Van den Hoven et al. 2012). The narrative is presented in a salvific role, solving all the problems that we face today (Guimarães Pereira et al. 2013). These assumptions are problematic because they can be proved wrong in many cases; economic profit does not automatically map into improvements of quality of life and the idea that all problems of society can be solved through technology (*techno-fix*) is

obsolete and misguided. Often, by solving one problem with technology, we generate another (Benessia and Funtowicz 2015).

Europe's growth strategy, Europe 2020, promotes the advances of future and emerging technologies – and WS are among them. WS are a key feature of what is called the Internet of Things, the largest world project on connectivity. Policy developments in the field of telemedicine, eHealth and ICT for healthcare are present in the Digital Agenda for Europe, the European Innovation Partnership on Active and Healthy Ageing in Horizon 2020. Hence, the proposed applications of WS do not emerge in a vacuum but they are rather coherent with the social and technological innovation hype that characterises many areas of EU policy and in general, human endeavour.

As noted in the staff working paper on telemedicine, due to "the importance of this sector and the benefits it could provide, Member States, regional and local authorities, payers of healthcare services, industry and the European Commission have been supporting research in the field of telemedicine for over 20 years. However, despite the considerable level of technical maturity of different technologies, the sector is not as well developed as could be expected" (EC SEC(2009)943 final of 30 June 2009).

The European Commission (EC) launched several calls for proposals for projects related to biosensors, mostly in the area of telemedicine, e-health and active ageing during the 2000s. Research for 'personalised healthcare' was funded with a budget of € 549 million in 2014, responding to the strategy to reduce the ever rising costs of healthcare in the ageing population of the EU. The analysis of these documents show that expectations are high. e-health and the use of big data in healthcare are expected to improve diagnostics, therapies, disease prevention and support healthy ageing (EC 2014). The 2013 EC call for proposals describes ICT for Health, Ageing Well, Inclusion and Governance, as one of the big challenges of Europe. Here, ICT in health is described as a tool for empowering the elderly generation, that will enable them to "live independently, delay/avoid institutionalisation and staying active as much and as long as possible" (EC C(2012)4536, pp. 53). The empowerment could "facilitate patient control through self-management and shared decision making, as well as promote equitable and collaborative approaches to healthcare and improved cost-effectiveness of care delivery" (Risling et al. 2017, 2). However, there are different views on whether patients will be really empowered through the use of these technologies or not. For example, Ammenwerth (2018) argues that "whether patient portals really can have a positive impact on patient empowerment or not seems to be quite unclear at the moment" (p. 22). Risling et al (2017) argues that the concept of *patient empowerment* is still not clearly defined in the literature, although it is becoming a focus of exploration of many studies on healthcare reform, but study of changes in health behaviour and outcomes are still missing.

The cost-effectiveness ratio is an important element when evaluating possible novelties in the healthcare systems. When it comes to WS, despite the promise that eHealth would reach more people, decrease costs and increase the effectiveness (Dobkin and Dorsch 2011), there is no straightforward answer about the increased cost-effectiveness ratio. While Kvedar et al (2014) state that "the increasing adoption of electronic technologies is widely recognized as a key strategy for making healthcare more cost-effective", improve the quality and patient satisfaction, as well as lower costs, Mistry (2012) and De La Torre-Diez et al. (2015) argue that there is lack of "concrete" evidence about the increasing cost-effectiveness of telemedicine and eHealth and that it is unrealistic to make broader generalisation about it.

We suggest that these *big promises* come with high uncertainties on a number of ethical questions that go far beyond concerns of privacy and data protection. So far, it is not clear who will own the data, or whether these will be open data; who would be responsible for medical decisions that are based on data produced by WS; or what would be the social implications of distant care for elderly or people with chronically ill patients in need of continuous care? Even the reliability of such devices is still questionable and different studies have concluded that their accuracy and reliability are variable (Wang et al. 2017; Byun et al. 2018).

Hence, this paper contributes to exploring whose and what knowledge is supporting the development of policy making with regards to development and adoption of wearable technologies in healthcare, and what *normativities* are developing through the design and use of these devices.

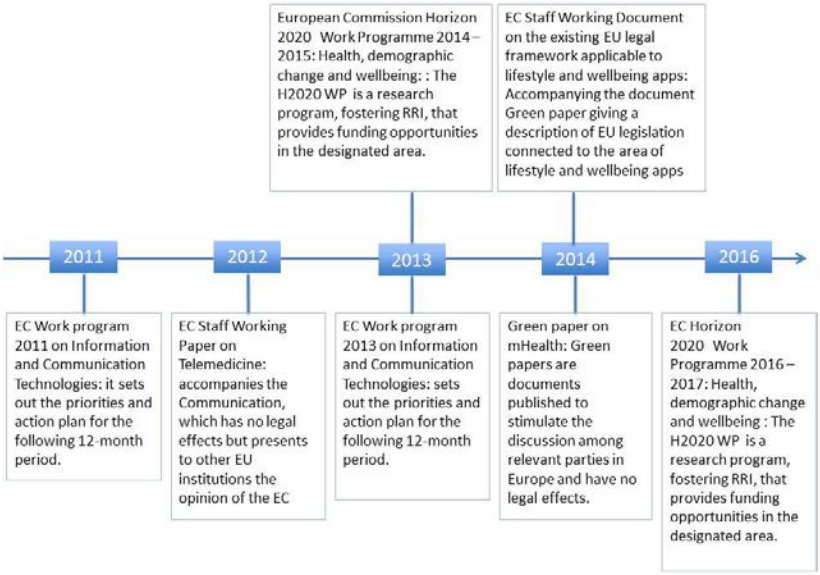
## 4. Research Design

KA contributes to a body of research that intends to get insights about what types of knowledge inform policy making. While some have analysed how the EU uses expert groups to inform policy making (Gornitzka and Sverdrup 2008), the KA approach aims at tracing the pedigree of knowledge claims. Our particular application of KA is focused on pedigree analysis and the engagement of the "extended peer community" (Funtowicz and Ravetz 1991). A pedigree analysis explores knowledge production and circulation; in practice, by investigating where knowledge comes from, one can establish which actors are relevant for the particular claims and assumptions and whose narratives are voiced in the policy process. The methodology further helps with making visible which actors and which views are excluded through the very process of engaging a number of relevant actors. We conducted a series of in-depth interviews to ascertain and further explore who, what and how particular knowledge claims get into policy documents. This methodology is particularly inter-

esting in cases where there is genuine difficulty in having an a *priori* understanding about *who* is informing policy.

### 4.1 Analysis of Policy Documents

For the purposes of this study, we identified policy documents issued by the European Commission that are related to the use of WS in health and wellness (see Figure 1). We selected not only documents that focus on this field but also those that relate more broadly to the application of




WS in health. The pedigree of the policy narratives was explored by looking at the sources quoted in policy documents, allowing identifying which institutions and actors are informing policy making.

Figure 1 – Analysed documents

### 4.2 In-depth Interviews

We conducted nine in-depth interviews with relevant actors which were connected to WS and telemedicine policies and practices; the interviews focused on deepening the assessment of policy narratives, extending their review to relevant actors, bringing more insights about the construction of specific visions and narratives around WS.

In-depth interviews are one of the major qualitative methods in order to explore individuals' opinions and insights about a specific issue or idea (Kvale 2007) and useful to investigate a certain topic with more in-depth information (Boyce and Neale 2006).

We identified relevant actors by looking at who holds strong interests in this particular issue and of what nature, i.e. expertise, influence in the policy process or opinion making regarding WS. That included the authorship of policy papers, scientific papers, articles in specialised media (e.g. Wired Magazine) and persons involved in projects related to e-health. Although policy papers are public, their authors are usually not known. Therefore, we also asked the interviewees to recommend other relevant actors. Five broad groups of actors were identified: policy makers, industry, academia (medical researchers, IT researchers, STS researchers), media, NGOs. We contacted 20 persons in total out of which 9 agreed to be interviewed (see Figure 2). We also contacted industry but none showed their availability to talk to us, which, we acknowledge could have enhanced our analysis. All the interviewees were either authors of relevant publications or known activists in the field. More interviews weren't necessary because, as Boyce and Neale (2006) state, the saturation is reached when the same information is provided by different interviewees.

The interviews were conducted in the period between 15 October 2013 and 16 December 2014 in English. They were semi-structured with open-ended questions, lasting between 35 to 60 minutes. They were conducted either in person or through electronic means by the authors. The respondents were first approached by email to arrange the time of the interview, inform them about the confidentiality, anonymity and the objectives of the interview and project.

The semi-structured interviews were centred around questions regarding the interviewee's involvement in the field of WS, the personal motivation to engage with this topic, the knowledge that was used when producing material on WS, and general questions on benefits and challenges regarding WS in healthcare, testing some of the claims made in policy papers. Additionally, we asked about how quality of knowledge could be assured when evidence was sought for the narratives these devices are being proposed and sold with; finally, we also enquired about which topics were not successfully discussed in debates surrounding WS. In the interviews, we focused especially on the issues regarding the use of WS in healthcare.

The interviews were transcribed and analysed by the authors. We used Ritchie and Spencer's (1994) framework for analysing the interviews. We first 'familiarised' with the data by reading transcripts and listening to the audio recordings, in order to understand what the most important issues to our interviewees were. This phase helped us building a set of preliminary codes. In the second phase, we identified a thematic framework based on the research questions, the analysis of policy docu-

ments, as well as the emerging themes from the interviews. We compared codes emerged from the documents' analysis and interviews and decided on the most important to be kept. We then indexed and charted the data, i.e. coded the interviews into the categories. The last phase, mapping and interpretation meant finding patterns and making sense of the coded data.

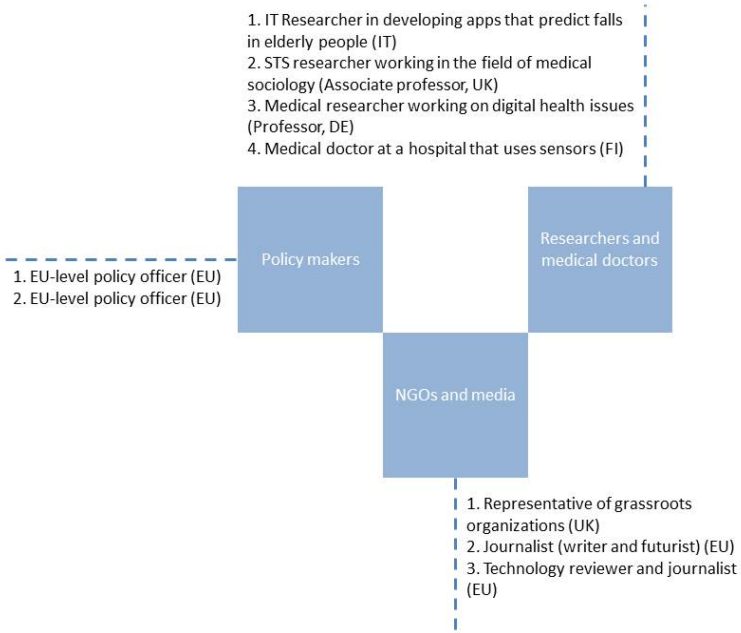



Figure 2 – List of interviewees

## 5. A Knowledge Assessment Journey

### 5.1 Wearable Sensors Related Policy Documents – Journey 1

While examining knowledge claims on the policy documents listed in figure 1, special attention was paid to the references that are enlisted to support major claims on the promises of wearable sensor technologies to address challenges in the healthcare sector. We found that many of the claims are not backed up by any reference, hence it is difficult to establish their *pedigree* in the KA sense. In the Commission Staff Working Document on the applicability of the existing EU legal framework to telemedicine services it is stated that,

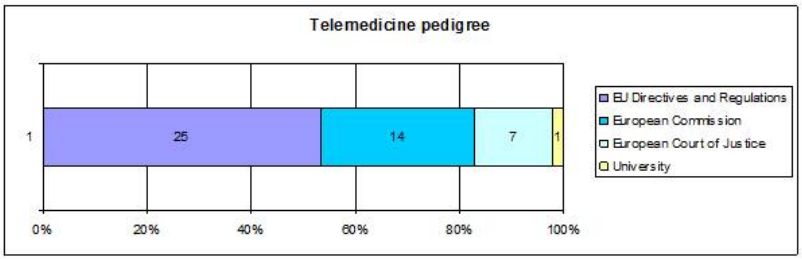
> Telemedicine can help to address major challenges faced by European healthcare systems. For example, telemonitoring can improve the quality of life of chronically ill patients through self-management solutions and remote monitoring from home, reducing hospitalization costs and saving on unnecessary emergency visits. (EC 2012)

These are strong promises and assumptions, but they are not supported with background knowledge, which could be verified. Other claims grounded on existing publications were not faithful to the original claims:

> Telemedicine can also significantly improve access to care, by delivering high-quality services to patients living in remote or sparsely populated areas affected by shortages of specialized healthcare professionals or by facilitating across border healthcare for the benefit of citizens in the EU. (EC 2012)

This section cites the 2010 EU citizenship report, which deals only with cross-border healthcare, not discussing telemedicine as a means for better care for people living in remote areas.

A common snag of the EC papers is self-referencing, i.e. the documents justify certain types of claims that (we argue) would require citation of expert studies or sources of evidence; instead citations of earlier




EC publications of policy nature are made. In the 2012 EC paper on telemedicine, we found the following sources (figure 3): policy documents: 25 EU Directives and Regulations, 14 from the EC, 7 from European Court of Justice; and one from academia. Whilst one can argue that the choice to have our healthcare mediated by ICT is a social and political one and not a technical one, it also can be expected that the reasoning offered is at least of social and political nature and not based on poorly referenced technical arguments.

Figure 3 - Pedigree of the 2012 EC paper on telemedicine

The green paper on mHealth (EC COM (2014) 219), has a greater variety of references, although the majority is again from the EC itself: 21

from EC, 17 from industry and consultancies (12 industry, 5 consulting), 4 from the World Health Organization, 3 from university and 1 from the media (figure 4). Similar observations can be made for the other documents we analysed; working programmes (EC 2012, 2013, 2016) have even less references and the Staff working document on the EU legal framework (EC 2014) refers to the EU legislation, consisting of different directives, only.

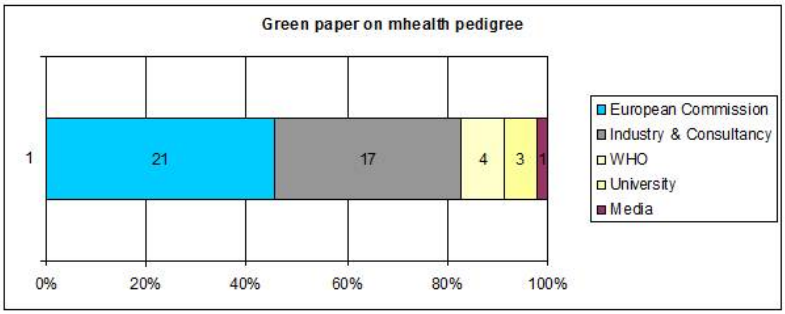



Figure 4 – Pedigree of the mHealth Green paper

## 5.2 Deepening the Process Through Actors Engagement – Journey 2

*Knowledge Assessment*

As previously noted, the EC is promoting e-health, m-health and WS as important means to improve the healthcare system. We asked our interviewees what their knowledge on WS builds on, especially taking into consideration the place WS seem to have and expectations they create in a rather complex transformation of healthcare.

With regards to scientific and clinical studies on WS in healthcare, three of the interviewed persons from different professional networks (academia and healthcare) argued that there was not enough research on WS for healthcare and a tele-health; some of them considered positive the financing of projects in this area by the EU because there is "little academic research" in this area and although the companies show customer satisfaction data, "this is quite different from the data that is required if you really want to look at the medical effects of the devices" (Medical Doctor, interview).

Referring to an EU-funded project on sensors for monitoring and predicting elderly people falls, our interviewees suggested that new technologies are often being pushed by the industry, although their effective-

ness in either improving health or reducing the healthcare costs is largely unproven.

The interviewees from the academia and the medical doctor we talked to also agreed that there is a need for more large-scale studies on the use of WS in healthcare:

> I would like to see more large-scale studies being done to really convince policy makers to change their funding behaviour. Whenever we want to study a topic, we have very small studies with a small number of participants. This is very costly, but we really need the evidence so that people will listen to us. (Medical Researcher, interview)

These views contrast with the claims in the policy documents, which describe the economic and health related value of WS as a fact. Could the lack of existing studies explain the WS benefits poor referencing in policy documents?

However, the views expressed by the researchers and the medical doctor are not in line with the visions of the policy makers that we interviewed. According to one of them, there is enough knowledge including clinical evidence available on WS used as medical devices that can be used to measure their cost-effectiveness. One of the policy makers claimed that it only needs to be gathered in the right way to get a complete picture:

> The new thing we are launching with DG CNECT tries to map out all the clinical evidence which is available on the market, to better measure the effectiveness and the cost-effectiveness of medical devices for e-health (…) but *we look at what industry produces* and everything that is in the Cochrane database or the Centre for Reviews and Dissemination (CRD) database. (…) Now [that] we have a complete picture, we will ask experts nominated by the Commission, a panel of experts on healthcare systems, to look at this. They will cast a particular eye on the quality of the literature which is being produced. (Policy officer 1, interview, emphasis added)

The policy papers analysis showed that not all actors' concerns and their knowledge have been represented. Whilst, there seems to be a focus on the need to involve industry in the quote above, it remained unclear who is invited to be part of the experts panel. Also, one of the interviewees (social science researcher) pointed out, that their research group used a range of methods, including discussions with different *stakeholders* to draft the Forward Look on Personalized Medicine (European Science Foundation, 2012). In the researcher's opinion, one group was underrepresented in the discussions, namely health economists.

At the EC, policy makers often engage researchers on expert opinion on a topic. Hence, investigating how knowledge is circulated and used in the policy making process is needed to investigate its quality. The re-

searchers we interviewed, raised the concern that it is often not clear to what extent their work is being considered in the policy making process and it is "hard" to estimate for them what impact their input has. As one of them states: "You give your input as an expert at that level and the hope is that somewhere downstream will inform policy" (IT Researcher, interview). This demonstrates a certain opacity of the policy making process, even for those who are participating in consultations, since it is not clear to anybody whose voices really get marshalled into the policy making process.

Another way of understanding if the EU policy documents are well informed by other actors' visions is by asking which and whose imaginaries and knowledge did not find its way into the policy papers. In the next section we therefore compare visions of WS by different actors and contrast them with the narrative laid out by EU policy documents.

## *Imaginaries of Health trough Wearable Sensors and Telemedicine: Which and Whose Knowledge Is Voiced in the Policy Narrative?*

The EC narrative on WS and e-health circles around the issues of cost-effectiveness, improved quality of care, patient empowerment, inclusiveness, healthy ageing, preventive care and e-health as a promising new market. In order to test the plausibility of the narrative with different actors we asked them: What was your motivation to engage with this topic? To which problem are WS the solution? What types of knowledge and sources of information did you use? What kind of impact did your work have on policy making? Which topics concerning WS are not sufficiently discussed at a political level?

On question: "To which problem WS are the solution?" it was argued that the use of WS in healthcare corresponds to the need to improve the quality of care and at the same time decrease the costs of healthcare. In Europe, the rising costs of healthcare are a burning topic, the current healthcare system being unsustainable (OECD 2015). One of the interviewees (IT Researcher, interview) works on a project that develops applications to predict elders falls, assess mobility and gait function; he sustains that the use of WS is related to the idea that proactive healthcare can reduce accidents and therefore reduce medical costs.

Another element often mentioned in policy papers is that WS could improve care of people with chronic medical conditions, by improving the life quality of patients but also reduce costs. The interviewed policy maker suggests that in order to decrease costs, there is a possibility to treat some chronic patients at home instead of hospital but for that, it is important that the medical staff can monitor them remotely.

The idea of reduction of costs has not been proven thus far. A study conducted by one of our interviewees showed that, the use of WS for health monitoring actually increased the number of medical visits and

therefore led to an increase in cost, without additional benefits for the patients.

> Actually, the results are sometimes quite surprising. We had a small study on diabetics in one of the cities in Finland, where glycaemic control was monitored using an application. What happened was that the patients who were monitoring their blood/glucose level themselves were using more healthcare services, but the end result was the same. They did not get any health benefit, but they used more services because when they noticed something problematic during their monitoring, they visited doctors and clinics. They used much more services, but they did not get any better outcomes than the other patients. (Medical Doctor, interview)

This view is shared by a policy officer who admits that, despite the EU strategy on e-health, whose objective is to reduce the costs of healthcare, the evidence of the savings potential is still missing, as well as it bringing any clinical value for patients. Our interviewees agree that it is not impossible that the use of e-health could reduce costs in some instances and "make healthcare smoother and more efficient". Even if sometimes this happens, "very often this does not happen (Medical Doctor, interview).

Another vision is that WS will allow gathering a greater amount and more "accurate" information about a person's health status. The medical doctor interviewed, argues that "WS provide a means to get more information, in contrast to what we do at the moment, which is what I call snapshot care […] when you contact your physician only after you already have a problem" (Medical Researcher, interview). Furthermore, he states that the information collected by the sensor is more accurate than a patient's memory.

> If you want to know about the condition or the physiology of a patient in between physician visits, such as in everyday life, you have to ask the patient. We all know that patients do not give accurate history. We get objective information about their state of health when we use WS. We can get out of lab conditions in an unsupervised way. (Medical Researcher, interview)

An interviewed policy adviser points out, that the sensors are only a "component of a complex system" and making conclusions based on that will produce "a huge error rate". Hence, WS reduce a person's health to a few factors that can be measured by sensors. The most problematic being "because this comes from an instrument with a nice number associated with it, people will believe it" (Policy officer 2, interview). This is shared by the medical doctor who thinks that WS and tele-care cannot be a substitute for traditional healthcare:

> WS just provide *part of our toolbox*. We will never replace the physical person-to-person contact. This is not really our intention and we do not

> want to replace the nurse or physician, but rather to provide better information for a broader base of making *better and more reliable decisions* about the patient. (Medical Researcher, interview – emphasis added)

Concerning the reliability and quality of the data from current devices, there is still a number of technical problems to be solved. According to the interviewed developers and IT researchers, WS are not measuring the data with desired accuracy, and it is not proven that they provide reliable outputs. The positive experience of wearing a sensor is related to the (wrong) belief that the data it produces are reliable:

> It makes you feel good to wear it because you believe that this is making a difference. […] [the effect] is almost psychosomatic because you think the number is correct, but often the number is not correct. (Medical Doctor, interview)

Another important strong element of the EC narratives on WS is that they are an empowering technology. There are different opinions on this narrative:

> As part of the services that we have defined using WS, we can provide feedback with the information we have, which can improve patient self-management. We use the term *patient empowerment*. I do not really believe that a patient can manage herself or himself completely alone, but this can provide support in the same way as using wearable devices when we go running. (Medical Researcher, interview – emphasis added)

The concept of patient self-management and patient empowerment raised three main issues in the interviews: responsibility, missing face-to-face interaction with the doctor, and increasing inequalities arising from possible digital divide. Patient self-management implies a shift of tasks and responsibilities from the healthcare professional to the patient.

Many of the devices are intended for eldercare. Nevertheless, certain groups in society might have difficulty to use the devices, because "many of the services that are provided by the Internet may be difficult for you to use". In this way, "*e-healthcare can actually increase inequalities* because it makes healthcare accessible for some, but does not help those who probably need the services more." (Medical Doctor, interview – emphasis added). While sustaining that e-health encourages alternatives to face-to-face relationships among citizens and professional careers, an interviewed policy maker agrees that there could be some ethical issues:

> I do not know whether it is an ethical issue or not. However, it is true that if we promote mobile health, we are also promoting a non-systematic face-to-face relationship between the patient or the consumer and the doctor. I do not know whether it is an ethical issue but anyway *we need* to move

> towards this new way of delivering healthcare. That can be an ethical issue for some people. (Policy officer 1, interview – emphasis added)

Also, related to the idea of empowering patients, the question arises of whether citizens will be able to choose the healthcare they wish to enrol with. Our interviewed researchers seem to agree that an empowering technology needs to be based on voluntary usage. In that sense, we need to *"make sure that this participation remains an opportunity*. It must *not* become a burden or a *duty* to people" (STS Researcher, interview – emphasis added).

Interestingly, these are quite contrasting narratives: choice ("an opportunity" vs. inevitability: "we need"). The latter is prevalent on the policy narrative.

In addition to the mentioned contrasting views about WS for healthcare, there is a number of other ethical issues that were pointed out by our interviewees, which are not reflected in the policy papers, official communications and strategies of the EC.

### *The Issue of Privacy and Regulation*

One of the issues that was mentioned by almost all the interviewees is their concern for privacy.

> We will know much more about a person's mental and disease state and therefore we will be able to hire or fire or associate with people depending upon what we think we are seeing from the sensors. That is not permitted in most countries, at least in the Western world, but that will not stop people from doing it. (Policy officer 2, interview)

Privacy is very relevant for healthcare insurance schemes; to some interviewees, this could result into new normativities about our health and healthcare and therefore constitutes an ethical issue.

> The only big concern I have is around health insurance […]. If we know everything about you from the day that you are born, we will know what burden you will be on the health system […]. It goes against the whole idea of insurance, which is the unknown that as a herd, we insure each other and some people will be unlucky and others will be lucky. Together we will cover the cost, but when you start to get more information about people and the premium changes – you can see it all happen. Some will be very heavily disadvantaged because they have a poor health condition and there is nothing they can do about it. (IT Researcher, interview)

Moreover, the issue of privacy leads to other ethical issues, namely property, autonomy and agency. For example, who owns the data from these devices? This is certainly not a new discussion – e.g. in the famous

case of Henrietta Lacks in the 1950's (see Skloot 2010) and that of John Moore in the 1990s (see *Moore v. Regents of the University of California* (51 Cal. 3d 120; 271 Cal. Rptr. 146; 793 P.2d 479)) with regards to property rights of their body materials and participation in research (see e.g. Tallacchini 2015 for a discussion of these two cases). The members of the quantified-self movement, for example, claim the right to own and also analyse their own data. Medical data could be marketed, but this raises ethical issues because "if you do not know where the data are going and what people will be doing with them, terms and conditions can be changed at will, as is often done. That is quite a big ethical issue for me." (Grassroots organisation, interview). The use of medical data for marketing purposes is currently in debate. The EC proposal for data protection states that the data should only be used for medical purposes and "not for purposes such as insurance or banking" (Policy officer 1, interview).

But in times where the "open everything" paradigm is being heralded as a key for restoration of trust, what kind of governance will protect existing rights and norms? This brings us to the issue of regulation. Given the numerous ethical issues and uncertainties associated with present and future uses of WS, some of the interviewees called for a need for more regulation, because "people should control the use of their sensitive health data. There is definitely a need for a legal framework for that." (Medical Doctor, interview)

The legal framework needs to address the question of which devices are considered medical devices, and which devices are for fitness purposes. The staff working document concerning the existing EU legal framework states that "there are no binding rules in the Union as to the delimitation between lifestyle and wellbeing apps and a medical device or in vitro diagnostic medical device" (EC, 2012, p.3). But our interviewees point out that:

> This is the regulatory issue at stake. Are these WS, apps or devices considered as medical devices or are they to be considered as consumer products? At this stage, they are considered medical devices in the legislation. On the other hand, in other cases, they are followed up or monitored as consumer products. […] the information in these sensors measures health issues […]. They should then be considered as medical devices. They should then be regulated as medical devices with CE marking and so on. (Policy officer 1, interview)

Another interviewee argues that:

> If you are really claiming that it provides health benefits, then you should have to have the same type of proof that you have for medicines, medical devices or medical procedures. You have to have medical data and studies to show that something could happen if people start to use these things. (Medical Doctor, interview)

Figure 5 summarises the divergence between the policy papers and the interviews' statements that we found while coding both sources. What this

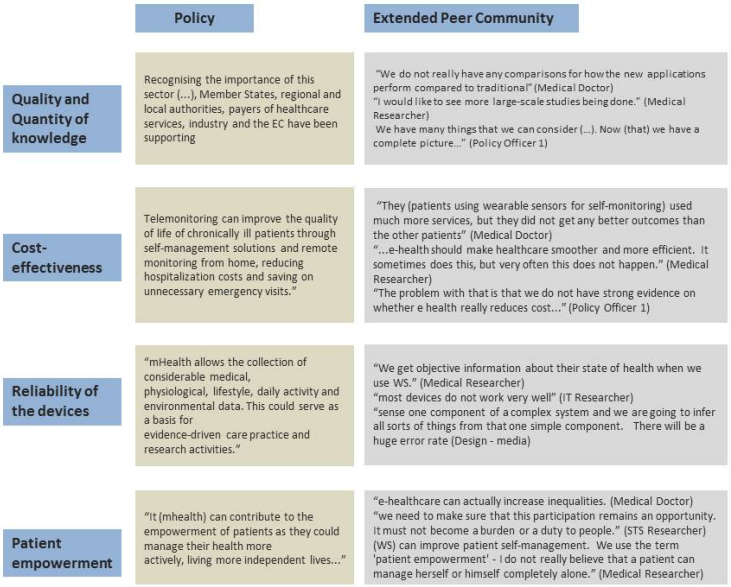



table intends to show is not who is right or wrong, but rather to illustrate that relevant actors in the WS field are not clear or disagree on major issues concerning cost-effectiveness, the role of the patient, reliability and the quality of the data that are produced by the sensors. These types of uncertainty are not reflected in the policy papers, which promise that WS and e-health will ease the burden of the health system and solve the problems of an ageing population.

Figure 5 – Divergence between the claims in policy papers and the interview

## 6. Discussion

Through pedigree analysis, a knowledge assessment methodology, relevant actors in the field of WS were identified. As we have seen from the section above, there is a disconnect between EU policy narratives and others'. All actors are active in producing different types of knowledge about the development, practices and policies related to the potential of WS in addressing different aspects of human health. It seems also that not all voices are voiced into the policy making process, given its positivist e-

health and telemedicine narrative.

A great deal of promises is made throughout the EU policy documents looked at in this paper (including the research calls sponsored by the EC), especially concerning cost-effectiveness of e-health and patient empowerment through personalised care. The underlying narrative and expectation is that technology will fix current problems of healthcare. In the policy papers we looked at, we found a number of issues that undermine their quality, namely: poor referencing for rather important claims, self-referencing, references to poorly conducted studies, which make knowledge claims amenable to scepticism.

Our analysis suggests that a great deal of the knowledge used in policy papers comes from industry and not so much from medical and healthcare institutions, citizen led projects (e.g. Quantified self movement) or academia. In fact, as one of the interviewees pointed out, industry seems to dominate the imaginaries surrounding WS technology applications. While at least part of the academic knowledge might be known to policy makers in the field, (evident from the interviews), the academic body of knowledge is not sufficiently reflected in the policy papers. The lack of references to sustain the big claims in the policy documents, leaves a reader, be it any citizen or the researchers involved in consultations for the EU, unsure about the grounds on which the EU e-health strategy is based on.

Moreover, policy papers that are mostly informed by visions of industry leave out important alternative visions to reform the current healthcare systems.

By assessing knowledge production *loci*, one can also see that there are disconnects between what the imagination of the current and future uses of these sensors are. There are several spontaneous experiments of self-care, *self-veillance* both by industry and citizen movements, which if assessed could help with understanding the impacts of these objects according to received notions of care and health. Yet the criteria with which such monitoring would take place is also a matter of negotiation. As with other technological developments, WS are also object of unanticipated appropriations both by institutions and citizens. The actors' views that we have presented show a great number of disconnects, not only concerning different imaginations of the role and function of these devices in health and healthcare, but also regarding supporting evidence that these devices can deliver what they promise to.

Moreover, besides analysing the origin of the aforementioned disconnects, it seems that further research on the impact of wearable devices and e-health on society, especially in Europe is needed; the vision articulated in the policy narrative develops in specific spheres but its deeper meanings for healthcare are in need of further investigation. Within the framework of KA, this suggests that the 'extended peer community' considered thus far has been limited to few actors with strong interests on

advancing the technology (WS) uptake by the health sector.

## 7. Conclusions

All current EU narratives place science and technology at the heart of its future but also its identity[3]; for some time the EU sustains a particular innovation narrative (EC 2015). In fact, "innovation" is presented in a salvific role, oftentimes with an imaginary of substitution, used to justify and encourage techno-science development. WS and e-health are part of the technological determinism and techno-scientific imaginary that suggests that, through technology, health and healthcare issues can be fixed (The Economist 2009). This expectation from technology is visible through the narratives of patient empowerment, effective and efficient healthcare and improved certainty (i.e. better and more complete health related data imply *tout court* better diagnosis and cures). This imaginary appears as an imperative in both policy papers and in the words of policy makers. Simultaneously, there is a number of unknowns and concerns, expressed diversely by different actors, e.g. unresolved ethical issues, namely privacy, inequalities, in particular originating from digital divide, or new ideas of care where face-to-face interaction is substituted with digital interfaces. Also, a number of uncertainties such as, quality of data and data ownership, responsibility, inadequacy of current regulation, actual economic effectiveness of WS deployment for health purposes, need scrutiny.

These 'simple' devices are designed and delivered to us with a narrative of 'healthy', of what needs to be shared and of what needs to be measured, of how we should be ageing and also of how our wellness, happiness and health are better dealt with through digital smart artefacts. Although current WS are mainly used for fitness purposes, the narratives around WS technology suggest that WS will become an integral part of the medical practice, preventative medicine, personalised medicine, mobile health, cure and care (Vesnic-Alujevic et al. 2016). The WS based healthcare vision presumes cost effectiveness but it does not discuss other social and ethical implications of the technology, such as privacy, data ownership and patient-doctor relationships. In particular, we wonder if the normative and performative aspects of these technologies are at all a discussion in the policy making process. We suggest that, before the narrative gets entrenched in the policy debate, that serious societal enquiry takes place through different public engagement strategies promoted by local, regional, national and supranational institutions, in order to understand what the actual matters of concern and care are among citizens and whether the smart innovations 'confident' proposal for healthcare are responsive to those. Additionally, tapping into existing public engagement visible in existing communities' practices, epistemologies and debate helps policy narratives being inclusive of extended facts and societal ex-

pectations. Above all, 'we', collectively, need to identify by which imaginaries of health, including values and ethics, we wish to live and that is only possible if spaces are made for these dialogues to take place. The institutions that lead policy initiatives should embrace this type of activity as *modus operandi*.

These types of enquiry, which fall on what we generally described here as 'knowledge assessment' and the engagement of the 'extended peer community' are useful beyond any geography; comparative studies across other regions of the globe could help understanding healthcare culture and broader contextual influences the constitution of institutional narratives that contemplate adoption of WS.

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[1] The terms wearable sensors, wearable devices or gadgets, wearables or wear-

[2] Quantified Self is a movement of users and makers of self-tracking tools.

[3] See e.g. the EC report *The future of Europe is science*, available at: http://ec.europa.eu/archives/commission_2010-2014/president/advisory-council-/documents/the_future_of_europe_is_science_october_2014.pdf. Or notably also the Innovation Union strategy (http://ec.europa.eu/research/innovation-union/index_en.cfm) or the more recent call for the digital single market (http://ec.europa.eu/priorities/digital-single-market/index_en.htm).

# Biorefineries as Models of a Sustainable Socio-technical Transition?

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**Abstract:** A biorefinery is an agro-industrial facility which creates an interface between the industrial and agricultural worlds: between technological and natural assets. Biorefineries are one element of a global socio-technical system and reflect how the sustainability transition is put in place at the local and regional levels. Analyzed according to the model of transition management, on-going generations of biorefineries are regarded as new niches of innovation and experiment, no longer solely dedicated to biofuel production. The stakeholders involved in their development try to find new processes of biomass transformation, rooted in their local situation, which consume less energy less energy, to use different types of feedstock and produce a variety of final products/ outputs. However, this biomass optimization is a controversial issue because it raises multi-scale societal environmental dilemmas. Based on empirical research this article reflects on the tangibility of socio-technical transitions and their respect for sustainability principles.

**Keywords:** biorefineries; sustainability transition; multi-level perspectives; socio-technical system; narratives.

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## 1. Introduction

Biorefineries are one component of a global socio-technical system and reflect how sustainability transition is conceived at local and regional levels. Analyzed in terms of the transition management model defined by Geels (2002) and Grin, Rotmans and Shot (2010), successive generations of biorefineries are regarded as new niches for innovation and experimen-

tation, with activities no longer confined to the production of biofuels. The actors involved in their development try to find new biomass transformation processes that consume less energy, that use different types of feedstock and produce a variety of outputs, while remaining embedded within their local context.

This transition towards a new agro-industrial system could be interpreted as a new and more sustainable "green revolution", since it impacts agricultural practices, industrial processes, energy production and distribution. In addition, it leads to changes in human organizations and collective systems of agro-industrial governance, as it is often rooted in principles of industrial ecology (Octave and Thomas 2009; Gobert 2017).

However, biomass optimization of this kind is controversial because it raises multi-scale societal environmental dilemmas (Olsson et al. 2004). The best known is the "food-vs-fuel" debate (Koh et al. 2008), but this is just one of the ethical and societal issues around energy and planning choices that deserves exploration at a variety of levels (Fitzherbert et al. 2008; Nieddu 2010). Moreover, this new way of thinking about an alliance of industry and agriculture to produce energy and materials should perhaps not really be called a "transition" if it does not result in a reduction in resource use and is not correlated with new practices (reduced carbon consumption) or a new "energy democracy" (Feenberg 2004), i.e. a system in which all stakeholders participate in decision-making. In fact, we believe that biorefinery development is often characterized by a disconnect between those who decide and justify these technical changes, consumers, and the farmers who produce the feedstock.

It therefore seems particularly appropriate to explore these ambiguities around the future of biorefineries by combining the perspectives of transition management literature and the multi-level perspectives (MLP) approach with developments arising from critical academic debate, particularly concerning the meaning of sustainability. The aim of this article is to question the narrative of biorefineries' proponents and their linear presumptions through the frameworks of transition management and multi-level perspectives. Indeed "[a]dvocates of sustainable transition management do not always appreciate the deep ambivalence of sustainability as a category and its power as legitimizing discourse" (Shove and Walker 2007, 766). In the case of biorefineries, this transition has not been fully explored, and certain issues relating to sustainability (participation, distribution, etc.) have been neglected.

Empirical studies were carried out in 2012 (Gobert 2016) and then consolidated by other case studies conducted in France between 2013 and 2016. They therefore offer an opportunity to reflect on the reality of socio-technical transitions and their adherence to sustainability principles (Allais et al. 2015). Our different case studies showed that the biorefinery industry – with its wide diversity of forms, technical processes and governance systems – is not as "sustainable" as its promoters claim. Certain critical issues regarding bioenergy implementation identified twenty years

ago by Roosa et al. (1999) have been not resolved. In fact, while bioenergy has attracted attention and state involvement (through R&D funding, subsidies, etc.), the social and societal issues at different levels have not been fully grasped (Gobert 2016). This is partly because of the ambiguous meaning of the notion of 'sustainability' (Redclift 2005). As observed by Vo et al. (2009, 294) "it therefore seems central to strengthen and clarify sustainable development as a policy problem that transition management is addressing".

In analyzing rural biorefineries as socio-technical systems that represent environmental transitions, it is essential to take into account the micro-level (as an innovation niche in which the industrial step and the socio-technical regime coevolve), the meso-level (the biorefinery as the outcome of a specific arrangement of local assets embedded in a localized "path dependency" process; see Gobert et al. 2017), and the macro-level impacts (change in biodiversity and land use, redistribution of power and value).

## 2. Biorefinery as an Indicator of Environmental and Bio-Economic Transition?

One of the major challenges for western society is to limit climate change, rather than simply reacting to it through changes in urban planning and public and private practices. Since human activities are considered to be the main cause of rising greenhouse gas emissions and natural resource depletion, the responses must entail a radical ecological shift, changes of practice, and multi-scale coordination between governments, experts, private entities and civil society organizations (environmental groups, residents, consumers, etc.). A more sustainable society has to be devised. Although the attempts to tackle this global change through transnational regulation have encountered problems (e.g. the failure of the 2009 United Nations Climate Change Conference, known as the Copenhagen Summit, the US withdrawal from the Paris Climate Agreement), a degree of international consensus (Kyoto Protocol, Rio+20 Conference, the 2016 Paris climate deal, etc.) and a number of supra-regional and national level decisions have opened the way to new societal, economic and environmental initiatives. These are helping to facilitate the quest for a new model. Decision-makers, experts and civil society together are considering a "new policy approach for dealing with persistent and highly complex societal problems such as climate change, loss of biodiversity…" (Loorbach and Kemp 2005). In this new approach, the imperative is to redefine collective action at different scales, with the participation of government bodies, economic actors (particularly industrial concerns) and ordinary citizens, who are collectively and individually responsible for significant negative impacts in their production, consumption and waste practices. This first part describes why biomass transformation

is considered as a sustainable transition. It explains what a biorefinery is and how can it be interpreted as a socio-technical system within the framework of transition studies, promoting innovation and incorporating ecological transition.

## 2.1 Biomass Transformation and Valorization: A Sustainable Transition

There is a wide range of definitions of biorefineries: some view them as production systems "that incorporate different firms and factories which may be geographically dispersed and operate throughout the entire value chain from raw material to consumer goods, whereas other definitions focus on the factory which utilizes an undefined set of processing technologies to produce certain products from biomass" (Bauer et al. 2017, 538). The biorefinery can be described as a classic model of a bioeconomy infrastructure, insofar as it is an agro-industrial facility that creates an interface between the industrial and agricultural worlds, between technological and natural assets. A "biorefinery should produce a spectrum of marketable products and energy [from biomass]. The products can be either intermediates or final products, and include food, feed, materials, chemicals, and energy (defined as fuels, power and/or heat) (…) a true biorefinery has multiple energy and non-energy products" (IEA Bioenergy 2009, 84).

The production of energy and materials of different kinds from the conversion of biomass is advocated as a more sustainable process than the use of fossil resources (Naik et al. 2010; Suhag and Sharma 2015). Biomass can be burned, converted into fuel gas through partial combustion, into a biogas through fermentation, into bioalcohol through biochemical processes, into biodiesel, into bio-oil, or into a syngas from which chemicals and fuels can be synthesized (Laurent et al. 2011). Bioethanol from either sugarcane or maize, and biodiesel from oilseeds, are currently the major products of first-generation biorefining. In economic terms, they continue to be the most productive processes, but they have attracted strong criticism. In response, industrial firms are striving to make the conversion process better and more sustainable by using the whole plant rather than just the edible part.

These incremental innovations are broadly conceptualized in terms of a succession of generations defined by changes in processes, in the biomass used or in territorial integration[1]. The objective for instance, is to consume forestry or agricultural waste residues and more specifically to convert lignocellulosic biomass rather than using only the edible part of the plant. In addition, the principles of "doubly green chemistry" (Nieddu et al. 2010) are applied to demonstrate green credentials. Green because they use renewable bio-material from agriculture or forestry, and because they claim to use safer solvents, design safer chemicals and increase the energy efficiency of synthetic methods (Anastas and Warner

1998). At the local level, the argument is that the new generation of biorefineries will benefit rural communities and old industrial areas by processing forestry and farming resources and thereby providing new sources of revenue (Antizar-Ladislao and Turrion-Gomez 2008).

Globally, industries and governments argue that bioproducts obtained through biorefining are a viable substitute for fossil fuels, and that all the technologies can enhance global productivity without exacerbating climate change, since they result in lower greenhouse gas emissions. Consequently, in social, economic and environmental terms, converting biomass into biofuels and various high-value products is interpreted as an efficient industrial method. It gives the European Union an opportunity to be highly innovative in a specific domain, and to address global concerns while fulfilling its international obligations to reduce greenhouse gas emissions.

## 2.2 Biorefineries as Socio-technical Systems in Transition

Making the transition to sustainability is a modern challenge facing public politics, and policy makers at different levels, necessitating a change in existing socio-technical systems (Akrich 1989). The field of "transition studies" employs several different academic frameworks and tackles a range of issues associated with the process: transition management (focusing on coordinated governance models for transitions) (Kemp and Loorbach 2006); strategic niche management (support for niche innovations as a way to trigger transition); and multilevel perspectives and technological innovation systems (Geels and Raven 2007). They deal not only with uncertainty but with complexity, since processes, habits and relationships cannot be isolated or separated from their context of emergence in order to be made "sustainable". Mossberg et al. (2018) explain that sustainability transitions, which entail long-term, multidimensional transformation processes, bring about a shift from established socio-technical systems to more sustainable modes of production and consumption. But this transformation is long and complex, and demands simultaneous changes in different domains and at different levels of action.

Biorefineries are often analyzed as a good example of sustainable transition, using the grid of transition management. The second-generation biorefineries are seen as innovation niches destined to upscale to industrial format and then gradually evolve to become part of the socio-technical regime (Geels 2002) (dominant technologies, practices, policies, regulations etc). However, this process runs into difficulties because of the numerous barriers to "full spectrum" innovation – not just in the technological or industrial sphere, but also in social and policy domains. It usually requires a "co-evolutionary process" (Bauer et al. 2017) and an interplay between society, technology and governance across different geographical and temporal scales.

It might be asked whether the dominant narrative around biorefining

as a transition pathway does not ignore certain fundamental dimensions of sustainability. Geels (2014) explains "regime stability" in the sector as the outcome of active resistance by incumbent actors. Our contribution argues that this relative regime stability is also due to a very narrow conception of sustainability, because the views of certain stakeholders dominate and exclude some dimensions of sustainability. Here the issue is not so much one of resistance as of only partial adaptation to the principles of a low-carbon society. The dominant players try to devise more environmental trajectories for biomass conversion, without fundamentally changing other components and thereby they do not cause a profound transition. Strategies of this kind allow some stakeholders to maintain their economic and social capital without any change in their roles. In accordance with Wittmayer and Schäpke (2017), we considered that fundamental changes in the roles of actors and in their relations with other are a vital element of transition. The disconnect between technical transition management illustrated by biorefinery evolution and the absence of concertation processes with local stakeholders also raises question (Hendricks, 2009). From this perspective, transition is less a question of innovation and multi-actor coevolutionary process, than of powerful stakeholders gradually adjusting to new environmental constraints.

This narrative is a strategy for agro-industrial groups to legitimize their activities by presenting them as a process of continuous progress towards sustainability and good environmental practice(s). "Narratives contribute to delimiting the space of what is 'politically feasible', thus contribute to the inertia of regimes with respect to socio-technical change beyond technological and political potentials" (Hermwille 2016, 238). They design the framework for their own evaluation. In this way, they seek to stabilize the very uncertain socio-economic environment while imposing their own narrative around biorefineries. In our different case studies, the stakeholders involved explicitly refer to programs described as the "biorefinery of the future", all depicting ambitious technical and economic goals. They emphasize the potential of new bio-based products in order to justify their research and development projects, arguing that they could revolutionize our oil-dependent economy and create the same products as traditional refineries: viscose for the textile industry; biopharmaceutical molecules etc. Future expectations create legitimacy as they paint a picture of future technological conditions. Industrialists need to generate belief in these expectations and innovations in order to obtain resources, attract attention and "stimulate agenda-setting processes" (Levidow et al. 2014). Similarly, the concept of "biorefineries of the future" evokes a rosy future and reinforces the widespread view that technical fixes can solve systemic problems like climate change, resource depletion, and biodiversity loss.

| | Kalundborg2 (Denmark) | Wanze3 (Belgium) | Lestrem4 (France) | Örnsköldsvik5 (Sweden) | Pomacle-Bazancourt6 (France) |
|---|---|---|---|---|---|
| **Initiator of biorefinery process** | Dong Energy (Inbicon) (energy supplier) | CropEnergie (Biowanze) (agro-industrial group - sugar refiners) | Roquette (starch producer) | A coalition of local firms | Different agro-industrial groups |
| **Transformed biomass** | Straw | Wheat | Corn - Wheat | Timber | Wheat – Sugar beet |
| **Governance of the biorefinery project** | Collective (Cluster Biofuels Denmark) | Individual (Biowanze) | Individual (Roquette) | Collective (Processum) | Collective through different structures |
| **Documents analyzed** | - Communication documents from the municipality about its green involvement;<br>- Dong Energy's information leaflets and reports;<br>- A Specific report describing the results obtained by projects (Integrated Biomass Utilisation System);<br>- PowerPoint presentations made by stakeholders in different conferences. | - Communication documents from Tierlemont (sugar refinery firm;<br>- Information leaflets about "l'agrobiopole wallon";<br>- Strategical reports from Sudzücker. | - Strategic orientations for innovations in the Pas de Calais Region (2010);<br>- Roquette's Annual sustainable development reports;<br>- Public inquiry files for the siting of new production units;<br>- Regional sustainable agriculture plan (2013);<br>- Documents issuing from regional clusters (like MAUD: materials for sustainable consumption). | - Numerous scientific productions concerning the forest industry and transformation;<br>- Vinnova reports (Swedish innovation agency);<br>- Annual sustainable reports of the different firms involved in the Processum cluster. | - Reports issuing from the pole IAR and the different firms involved in the biorefinery project);<br>- Regional documents concerning bioeconomy and innovation. |
| **Interviewed stakeholders** | - Two representatives of Kalundborg municipality;<br>- A Representative of Inbincon;<br>- A meeting with Novozymes and Inbincon to be informed on the refining process;<br>- A researcher involved in the R&D projects IBUS and KACELLE;<br>- A representative of the Region, to understand the global strategy and the local implementation of Energy Technology Development and Demonstration Program better. | - An Official Manager of the biorefinery;<br>- Two researchers involved in biorefinery research projects in the Wallonia region (Valbiom);<br>- A Representative of Wallonia region;<br>- A representative of a local environmental grassroots organization;<br>- A representative of Wanze municipality. | - Representatives of farmer cooperatives (providing feedstock to Lestrem);<br>- A representative of Lestrem municipality and conurbation<br>A representative of the Pas de Calais Region;<br>- A representative of Roquette at Lestrem (manager of innovation affairs). | - A representative of Ovik Energy<br>A representative of SEKAB producing ethanol, black liquor;<br>- A representative of Akzo Nobel (a paints and coatings company producing cellulose derivatives);<br>- A representative of Örnsköldsvik municipality<br>A representative of the Processum cluster focused on the biorefinery of the future;<br>- A representative of Domsjö Fabriker producing cellulose and hemicellulose. | - A representative of BioAmber;<br>- A representative of Cristanol (sugar refinery)<br>A representative of ARD (common R&D centre);<br>- A representative of Pomacle municipality<br>The cooperation manager of the Pole IAR (cluster);<br>- A member of CARINNA (regional innovation agency);<br>- A representative of the Regional Chamber of Agriculture |

Table 1. Case studies analyzed and mobilized for this article

## 3. Methodology

This paper is based on the results of qualitative and comparative research which was presented in different articles (Gobert 2017; 2018). This research was part of a regional project (FASE) and a 10-year global study on "the oilseed biorefinery of the future", named PIVERT[7].

We conducted a sociopolitical study based upon a comparison of five biorefineries. The method was qualitative. We read the relevant documentation available relating to the transformation of the industrial process in these territories (annual reports, internal documents, answers to research bids which gave data on the way the biorefinery stakeholders present their project and its story). This "grey" literature was specifically chosen to understand the economic, social, local contexts and provide data about the different routes by which biorefineries emerge.

We also conducted between 5 and 8 semi-structured interviews with different institutional stakeholders and firms involved in the development of the biorefinery project (companies, local academics familiar with the site, representatives of local communities). These interviews were then analyzed using a qualitative method (Beaud and Weber 2003; Lejeune 2014). The analysis grid was focused on the role of the stakeholders in the biorefinery process, how they related the biorefinery story, the relations they had with other actors, their sources of supply and the integration of environmental questions (Table 1).

We decided to select different European Union case studies characterized by both common features and interesting disparities. With regard to the shared characteristics, they are all subject to Europe's regulatory framework and eligible for EU funding. They are industrial sites, located in peripheral zones, which are not new entities but have been recently reclassified as biorefineries. However, they work with different types of biomass, which are seldom a pure local resource. The project to convert biomass into multiple products is either driven by a single main player (a big industrial firm) or by a plethora of stakeholders who have pooled their strengths and resources. In the table shown here, we have distinguished between the project initiator and the project coordinator (a firm or a coalition of persons). It provides a context-rich empirical description that helps us to understand the narratives of innovation deployed in favor of biorefineries.

## 4. Biorefineries: An Incomplete Sustainability Process

Biomass processing is the conversion, by means of human intervention, of natural capital – whether domestic or not – into different products: energy, high-value chemicals, purportedly more environmentally

friendly and biodegradable bio-products. The dominant narrative advanced in support of biorefinery development claims that the transition from fossil to bio-sourced feedstock is an indisputably rapid and sustainable path. However, it can be argued that the characteristics of the current conversion processes and the social integration of biomass engineering are more consistent with weak sustainability (Dobson 1998; Vivien 2009). Why are we making this assertion? Firstly, the dominant narrative displaying the bioeconomy and biorefinery as the result of disruptive and innovative strategies can be questioned, insofar as biorefineries, as transition symbols, are more or less embedded in their siting area and exemplify historical innovation and existing stakeholders' relations. Secondly, wherever a high degree of entropy (Samieia and Fröling 2014) continues to be generated (e.g. land-use change, use of genetically modified organisms, pesticides) without consideration of the impacts at all scales and on all affected spaces, the production system will lead to environmental irreversibility (Gobert 2016). Biorefining raises issues around biodiversity and land-use change, plus lack of integration into a global environmental trajectory. Moreover, the social and political system that facilitates this development does not contribute to existing value and power redistribution principles: "New energy production is often portrayed as providing economic benefits through new jobs, declining energy prices, and ancillary economic development. Yet, this perspective is often narrowly framed in terms of net benefits to specific regions, ignoring a range of additional considerations" (Miller et al. 2015, 78). We illustrate our argument by referring to the different case studies.

### 4.1 Territories and Path Dependency. Innovation Pathways Designed by the Past

The biorefinery projects could be seen as innovation niches, both technical (e.g. lignocellulosic fragmentation), and in some cases organizational: i.e. in the use of new feedstocks or the generation and subsequent sale of new products (Bauer 2017). However, niches do not appear suddenly. They result from a combination of factors, including the willingness and ability of stakeholders to act, local economic culture and know-how.

Our case studies revealed that rural biorefineries are not created from scratch but result from the evolution of previous industrial and agricultural activities, followed by movement along a technological path (Rakotovao et al. 2017). For example, the Örnsköldsvik area was already heavily involved in the timber sector, which had been seriously affected by global competition. It had continuously been forced to adapt following sharp decline in the European pulp and paper industries in the 1990s. Since then, innovations devised by numerous industrial actors had emerged, establishing new technical processes and developing new products (biofuels, bioplastics). Using the vocabulary of biorefining would

thus seem to be primarily an attempt to acquire a positive green image as a producer of renewable energy and bio-sourced materials, rather than as reflecting a profound change in the essence of the initial economic project. Likewise, the firm Roquette has been established in the north of France since 1933 and from the beginning has had an activity of starch production, in particular for the local textile industry.

Our comparison revealed that the path dependency processes in play are more significant than the biorefinery players recognize (Pierson 2000). Acknowledging the influence of the past on current choices challenges the idea of disruptive innovations that constitute a break with previous socio-technical and political practices. Industrial trajectories are therefore dependent on the industrial history and resources of the territory, even if some firms have the size and financial capacity to attempt to escape (at least partially) from these dependencies (by relocating, closing plants, etc., see Arbuthnott et al. 2010). Industrial facilities themselves can reflect this territorial legacy, insofar as their existence, as well as their organizational and institutional links, predates the term biorefinery. A number of academic works have underlined this technical, social, economic and institutional continuity. Béfort and Nieddu (2017) pay particular attention to the material and immaterial nature of production assets. Gobert and Brullot (2017) describe how stakeholders move local assets into or out of a territory, thus creating specific territorialized arrangements, whose study can help us to understand how an agricultural and industrial project may have emerged. For example, Biowanze began processing wheat and sugar beet in 2008, at a time when the region was severely affected by market difficulties in European sugar production and the large-scale closure of sugar refineries. Biowanze proposed new solutions for feedstock processing, using existing assets (water infrastructure, local agricultural production). In the Örnsköldsvik area, a number of firms decided to create a biorefining cluster to produce cellulose and cellulose by-products, such as black liquor, substances that had already been produced during the Second World War because of restrictions, but were not adopted by the market when the conflict finished.

> Our location is considered one of the birthplaces of Swedish chemical industry, and during the blockade of the Second World War, a chemical industry based on forest raw materials was developed here. (Interview with a representative of Domsjö Fabriker, 05/2012).

To apply a path dependency framework that identifies the influence of historical, social and economic factors is not to deny the reality of change, caused by different drivers: sudden events, new stakeholders, exogeneous elements such as new legal frameworks or incentives or opportunity windows (Kingdon 1984). It simply takes into consideration the role played in innovation by "historical" and "local" factors (Greener

2005). It also helps us to understand what aspects of territorial and industrial systems can generate inertia. Legacy may be a positive basis for new dynamics, but it may also prevent social and environmental innovation.

Embeddedness and path dependence enable the integration of the different lock-ins which can interfere with innovation into the transition management approach. However, other environmental challenges at local and global scales also have to be taken into account.

### 4.2 Biodiversity and Land Use Change

Several studies have underlined the negative impacts of the first generation of biofuels: biodiversity erosion (Fitzherbert et al. 2008); landscape fragmentation; food price increases (Mitchell 2008). Moreover, even where biofuels may be more environmentally friendly and economically beneficial to local communities than conventional fossil fuels, some of their effects are ill-understood and underrated (land-use conflict, net energy consumption). Products originating from biomass compromise a number of ecosystems such as food, and freshwater services (Fisher 2009). In examining these criticisms, different scales of impact can be identified. The land-use issue has local, regional and international repercussions (Gawel and Ludwig 2011). Direct land-use change occurs when forests or woodlands are converted into biofuel crops. Indirect land-use change (ILUC) takes place when food or feed crops are displaced by biofuel farming to other places and countries, in other words when this kind of agriculture competes for available land with food crops. Converting rainforests, savannas or grasslands into farmland for biofuel crops releases billions of megatons of CO2, far more than the annual reduction in greenhouse gas emissions supposedly brought about by the substitution of biofuels for fossil fuels. This process creates a biofuel carbon debt (Fargione et al. 2008) that will take a very long time to repay. For many years, life-cycle analysis methodologies have minimized this ILUC criterion, and the potential displacement of negative effects from one region to another. Another effect is that farmers and agricultural cooperatives may become more dependent on industry for their markets, a shift that could profoundly alter the role of farmers, making them suppliers of "molecules". In order to meet industrial demand, they may have to employ intensive agricultural or silvicultural methods (short rotation forestry), add polluting external inputs (insecticides, fertilizers) or plant genetically modified crops, which contribute to biodiversity loss. Biomass production also increases water use. Other issues include competition with other investments, limited or uncertain return on investment (Adams et al. 2011; McCormick and Kaberger 2007), that are particularly dependent on a stable policy environment, which is conspicuously absent, and the possible seasonality of bioenergy supply.

The economic and social effects of increased biofuel production (food insecurity, volatile commodity prices, poor working conditions and viola-

tions of land rights, unfavourable net lifecycle greenhouse gas emissions), and the reactions to them (Ribeiro 2013), have forced the advocates of biomass conversion as an efficient alternative to fossil resources to improve technical processes, to use biomass differently and to pay more attention to negative impacts. Social learning from the controversy has thus provided impetus for industrial change (Rip 1986). This change is clearly visible in the case studies analyzed, as in each case the project managers are striving to move beyond first-generation biorefining (not using the edible part of the plants, producing products other than fuels) and to obtain their feedstock from "local" biomass. Agro-industrials and cooperatives claim a strict differentiation between their "sustainable activities" and those which lead to deforestation. A representative of the Wanze biorefinery asked for biofuels to be distinguished according their production process:

> Comparing all biofuels and sources of biofuel production is the main problem at the European and international levels. Because this puts together biofuels coming from agricultural areas with those produced after deforestation. The legislation has to be careful before comparing our products and take into account the production process, the energy consumed … Currently we cannot find a reliable and neutral study (Interview, 18/06/2012).

According to the actors involved, technical progress and innovation are bringing step-by-step solutions. However, this does not resolve issues such as how these processes fit into a global strategy of decarbonization.

### 4.3 Poor Coordination with Other Dematerialization and Decarbonization Strategies

As summed up by Shove and Walker (2007, 278): "For all the talk of socio-technical coevolution, there is almost no reference to the ways of living or to the patterns of demand implied in what remain largely technological templates for the future." A basic weakness of biorefinery promotion is the poor coordination with other dematerialization and decarbonization strategies. Firstly, using bio-products and biofuels as a substitute for the petroleum industry is not a preventative but a reactive response to climate change and resource depletion. This biomass conversion system does not deal with problems at source, but consolidates "business as usual" practices and therefore treats biomass as a resource like any other, with the capacity to resolve one major problem (petroleum depletion). It acts as an obstacle to serious changes in consumption, mobility and waste disposal patterns. It does nothing to reverse the dominant economic paradigm, in which economic activities and industrial development are not subject to ecological constraints (Nahrath and Gerber 2014). Biorefining does not call into question agricultural practices or or-

ganizational schemes (Shove 2010), but sheds light the technical innovation induced by feedstock fragmentation and transformation. Biomass production for biorefineries often relies on resource and technology intensive modes of agricultural production (Plumecocq et al. 2018) and therefore does not open the way to agro-ecological transitions (Ollivier et al. 2018).

In the interviews conducted for the case studies, the stakeholders in the different biorefinery projects seldom or never mentioned the upstream or downstream changes needed to effect a sustainable transition. Instead, the talk was primarily about local feedstock supplies. In fact, in some cases, even this was not an issue. In Kalundborg, the energy supplier's goal was to obtain low-cost biomass, even if this meant importing it and accepting the longer value chain and the environmental impact of transport. Similarly, Wanze acquires its supplies from a very wide harvest perimeter (300 km).

The main biorefinery stakeholders make no clear temporal and spatial connections between resources, production systems and consumers in their strategy. The resource "biomass" is rarely analyzed in its global context (associated ecosystemic services, production, et al.), but rather as a "normalized" input into the industrial production system. From the institutional point of view, when representatives of state agencies or local communities were specifically asked, biorefinery development was linked to the bioeconomy promises of energy transition and oil substitution, but not to the other essential components of this transition: cutting energy consumption, dematerialization and decarbonization.

### 4.4 A Weak Participatory Process at the Meso and Global Levels

Transitions are described as "multi-actor processes" (Geels 2010), however, as pointed out by Wittmayer and Schäpke (2017) it is important to understand how actors and their relations evolve in a changing environment.

Some of the academic literature (Rumpala 2013; Feenberg 2014) argued that the development of renewable energy is pushing society to create new technical models (less dependent on very large transport and distribution networks, as production sites are more localized), and therefore new political forms based on new communities of action and practice. In fact, they argue that the transition also has social and political dimensions with its capacity to "nurture public trust in energy decision-making, create a collaborative environment for energy deliberations, and build effective partnerships on wider scales between communities and energy industries" (Miller et al. 2015, 81). As Vo et al. noted (2009, 293), it is particularly important to consider democratic legitimacy, for example by designing new forms of deliberation, new participatory arenas for different kinds of stakeholders. Nevertheless, no such development seems to be visible in biorefining and no avenue for empowerment and redistribution

appears (Schreuer 2016), which is visible in the choice of power plant sites.

From a societal perspective, one of the major aspects is that this change in energy and agricultural production does not appear to have any impact in terms of more equitable power and revenue distribution between stakeholders. The "era of biomass transformation" is apparently neither a green nor a societal revolution. At this stage of development, renewable energy has brought about no major change in the incumbent socio-technical regimes (Geels 2002), i.e. no adjustments in other fields and in social representations of the world (Dobigny 2009; Rumpala 2013). Industrialists have consolidated their dominant role in influencing economic orientations and as managers of "environmental change". They dominate at the strategic level, imposing their vision of sustainability and influencing European and national decision-makers through highly effective lobbies (Grossman 2003). Their strategy is clearly based on efficient networking with influential stakeholders and the construction of powerful coalitions at different levels. Their aim is to formulate long-term goals to consolidate their investments and their markets. At the tactical level, they help to develop public instruments that will be useful to them. At the operational level, they participate actively in experiments (pilot and demonstration units to trial new processes before upscaling to industrial production), which are at the heart of European and national programs to test the technological and economic viability of different processes. This is enables them to bypass legislation and, as far as possible, to reduce uncertainty by influencing regulatory and legislative frameworks. These strategies create carbon lock-ins and can prevent more significant changes in the environmental transition.

In consequence, decisions on the development of biomass conversion are rarely rooted in a participatory process, and do very little to involve local stakeholders and, in particular, public opinion. The following quotation illustrates how the decision is progressively moved away from the farmers, i.e. the biomass producers:

> A cooperative spirit is important. Cooperation depends on farmers, who get together. Then cooperation depends on cooperatives, which work together and then with the researchers… and other external actors. (representative of Pomacle-Bazancourt biorefinery).

As a result, local renewable energy strategies are not negotiated with farmers and civil society. Although biorefineries do not always generate local opposition and conflict, they acquire "weak acceptability"[8] (Gobert 2016), something that would be worth exploring through specific case studies (McGuire et al. 2018). In fact, biorefinery developers comply with planning procedures and licensing processes, but local authorities do not take the process further by examining the impact that these choices could

have on local development and the local environment. In the Biowanze case, a special local committee was created to tackle odor and risk issues, but it did not cover other questions. It was the only example of a participatory forum that we encountered in our research. Even if biorefinery managers are regularly submitted to administrative procedures when they want to expand or transform their facility, the compulsory processes (public consultation, environmental impact assessment) do not cover all impacts of biorefining, seldom involve the participation of the people concerned (Morgan 2012). In fact, they are often not accessible to farmers or inhabitants, because they use expert language and open arenas not usually open to public discussion.

## 5. Conclusion

This article has analyzed rural biorefineries as socio-technical systems and as a possible model of environmental transition. It considers the micro-level (the biorefinery as an innovation niche in which the industrial process and the socio-technical regime coevolve), the meso-level (the biorefinery as the outcome of specific arrangements and visions of the future, embedded in a localized "path dependency" process), and impacts at the macro-level (biodiversity loss and land use change, power and value redistribution). This was an opportunity to explore not only the ambiguity of the notion of "sustainability" promulgated in the dominant narrative on biorefining, but also to contribute to the perspective of transition studies. As a matter of fact, representations of biorefineries are dominated by the technical aspect of the biorefinery system and the associated changes, and do not embrace the full meaning of sustainability (participation, social equity, etc.). The different European case studies offered a way to apprehend and question the dominant narrative. What actually emerges is the relative regime stability and the difficulty of effecting societal change in response to the challenge of climate change. This is also linked to a narrow conception of sustainability held by the main stakeholders. In the absence of a common vision of the characteristics and limitations of a desirable future, the likely outcome will be opposition and environmental fallout (transfer of impacts from one locality to another, agricultural intensification).

This is one reason why transition is hard to manage. Transition policies are supposed to coordinate strategies, to encourage global cohesion between the different niches and to stimulate profound and simultaneous transitions in different fields (Kemp 2010). But this would require knowledge management and governance capabilities for example through the creation of arenas where all viewpoints and objections can be expressed and, if not solved, be defined clearly enough so that shared and sustainable transition pathways can be outlined. In fact, it is not sufficient to build biomass conversion facilities and to organize the supply chain,

other changes need to take place at the same time: "the challenge is not simply what fuel to use but how to organize a new energy system around that fuel" (Miller et al. 2013, 139). While biorefinery development has received strong support from public authorities at local and national levels, other dimensions have not been so easily tackled and handled at each level: social acceptance, economic viability relative to oil prices. Moreover, biorefineries have not brought about major changes in the value chain (for farmers or customers).

For all these reasons, further research is needed to address more specifically the links between the upstream dynamics of biomass supply (and perhaps provide recommendations on localizing flows and producing feedstock that is more sustainable for the soil, for farmers and for communities). Moreover, research dedicated to bioeconomy would gain credibility by introducing social dimensions (acceptability, changes in social structures), defining new participatory structures (societal consensus on the desirable future), and contributing to the global dematerialization and decarbonization of our societies from the individual to community level. In this way, transition studies which enable us to understand large societal processes, the possible drivers and lock-ins will be closely linked with a reflection on the satisfaction of sustainability principles (Loorbach 2015).

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[1] In interweaving the discourses of different stakeholders, we observe significant differences in their understanding of what a 1st or 2nd generation biorefinery is (from one to multiple products). Others distinguish the type of biomass (sunflower, maize, lignocellulosic biomass etc.) or the method of biomass processing.

[2] Kalundborg in Denmark was one suitable example. Although known for the systematic implementation of eco-industrial principles, the industrial area presented one major limitation: the fact that the system of industrial symbiosis depended on the coal-fired Asnæs Power Station, hardly a symbol of sustainability. The goal was to test the possibility of using straw and converting the power plant to biomass. A second-generation ethanol demonstration plant was then built in Kalundborg in the environs of the existing plant.

[3] The Biowanze facility in Belgium converts wheat and sugar beet into ethanol and other associated products. Another current project aims to transform bran into surfactant agents. This biorefinery was presented as a way to find new markets for growers severely affected by European sugar beet quotas.

[4] Roquette is an old, family-owned agro-industrial group, which processes corn and wheat in Lestrem in France and produces starch. The firm has launched different innovative programs (Biohub, Nutrahub, etc.) to test new technical processes (based on green chemistry) and develop their product range (biopolymers, bioplastics).

[5] At Örnsköldsvik, in Sweden, a number of firms located in an industrial zone, largely working in the timber processing sector, decided to form a forestry-based biorefinery cluster (Processum) specializing in the production of bioethanol and cellulose.

[6] The Pomacle Bazancourt biorefinery near Reims in France is a biomass processing site. It encompasses a sugar factory and drying plant, a combined research center, a starch and glucose plant, an ethanol production plant, an industrial demonstrator, a CO2 collection center, a production and research center specializing in active ingredients for cosmetics, the pilot plant for the FUTUROL second-generation fuel project, and a White Biotechnologies Centre of Excellence, the product of a partnership between academic institutions.

[7] PIVERT for Picardie Innovations Végétales Enseignements et Recherches Technologiques (Picardy Plant Innovations, Teaching and Technological Research) is an Institute of Excellence in plant chemistry, which was selected for support under France's Investment for the Future Programme. The goals of this research are to transform oilseed biomass, i.e. the whole plant, into renewable chemical products for numerous applications. It is built on the concept of industrial ecology: the idea that one company's by-products can become another company's resource. In the biorefinery concept, all waste is seen as a potential input for another product. Water and energy are to be recycled to limit negative environmental impacts. The biomass refinery must use local agricultural and forestry resources from the region where it is located (Picardy). It is a cross-disciplinary project involving numerous research fields.

[8] The siting or the development of bioenergy plants is decided by companies and national authorities and not negotiated with all potential stakeholders. The impacts resulting from biorefineries' growth are not discussed in public arenas (landscape changes, new requirements for farmer, etc.). A strong acceptability would have obliged biorefineries proponents to overcome an "end-of-pipe" acceptability only focused on the technical facility and to enlarge their environmental scope.

# Big Data from Below
## Researching Data Assemblages

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**Abstract:** This paper aims to study the data assemblage of three centres of calculation which produce and use big data for social research. By unfolding how big data are produced we want to compare and contrast different aspects of data construction, management and exploitation. The results are drawn from focus groups and in-depth interviews of data experts. Respondents were interviewed about the activities of setting objectives, design decisions and choices with respect to expert languages, influences, constraints, debates with actors internal and external to data assemblage. The analysis presented in the paper focuses on the methodological activities run in the assemblage, and on subjectivities and communities involved in big data.

**Keywords:** data assemblage; big data; qualitative methods; data centres; data interoperability.

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## 1. Introduction

The article critically examines the data assemblages of three centres of calculation which produce and use big data for social research. The aim is to unfold how big data are produced by comparing and contrasting different aspects of data construction, management and exploitation. Furthermore, it addresses some criticalities in big data research in relation to contexts (public/private; national/international, etc.) and objectives (official statistics, policy design, academic research etc.).

Data are commonly considered neutral and objective material that condenses pieces of social reality in numbers and other symbolic forms,

but actually Manovich explains that: "data [do] not just exist, they have to be generated" (Manovich 2001, 224). In the philosophy of science, it is at least from the rise of post-positivist thinking that data have been critically considered a selection from the total sum of all possible data available (Kuhn 1962; Feyerabend 1969). Data are framed by methods and techniques, theories and background knowledges (Lakatos 1976), practices and contexts. Their production is situated and historically specific, a result of the conditions of inquiry, which are at once material, social and ethical. This idea that, to use the words of Gitelman (2013), "raw data is an oxymoron" (see also Leonelli 2016 for data in biology) raises questions about how data are assembled, and it calls for a critical investigation of the intertwined processes of collection, management and use that prepare data for becoming information, and then knowledge (Floridi 2010).

A long tradition of research has been devoted to study the processes where classifications, indicators and measures, and the data originate, are constructed through a series of activities where many actors with different cognitive frames interact (Thévenot 1984; Alonso and Starr 1987; Desrosières and Thévenot 1988; Salais and Storper 1993; Desrosières 2010). With the developments of data infrastructures, open data and big data, data intensive and positivistic approaches to scientific knowledge have disputed post-positivism (Kitchin 2014a). Discourses and practices surrounding the big data revolution (Mayer-Schonberger and Cukier 2012) moved towards an emerging variety of computational social science techniques (Lazer et al. 2009), which provide granular analyses that are said to no longer require theories (Anderson 2008) and critics (Iliadis and Russo 2016). The need to unpack big data assemblages has been then advocated by Dalton and Thatcher (2014), who have called for 'Critical data studies' (CDS), studies that apply critical social theory to data to explore the ways in which they are never neutral, objective, raw representation of social reality, but are situated, contingent, relational and contextual.

The objective of our research is to reconstruct contexts, activities and the long chain of human and non-human actors which construct big data. We interviewed experts and professionals who work within three European data centres by means of focus groups and in-depth interviews. We chose these interviewees because they are directly involved in big data assemblages and may reveal relevant information about its socio-technical apparatuses. The analysis focuses on three specific topics: some methodological challenges of data curation and data management that arise in a context of multi-stakeholder informational needs and objectives; the skills needed and the interdisciplinarity approach for dealing with big data; the ethical implications of using digital data collected on a wide international scale, and coming from a layered network of administrations and corporations.

This article is structured as follows: section two presents big data assemblage and its various apparatuses; section three frames the research design and explains the method adopted; section four and its sub-sections

show the results of the analysis. The last section concludes with some remarks about the undertaken work and future perspectives.

## 2. Big Data Assemblages

Critical data studies (CDS) aim at retracing the contextual and relational processes through which data are constructed. One example is research on algorithms (Gillespie 2014; Kitchin 2017), which have concentrated on how algorithms are generated (Bucher 2012; Geiger 2014), or how they worked within specific domains such as journalism (Anderson 2011), security (Amoore 2006, 2009), or finance (Pasquale 2015). A further example of CDS is research on data curation practices. Diesner (2015) affirms that small pre-analytical decisions concerning data preparation for analysis (for example merging, sorting, cleaning, structuring, data reduction, normalization, etc.) −which are often not given careful attention, and about which there are few "best practices" −can have enormous (often undesired) impact on the results of big data research. Finally, some CDS research aims at specifying how cultural, symbolic, and normative values may play a role in promoting certain images of the social world through data. Their objective is the analysis of the connections between the material sphere (technologies, devices, infrastructures) and the socio-cultural one (values, symbols, expert knowledge, disciplinary "discourses", interests, and logic of action). For example, Taylor et al. (2014) demonstrated that the access of corporate big data is proprietary, and that may limit the replicability of studies.

All these pieces of research have focused their analysis on the data assemblage that is "a complex socio-technical system composed of many apparatuses and elements that are thoroughly entwined, whose central concern is the production of a data" (Kitchin and Lauriault 2014, 6). The diffusion of the term assemblage, in French *agencement*, is attributed to the French philosopher Deleuze. He believed that assemblages are entrusted with the function of dismissing the representative thought that arrogates the control of meta-discursive knowledge, of disciplinary specialisms and related institutions. Assemblage is above all the attitude to recognize the production of data as fields of force, heterogeneity of the processes, unforeseen connections in which they are located, and which contributes to produce (Deleuze and Guattari 1980). And just as data are a product of the assemblage, the assemblage is structured and managed to produce those data (Ribes and Jackson 2013). Data and their assemblage are thus mutually constituted. Importantly, they are responsive, dynamic and lively, constantly reconfigured as new data are generated and datasets are combined in different ways (Andrejevic 2013; Beer 2013). Moreover, each data assemblage forms part of a wider datascape (Berry 2011), which encloses the whole spectrum of existing data sources (official statistics, big data on the internet, administrative open data, etc.) and data infra-

structures (data holding, data archives, repositories, etc.) on a specific subject (Aragona and De Rosa 2018). The datascape is therefore composed of many others inter-related and interacting data assemblages and systems.

The fact that any big data assemblage is inextricably linked with other data assemblages makes it hard to empirically isolate it. We have therefore decided to run our research in three European centres of calculation, which produce, use and share digital data. According to Latour (1987), centres of calculation are venues where knowledge production builds upon the mobilization of human (directors, researchers, collaborators, etc.) as well as non-human (documents, books, data, instruments, machines, methods, etc.) resources. He stated that the non-human resources mobilized within centres of calculation by the scientists fulfil three conditions: firstly, they have to be mobile, so they can be transported to a 'centre of calculation'; secondly, they have to be stable to be processed; and thirdly, they have to be combinable in order to be aggregated, transformed and connected to other resources in the process of knowledge production. These properties configure non-human resources as immutable mobiles (*ivi*, 223). Neresini (2015) affirms that digital data have all these three characteristics. They can be shared easily through data infrastructures and digital devices, condensed in numbers and other signs that "are able to communicate meanings that are not direct manifestations of *hic et nunc* subjectivity" (Berger and Luckmann 1966, 58), and finally aggregated, shuffled combined, merged and linked within databases. Data are seen as boundary objects (Star 1989), objects that have different meanings in different social groups, but their structure is sufficiently common to make them acknowledged means of translation. Different from symbols – for every symbol we have a set of stereotypical meaning – the meaning of boundary objects does not come from familiar uses, but is brought to it by the actors who are using and interpreting it in their interaction. Nevertheless, data do not only participate to the formation of knowledge in a symbolic way, but also in a denotative way, giving an active contribution to its construction. As Gitelman and Jackson (2013) argue, data are both framed – actively produced in specific contexts – and framing – themselves producing objects and subjects of knowledge. For example, classifications in social sciences, when acted within institutions, change the ways individuals understand themselves (Hacking 1999). A clear illustration of that is gender statistics, that is the segmentation of any statistical indicator in two categories, men and women. Some kinds of gender inequalities, such as gender pay gap and work-family balance, were not so pressing in society as far as they were measured. Gender statistics helped to claim equality of income between women and men, and a better work-family balance. At the same time, LGBT movements, which defend multiple different gender identities, consider as a discrimination the segmentation of statistics in simply men and women. The problem is that once stabilized, data become autonomous, independent from their construc-

tion procedures and without memory on their origins (Neresini 2015). Data have their own agency, not only because, as symbols, they are cultural products but overall because their meaning, and what they represent, is the result of choices made by a long chain of actors.

Big data assemblages are the joint product of different apparatuses and many competing communities of actors. The apparatuses interact with and shape each other through a contingent and complex web of multifaceted relations (fig.1), with the result of being 'black boxed'.

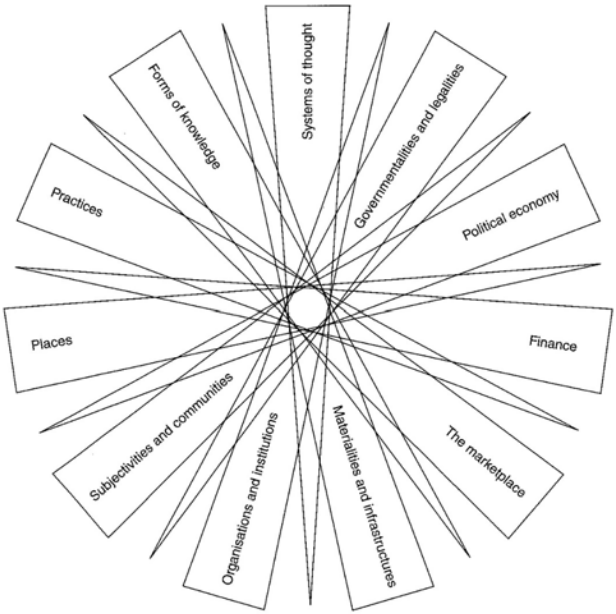


Figure 1 – Apparatuses of the data assemblage. Source: Kitchin (2014b, 26)

In cybernetics, a part of a machine is said black boxed when only the inputs and outputs are known, but not what is in-between. Pasquale (2015) notes that the black box question has been a problem for data even before the advent of big data, because data, whatever its size, are part of different layered activities. It is therefore crucial to follow these elaboration and exchange processes and to retrace the chain of human and non-human actors that compose the big data assemblage. This consists of more than the centre of calculation itself, to include all the technological, political, social and economic apparatuses that frame data. Whenever black boxes are opened, the elaboration processes are revealed, working groups, decisions, competitions and controversies come up (Latour 1987).

Our analysis concentrates on the methodological activities run in the assemblage and on subjectivities and communities. Methodological activities concern techniques, ways of doing, learned behaviours and scientific conventions. They are all the procedural aspects of data, which have changed dramatically in big data assemblages and that mainly refer to the following aspects:

- Data collection: data selection, archive integration techniques, metadata, etc.;
- Data management and organization: responsibilities for data management, intellectual property, consent and ethics, etc.;
- Data analysis: pre-analytics, data mining, text mining, etc.;

Subjectivities and communities refer instead to the different agencies involved in big data assemblage (producers, social scientists, users, etc.) and recall its social aspects. In big data assemblages a dialogue between different kinds of expertise is needed (i.e. statisticians, IT experts, domain experts etc.). Along with this, the socio-technical aspects of data assemblage refer also to the different stakeholders the data are directed to (policy makers, researchers, communication experts, data journalist, citizens). Our analysis focuses on composition of teams (professional profiles, skills, etc.), and the links between the internal actors of the assemblage and other external actors (brokers, corporations, public agencies, etc.). Because it is not possible to separate the apparatuses of the assemblage, by studying methodological activities and subjectivities and communities we have inevitably addressed some questions that are connected with the other apparatuses.

## 3. Method

Qualitative methods seem suited to deconstruct the contingent and relational nature of big data. We conducted our research on data centres because they are venues where all the apparatuses of data assemblage take form (Aragona et al. 2018). We selected three centres in Europe: Web Science Institute (WSI), Italian National Institute of Statistics (ISTAT) and Norwegian Centre for Research Data (NSD). We chose these three data centres because they are all involved in big data assemblage. They have specific priorities and aims, and different organizational structures; these centres rest also in three different territorial contexts. ISTAT serves the Italian community to produce and communicate official statistics. It is composed of various departments, sections and units that depend from a central executive body. NSD is the Norwegian national archive, and its mission is to help in finding data, and to ensure and control their quality. It has an organizational structure less hierarchical than ISTAT, which is

divided only into three sections (information technology, data services, data protection). Finally, WSI is a research institute within the University of Southampton that has a flat organizational structure without levels of middle management. It aims to undertake interdisciplinary research and to provide insight and intelligence that can lead policy, business strategy, civic engagement and individual choices to meet the social and technical challenges posed by web technologies. These three centres have some common traits that entitled us to compare their activities. At the same time, they have also different characteristics, which allowed us to explore a much wider spectrum of existing sources and of scheme of actors, roles and systems of influence (Aragona and De Rosa 2018; Aragona et al. 2018).

The analysis of data assemblages is usually realized through ethnographies (Geiger 2017; Seaver 2017), we preferred to adopt only qualitative interviewing (in-depth interview and focus group)[1]. The reason for this choice is that we gave priority to the meanings and the relevance that actors participating in the assemblage attribute to the activities they run, according to their role, background knowledge and the context. We run in-depth interviews with directors (2) and heads of sections (7) to encourage a critical reflection on the apparatuses, and a reconstruction of the whole data assemblage. In addition to interviews, we conducted three focus groups – one for each centre – with data team members without managerial functions. Focus groups participants had different educational and professional backgrounds (computer scientists, social and political scientists, statisticians and legal experts on data protection). Focus groups helped us to collect a wider range of opinions, and to explore different procedures. Moreover, they allow us to grasp the relational dynamics between different communities of experts, and their level of engagements in the layered stages of the assemblage.

## 4. Results

The results of the analysis may be organized in five sections that cover the main problems and challenges that emerged from both the interviews and the focus groups. The first three concerns the methodological aspects (access, selection and interoperability), while the last two focus on the skills needed in the assemblages, and the ethical implications of big data research.

### 4.1 Access

In recent years, open data initiatives and the building of new data archives and data infrastructures have encouraged the sharing and use of

public data for research. Nevertheless, the problem of data access is still urgent, especially for data produced by private companies:

> When you think of Twitter...the process is massively irritating…it is actually almost impossible to get some kind of data that you want without a special relationship with Twitter. (L., WSI)

According to boyd and Crawford, access may be actually granted to somebody according to their influence, budget and goals: "This produces considerable unevenness in the system: those with money – or those inside the company – can produce a different type of research than those outside" (2012, 674):

> Compared to other social networks, we did not used Facebook due the difficulty to access in terms of economic resources; we have used Twitter because it is free. (B., ISTAT)

Mobile-phones operators, app developers, social media providers, retail chain, and surveillance and security companies are under no obligation to share data. Access is therefore usually individually negotiated, and it involves layered networks of agencies and the signs of a series of agreements concerning intellectual property, non-disclosure and re-sharing:

> You can image the effort to get call detailed records; agreements between institutions and authorities, and all kinds of guarantees […]. I spent two years trying to obtain contacts, appointments and agreements. (B., ISTAT)

The question of the access of private data is not a trivial one, because it completely changes the way of thinking about data and their value. When talking about the call detailed records of telephone companies, an interviewee of ISTAT highlights this problem:

> We have never paid for data and we do not want to create a precedent because in my opinion these data are public good; they are not a private property, we all have generated the millions of data by telephoning and they are stored by companies. (A., ISTAT)

This is a clear example of how values come into the activities of the assemblage. In a public data centre, such as ISTAT, data are considered as a public good. The value of public goods is inverse to their scarcity; more the good is diffused, more its value is. On the contrary, in the private market it is scarcity that gives value to goods; rarer is the good, more its value is. For example, a WSI interviewee explains that the access to social data is often constrained and requires agreements with data brokers, specific companies (data aggregators, consolidators and resellers) that allow to buy a large amount of data and layers of services:

> We have got a range of channels for getting social data…One of this to get through is paying intermediate company that gathers social data and provide some added value analysis. (S., WSI)

These findings support the idea that data, are not neutral, impartial expressions of knowledge, but they construct and implement regimes of knowledge (Campbell and Pedersen 2011). Furthermore, they show that the number of intermediaries between the producers and the users of data is growing in big data assemblages. The relations of the centres with data brokers and governmental authorities are just some examples of the multiple possible configurations that the wider networks between the different public and private agencies that participate in the big data assemblage may take.

## 4.2 Selection

The selection of data emerges in different means. Firstly, interviewees discuss the criteria that orient the choice of big data. Actually, despite the often made claim that big data provides total populations ending our reliance on samples, this is rarely the case for social media data (Highfield et al. 2013). When using data coming from the web, part of the population may not be accessible, because not accessing the internet, or because individuals are passive consumers of internet information, rather than active participants on the web. Respondents wonder about the quality of these data in respect to the selection of a sample from the right population and its representativeness:

> Our purpose is to estimate matrix of flow inter-municipal within both region and province (…) This data source entails methodological problems due to single market share of Telecom[2], then the fact that the same subject can possess more Sim cards and it is not sure that the account holder coincides with who effectively use the Sim card. (C., ISTAT)

Selection errors may become more acute in the case of social media data, because it is more difficult to identify the people and their characteristics:

> The problem would be the quality because social media data are a kind of new data on who are the people. Are the people on Facebook really people? And who are those? The gender, the attitude, the quality of the data comes across that. And that would be one of the main problems. (E., NSD)

> These data as an output of activity in social media are self-selected; you are only analysing people who use Facebook. Twitter is the same and people who use Twitter, although they have a very variable profile and features

> and personalities, there is a common threat and it is that they are Twitter users, and for being a Twitter user you need to have certain treats. That happens with me when I analyse Mooc data as well, to start with I am only analysing learners who are using Moocs. (I., WSI)

Other selection problems are generated by the "velocity and ever-changing nature of big data" that requires a modernization of the organization and of the technologies:

> The structure of the website is always being changed over time and we have to keep up with the technological changes. (…) The velocity and ever-changing nature of big data generates acquisition problems, and it needs the development of new data capturing practices (…) Regards to web scraping (…) it implies a new form of organization than we did until now. It needs to figure out how select the data. (B., ISTAT)

Some critics consider that because the web is changing fast it could make no sense to snapshot phenomena when they can variate very quickly (Lieberman 2008). It is almost impossible to draw any kind of generalization. Selection criticalities are not only technical, but they also require a "new form of organization" able to work with the ever changing form of big data which – as will clearly emerge in section 4.4 on skills – necessitate an overall restructuring of the routinized working activities inside the data centres.

### 4.3 Interoperability

One of the claims about big data revolution is the possibility to create datasets with strong relationality, which can be combined to generate additional insight and value (Mayer-Schonberger and Cukier 2012). The question of interoperability is not new, and it has been pursued for long time by data infrastructures such as archives, informative systems and repositories. For data to be integrated into new datasets they require shared indexical fields and data standards, consistent metadata systems and compatible format. A broader set of managing and handling problems arises not only with big digital traces on the internet, but also with big data operating in context alongside traditional forms of data, the scaled-up data, what we call "the data that are getting bigger" (Aragona 2016). Data that are getting bigger are research and administrative data that have been integrated, merged, linked and restructured within data infrastructures (i.e. datawarehouses, dashboards, archives, etc.). These have been also named 'small big data' (Gray et al. 2015). It is not always easy to scale-up databases coming from different institutions, because they may be structured on dissimilar standards:

> Well, the data sources that I use have been 2000-3000 institutional repositories around the globe...they attain to specific shared information

> and so from universities all round the world...The problem with that is that it becomes very costly to keep helpful at having an infrastructure which is made by 3000 repositories and their different uses of the different standards…there are, say, 3 or 4 major platforms...but each of those...have 10 different versions around...and they use different metadata standards…And then you have got the different archival and librarian practices in every institution and they will use the software differently and use the metadata alternatively. (L., WSI)

This simultaneous use of various standards calls for metadata harmonization. Metadata standards do not always meet the needs of interoperability between independent standardization communities. The combinations of different specifications seem a core issue for web-based metadata. An interviewee faces the coexistence between multitude of metadata standards with different characteristics:

> We have been using various metadata…Ddi, for instance….Sdmx (…) But what we are working now with is much more on how we can integrate the metadata (A., NSD)

Metadata perform a double function. They help data to become mobile immutables (Latour 1987). The anchoring of data to specific classifications, methods of data collections and procedures keeps them stable, as well as increases their mobility, because it eases the combination with other data. At the same time, metadata facilitate the development of standardized procedures for the management of data flows, which may be implemented in different data assemblages. For example, The Generic Statistical Business Process Model (GSBPM) introduces a new methodology to connect traditional research (survey and administrative data) with big data within National Statistical Institutes, integrating data and metadata standards and harmonizing statistical computing processes[3]:

> GSBPM has spread starting from Unece that it introduced this methodology to standardize the process within National Statistical Institutes. We are trying to introduce and connect the production with big data in this scheme (GSBPM) to represent and standardize each modification on traditional flow of the model for the purpose of replicability and transparency. (B., ISTAT)

Metadata specifications and standard processes therefore add further value that may enhance the combination, exchange and reuse of (big) data coming from different sources. Examples are the data stored by social science data archives such as Cessda, the Central European Social Science Data Archive, or the Information Systems that have been built by Eurostat and National Statistical Institutes. One problem is to handle these data to prospective users.

> And then we have the problem of storing and organising what we have produced and get access to. We have all kinds of metadata problems, how you describe a document, a data, a service so that is easy to find? And then we have the (…) discovery and dissemination systems: how do you push out the data again to the prospective users? And how do we make them able to analyse the data? What kind of statistical packages are they using? Are they using Salstat, Spss or whatever could be…How do you create flexibility? There is a big difference in data format if you want to use Spss versus R or Stda to do the analytic work. (A., NSD)

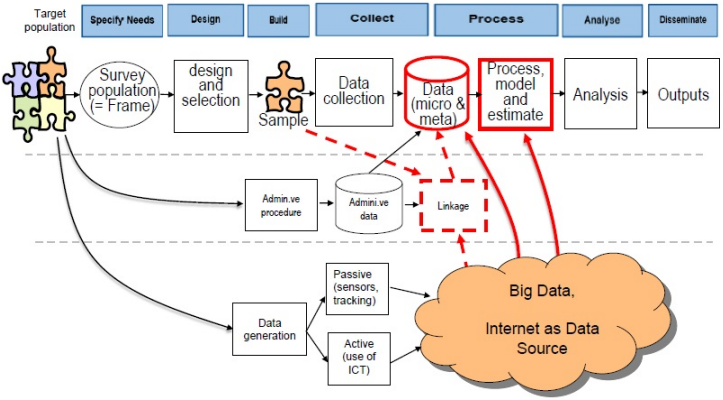


Figure 2 – The use of Big Data in Italian Official statistic according to Generic Statistic Business Process Model. Source: De Francisci (2017)

The adoption of common standards may offer more complete documentation, more widespread know-how and better access to reusable tools. Unlike traditional data assemblages that stopped when data were released, current big data assemblages must follow up on the way data are handled to final users through platforms, infrastructures and the media. Interviewees wonder if users are able to transform these data into knowledge, and how this process works (Giovannini 2014).

### 4.4 Skills and communities

The lack of the proper skills for handling big data in statistical offices is a challenge that needs to be addressed (Baldacci 2016). Indeed, statisticians, experts of fields, computer scientists, and all the other communities of experts who for long have been dealing with data are significantly affected by the assemblage of big data:

> We have been tackling new problems: for now, problems of production…we had response problems…so different troubles than we were used to face, however I would say that we are equipping ourselves with a new instrument and acquiring a culture which is in line with that is happening in the world, such as data science, technics of machine learning, production of models…we are approaching these tools and using them jointly the methodological tools that we already have. (B., ISTAT)

The skills needed are not simply technical, but also deeply epistemological, which consist of the ability of mixing social theory and computation, data and modelling in an innovative way. In this respect, the same interviewee continues reporting the lack of big data experts with these skills on the labour market, and he affirms that the higher education is not sufficiently focused on targeting big data:

> I think that university should provide more competences to the students to work with these kinds of data (…) only in the last years they have started to set up master focused on data. But in the next few years, we expect a major demand on the labour market (…) machine learning, the skills about the statistic but also the new skills relating to data science. (B., ISTAT)

Apart from the new skills, in big data assemblages a dialogue between the different communities of experts is required to blend methodologies and disciplinary matrixes, and shape what Lakatos (1976) called background knowledge (the whole set of facts and parameters used in the construction of any given theory, and of any given data):

> I have been lucky enough to come across and work with people in all their disciplines that have not been to heavily shade by their own discipline which means they are still "malleable" and this means the way you approach a problem, and the universe from which you depart it is negotiable and is negotiated. We have been able to easily accept that there are other ways to see the world and other ways to get to a conclusion or other ways even to name it. (L., WSI)

One interviewee traces a distinction between interdisciplinarity and multidisciplinarity. The former is supposed to be a new thing that comes out from the blending of concepts and backgrounds from different disciplines. It is related to the overcome of some political struggles between scientific communities. The latter is just limited to the sum of the different concepts and methods borrowed from the various branches of research and knowledge:

> Multidisciplinarity is very rich and very useful, but interdisciplinary is far beyond it, because it demands that if you have some stand points and others contribute, if there is synergy between them they can make-up with

> an ordered new think and this is interdisciplinarity about. It is not only collaboration between two disciplines, it is to come up with something new that all of them can agree and can transport on their research field. (…) For me, multidisciplinarity, I agree, we can talk with people from different discipline sets, we share knowledge, and it's very useful, but interdisciplinarity is more than this, that's my point. (P., WSI)

Therefore, an interdisciplinary context fosters the discussion between experts and greater openness in approaching a problem. As Berger and Luckmann noted when talking about the maintenance of symbolic universes, a pluralist situation mines the capacity of the definition of reality based on traditional symbolic universes and of resisting to changes. Pluralism: "encourages skepticism and innovation, it is intrinsically subversive of *status quo* taken for granted reality" (1966, 174). According to the interviewees, a pluralism of disciplines seems to be a key aspect of transition from data to big data assemblages.

### 4.5 Ethics

According to the EU Parliament[4], European citizens should become aware not only of their digital rights, but also about algorithmic governance, automated data processing, and means of collecting data (web scraping, social networks, etc.). Yet the differences in the legal frameworks, and high bureaucratization have been obstacles for research collaboration and data sharing across national borders. For this reason, European Union adopted the regulation on personal data protection, the *General Data Protection Regulation* (GDPR), to safeguard the privacy of EU citizens. GDPR regulates data breaches notification, right to access, right to be forgotten and data portability. It pursues the creation a common legal framework that can push cross-national research through trust common legislation and harmonized practices. This new legislation should guarantee the rights and privacy of the citizens, fostering a greater control on their own data:

> The main reasons on the process of making the GDPR started are all these new fonts of data and all the data a lot of people do not know their rights, they do not have control over their data (…) And move from regulations that shows it will be implemented more or less in the same way in all the European countries. (S., NSD)

Big data seem to challenge the entire ethical system that has been created and institutionalized on different kinds of data:

> I think that the kind of data that existed has shaped out the structure of the ethical regulation system (…) But I think that the new form of data that we have challenges the ethical system that we have as a bureaucratised system. (S., WSI)

Nevertheless, an interviewee explains that GDPR does not fully overcome the problems of big data research, rather it has a limited flexibility in its application. Specifically, the access to data is still costly and time consuming; each authority requires information about the project with descriptions and justifications for the processing of personal data:

> That is one of the many issues for big data researchers in any industry or GDPR is the data limitation. One of the main aims of a data researcher is that it should collect all the data that you can gather and see if you can find a pattern. So, I think that the GDPR and big data researchers are difficult to combine. (M., NSD)

The ethical concerns are more urgent with social media data. As the case of *Cambridge Analytica* has shown, mapping personality traits based on what people had liked on Facebook, and then use that information for profiling and influencing citizens may rise important ethical implications because, as an interviewee notes, it is somewhat obscure who these data can be handled to:

> I think, we are quite good with research ethics… but, I think, as we generate more and more data with social media, in particular, when you look at the terms and conditions of things like Instagram or Facebook, we are really lowering the expectation bar of how people treat data and use data. Who you can give it to? What you can use it for? (L., WSI)

These findings show that new ethical regulations may reinforce hyper-networked ethics. Floridi (2013) refers to this as "infra-ethics", where at least three main stakeholders are affected: data generators, data collectors and data users. Alike our interviewees, the agents in this network may have different opinions about data ethics. Since they interact with other actors within the data assemblage, they may cause collateral consequences on all the others by facilitating or hindering ethic actions.

## 5. Conclusions

The research shows that data happen through structured social practices "in and through which various agents and their interests generate forms of expertise, interpretation, concepts, and methods" (Ruppert et al. 2017, 3). By inspecting the work of data centres of calculation, we were able to identify some stabilized activities (for example the establishment of agreements at different degrees of formality with data providers and data brokers) and to assess their consequences on data quality (for example on representativeness). In addition, we addressed the effects of some criticalities on the whole big data assemblage. One example is the lack of

interoperability, which can affect the timeliness and accessibility of big data. Furthermore, we retraced the different communities of experts that participate to the processes of the assemblage. Big data assemblages are imbued with multidisciplinarity. On one side, this is needed because big data requires multiple computational, statistics and domain expertise. On the other side, pluralism of disciplines is seen as a way to improve adaptability and enhance innovation. Finally, the specific layered activities of big data assemblage are throughout concerned with ethics, but they all pose various ethical problems to be overcome, and a size fits all solution does not emerge from the interviews.

The analysis brings some valuable insights about the problematic issues related to big data assemblages. A central question is how we could arrive at better conventions that can help an effective use of big data. Access constraints, acquisition problems, selection biases and pre-analytical work may be problematic unless a series of routinized activities takes place. Conventions are necessary to fix standards that insure the quality of data, and in our opinion, an institutional setup – as the one is moving its first step forward inside ISTAT and the others European statistical institutes – is a very reasonable thing to wish for. This institutional setup has served so well in the case of survey data, for example through the standard definition of the total survey error, the adoption of classification standards and the exchange of metadata. The establishment of routinized activities is strictly connected with the experts needed inside big data assemblage. The lack of skills lamented by the more established data centres may hinder the development of big data assemblages and their effective functioning. Moreover, the ever-changing nature of big data infrastructures, platforms and interfaces involves not only acquiring new skills from outside the centres, but also constantly, and probably costly, updating the expertise and capacities required to run the activities of big data assemblages.

The methodological posture adopted in this paper allowed us to pick up choices, compromises and agreements and to unveil black boxed aspects of big data assemblage. The comparative focus on the three centres of calculation entailed us to disentangle the different resources (human and non-human) mobilized within the assemblages and to explore "from below" – through the words of the main actors participating in the assemblage – the contingent and contextual making of big data. This piece of research stresses that the definition of data and big data should be always seen as a product of a convention and subjected to debate. By isolating and inspecting some methodological aspects of the big data assemblage (i.e. access, selection and interoperability) it is possible to increase the awareness that data are not given, but actively constructed through socio-technical practices.

Our study should be seen as an attempt to grasp the complex apparatuses that form big data assemblages, because it concentrates only on the socio-technical practices of big data production and management,

and it is confined to the study of big data in social research. Further work should isolate some applications of big data (i.e. government or business) in order to observe how they are brought to use within different communities of stakeholders and users, and to reconstruct the practices within the other apparatuses of the assemblage.

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[1] The interviews in ISTAT were conducted in Italian language and then translated, while those conducted in WSI and NSD were transcribed verbatim.

[2] Telecom is an Italian telecommunication company that offers fixed and mobile communication services.

[3] For details, see https://statswiki.unece.org/display/GSBPM/I._Introduction #I._-Introduction-_Toc375051192.

[4] For details, see http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P8-TA-2017-0076+0+DOC+XML+V0//EN.

# Explorative Nanophilosophy as *Tecnoscienza*

## An Italian Perspective on the Role of Speculation in Nanoindustry

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**Abstract:** There are two primary camps in which nanotechnology today can be categorized: normal nanotechnology and speculative nanotechnology. The birth of nanotechnology proper was conceived through discourses of speculative nanotechnology. However, current nanotechnology research has detracted from its speculative promises in favour of more attainable material products. Nonetheless, normal nanotechnology has leveraged the popular support and consequential funding it needs to conduct research and development (R&D) as a result of popular conceptions of speculative nanotechnology and its promises. Similarly, the scholarly literature has shifted its focus away from speculative nanofutures towards normal nanotechnology R&D. This paper shows the incongruences between the representation of nanotechnology in the media, scholarly journals and industry.

**Keywords:** nanotechnology; atomically precise manufacturing; speculation; anticipation; nanoethics.

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## 1. Introduction

Manufacturing today is capable of some impressive high-precision techniques such as x-ray lithography for building electronics components. However, existing methods struggle to achieve atomically precise manufacturing (APM), which is the assembly of materials with atomic precision. In APM, materials are built atom-by-atom. This is one form of nano-

technology. The idea of APM dates to Richard Feynman's 1959 talk "There's Plenty of Room at the Bottom" and active APM research began with K. Eric Drexler's 1986 book *Engines of Creation*. Despite this rich history, APM today is crude, limited to a handful of select materials, and many in the field doubt that more advanced APM can ever be realized (Drexler et al. 2007). The debate about the feasibility of APM centers around its mechanical conception of atoms and molecules (Auffan et al. 2009; Snir 2008; Baumberg et al. 2007). In APM, individual atoms are put in place in a fashion analogous to the mechanical assembly of components in traditional macro-scale manufacturing. However, critics like Richard E. Smalley believe that this concept is fundamentally flawed (Baum 2003). They argue that it is impossible to create the physical bonds between atoms or molecules directly by mechanical means (Baum 2003). Instead, an additional physical or chemical agent is needed to create the bonds, as found throughout traditional chemistry. If the critics are right, then APM is no more than an interesting intellectual exercise with negligible scientific merit or practical application. However, if the critics are wrong – if advanced APM is indeed feasible – then the implications are enormous. Simply put, APM could enable unparalleled sophistication in manufacturing. Some APM proponents postulate that APM would usher in a revolution in manufacturing on par with the industrial revolution or the computer revolution. Drexler refers to this as "radical abundance" (Drexler 2013b). The sweeping vision includes no less than unparalleled solar cells to combat climate change, the abundance of medicines and foodstuffs to eradicate disease and poverty and the strict control of manufacturing by-products that will make harmful waste a remnant of the past. However, APM also has the potential to create an abundance of highly precise and effective weapons system and surveillance technologies (see also Altmann 2005; Drexler 2007; Joy 2000). APM thus falls into the same category as other high-stakes speculative future technologies like nuclear fusion power and artificial superintelligence. These technologies might not be possible or might never be achieved by human engineering. However, if they are achieved, they could fundamentally transform global human civilization. A counterargument – arguing against R&D – can be made on the grounds of cost-effectiveness. Developing these technologies can be very expensive. Funding bodies often hesitate to allocate scarce resources to projects with such uncertain payoff. Indeed, APM has historically struggled to attract investment, with nanotechnology funding going primarily to more low-risk, low-reward technologies. Fusion power and superintelligence have faced similar situations in the energy and AI sectors, respectively.

Regardless, although APM proper as an object of research has failed to secure direct research investment, other 'normal'[1] nanotechnologies such as nanomaterials have become a multi-billion-dollar industry (Harper 2011). The causes of these substantial investments can be accounted primarily by the merits of the technologies per se. However, the conten-

tion of this paper is to discuss the effects of technological speculation on early-stage nanotechnologies. In a word, this article seeks to determine the effects that speculative nanotechnology has and is having on normal nanotechnology research. To accomplish this task, this paper situates itself by limiting its scope to the Italian nanotechnology industry. Because nanotechnology R&D is relatively young in the Italian sovereign in comparison to the United States and the United Kingdom, Italy provides this paper with a nesting ground in which policy and governance recommendations have the best opportunity to inform the responsible innovation of nanotechnology.

## 2. Methodology

This paper takes a wholly unorthodox approach to the investigation of the effects of speculation on current research trends. Existing nanotechnology literature has traditionally focused on nanotechnology funding (Roco 2005; Harper 2011), the feasibility of advanced nanotechnologies (Drexler 2006, 1986; Phoenix and Drexler 2004; Freitas 2016; Freitas and Merkle 2004; Jones 2005), its potential future applications (Freitas 2015, 2010, 1999; Boenink 2010; Moscatelli 2013; Vandermolen 2006), as well as its risks and governance (Boenink 2009; Wejnert 2003; Cowper 2006; Vandermolen 2006; Phoenix and Drexler 2004; Moscatelli 2013; Pelley and Saner 2009; Roco 2008). As such, this paper provides a novel analysis by looking specifically at the exponentially growing Italian nanoindustry and showing that a strong correlation exists between the media/scholarly speculation and anticipation of nanofutures and the current 'normal' nanotechnology ventures[2]. This paper does not intend to replicate existing research literature on funding or policy in coming to its conclusions if any, but instead, provide both a media and literature analysis of how nanotechnology is represented in the media and elite scholarly journals. As such, although Italy and its nanoindustry will comprise the centre of this investigation, broader global implications for research and speculation will necessarily come into play. The preliminary conclusions of this paper show that the funding and current nanotechnology research has, at the very least, been spurred by the springboard of speculative nanofutures. However, there is a 'severing' both in the media and the scholarly literature. This paper will show that the media often represents and mediates humbler 'normal' nanotechnology creations as speculative nanofutures. Whereas the discussions of nanotechnology in scholarly journals have shunned discussions of speculative nanofutures in favour of discourses surrounding these humbler pursuits. Thus, current nanotechnology ventures have profited dramatically from funding bodies and public acceptance as a result. This incongruence – this severing – provides an unrealistic account of what is occurring in nanoindustry, how speculation and ongoing research co-construct one another through a series of indi-

rect assemblages that are mediated, translated and eventually represented by the media and scholarly research. Because the thesis of this paper dramatically hinges on media stories that cite nanotechnology, the identification of such stories in the Italian sphere is of primary importance. To do this, this article is heavily based of the conclusions drawn Arnaldi (2014) in retrieving Italian news stories, reports, and interviews that feature nanotechnology and notable Italian nanoscientists ranging from 01 January 2001 to 31 March 2012. His report used a complex Boolean search string to retrieve news stories. This work, based on that of Dudo et al. (2011), has the benefit of reducing false positives and only presenting tangential search results thus decreasing the screening work needed (Arnaldi 2014; Dudo, Dunwoody, and Scheufele 2011). Going one step further, this paper uses the work of Arnaldi (2014) as an implicatory index for that date range. As such, because the contention of this article is to unearth the division between media and academic discussions of nanotechnology, and given that the debate on speculative nanoethics, which partially took place in the journal Nanoethics[3], took place roughly between 2007 and 2010, the work by Arnaldi (2014) is only partially sufficient for this paper. What is needed is both the work drawn from his article as well as media and academic coverage of nanotechnology that proceeded it. Thus, this paper builds on this previous work by revaluating the narratives from that period as well as news stories from 2012-2017 (inclusive). Like the mentioned study, three major Italian daily newspapers have been selected to provide the sample of nanotechnology media coverage (Corriere della Sera, Il Sole 24 Ore, La Stampa).[4] To accomplish this, the three daily newspapers have been searched using the online search engine Factiva for pertinent articles containing the keywords 'nanotechnology', 'molecular manufacturing,' 'atomically precise manufacturing' and 'nanoscience.[5] The search was run for news stories from 1 April 2012 to 31 December 2017.[6] The starting date was chosen as it directly follows from Arnaldi (2014)'s last search date selected, thus providing a smooth continuity of news coverage that could be relevant to the present study. News stories were then screened for at least one present complete phrase pertinent to nanotechnology, anything less provided insufficient information, including classifieds, obituaries or other directly irrelevant results. A total of N = 55 items were retrieved from the database, notably less than the 218 items retrieved by Arnaldi during the 2001 – 2012 range. Additionally, replicating the Arnaldi Boolean search string, this time with the addition of the search terms for 'molecular manufacturing' and 'atomically precise manufacturing', the original 2001- 2012 search span resulted in a new total of N = 224 items (6 more which specifically mention the future nanotechnology pertinent to this paper's thesis. Similarly, of the N = 55 items from the 2012 – 2017 search range, a total of N = 0 items mention any of the future nanotechnology search terms even once.[7] The following section will introduce the theoretical groundwork and literature that has focused on the implications of speculations on the

development of emerging technologies and how such discourses can be used with this particular case study.

## 3. The Role of Speculation in Contemporary Development

Speculation also termed anticipation (particularly within the diverse technoscientific discourses) has played a critical role in the development of nanotechnology since its inception. These speculative narratives have had severe material consequences, the most significant of which has led to the suppression of speculative nanotechnology narratives in most nanotechnology discourses (see Michelfelder 2011; Grunwald 2010; Nordmann 2007; Nordmann and Rip 2009), however, there has also been some pushback by scholars, proposing that speculation, aside from having real effects over contemporary technological developments, in itself has utility in the scientific and governance discourses (Roache 2008; see also Selin 2007). The severing is multifaceted, and this paper aims to unearth some of these incongruences. Similar to the scholarly discourses that have their own debates on the value of speculative nanophilosophy, the risk assessments of both current nanotechnology ventures and potential nanotechnology applications and future developments have a severing of their own. The scope and context of risk assessments with nanotechnology differ between expert and public evaluation (Tyshenko 2014; Hinds 1999). Expert evaluation of risk tends to focus more heavily on a limited scope of potential risk-outcomes such as expected loss, death or grave injury whereas public assessments tend to be less formalized and broader (Hinds 1999). The public perception of risk as such has become the subject of further study given its material impacts on the development of emerging technologies (Lee et al. 2005; Lemyre et al. 2006). Not only this, but efforts to deconstruct the causes for public rejection of specific emerging technologies genetically modified organisms and nuclear energy production (Gupta, Fischer, and Frewer 2012). Several of these research reports that focus on public perceptions of nanotechnology have been published (Cobb and Macoubrie 2004; Priest 2006; Siegrist et al. 2007). Although these surveys are over a decade old, they continue to provide novel insights on the discrepancy between public and expert opinion of current and potential future applications of nano-technological systems and materials. The primary conclusion of these studies is an observation that despite decades of public funding and development of nanotechnology and its now widespread influence and interdependency with a large number of other industry and research domains, public attitudes, and understanding of nanotechnology remains limited and not well-informed. Initial conceptions of nanotechnologies were entirely dichotomous, either framed as utopian or dystopian in character. Discussions about the 'radical abundance' of energy, material wealth, and basic life necessities were envisioned with arguments that it would be this transformative technolo-

gy that would be the centre of the fourth industrial revolution (Curtis et al. 2006; Tyshenko 2010; Salamanca-Buentello et al. 2005; Drexler 2013b, 2013a). Catastrophic consequences to the development of the same technology were also projected, including environmental devastation, the erosion of any notions of privacy and the infamous 'grey goo' scenario (Joy 2000; Drexler 2006, 2013a). These radical future speculations were, over time, overwritten with more 'down to earth' framings that provided less extreme interpretations of nanotechnology benefits and risks and relegated the catastrophic and abundance characteristics unlikely probabilities (Dowling 2004). This characterized the first decade of 21st-century nanotechnology and nanoethics research; heaver focuses on more immediate nanotechnology innovations and a shift away from speculative nanofutures. As things currently stand, as of 2012, academic research that focuses specifically on speculative nanofutures had all but died out. Mentions of speculative nanotechnology in academic scholarship has been relegated to an ancillary role in demonstrating potential convergence characteristics of nano-bio-info-cogno (NBIC) technologies and risk research (i.e., Bostrom 2014; Torres 2017) or published privately outside traditional academic peer-reviewed platforms (i.e., Freitas 2015; Vassar and Freitas 2013; Freitas 2016; Lewis 2016).

However, persuasive arguments have been levied that it was the foundational character of earlier media and other popular works that spurred public investment and interest in what is now normal nanotechnology by showing particularly utopian speculative futures (Arnaldi 2014; Arnaldi and Tyshenko 2014; Drexler 1986, 2006). As such, the current global nanoindustry, particularly that of the United States and its federal National Nanotechnology Institute, have significantly profited from the public support for nanotechnology, even though the current nanotechnology research is far removed from the promises of molecular engineering and radical abundance that nano-optimists[8] have speculated (Drexler 2013b)[9].

## 4. Italy and Nanoindustry

As such, how do we situate all of these states in the context of the Italian nanotechnology industry? Despite Italian innovations and investments lagging significantly behind those of the US, Russia, China and other EU states, there is nonetheless a growing interest in nanotechnology research and increase in public funding (Istat 2013). There are several dimensions contributing to Italy's past and current position in nanotech innovation such as a small number of large firms that operate in sectors that are knowledgeable in nanotechnology, the restricted role that business play in research and development, the narrow use of public research on the actual industrial practice (even though Italian scientists have been lauded for their scientific achievements). These factors are not exhaustive, but all

play a role in the hindrance of the Italian contribution to nanotechnology innovation (Wired and Cotec 2009). Regarding the investments made on the peninsula, they are relatively low in comparison to other states.[10] Investitures are estimated at roughly 100 million euros annually; comprised both of Italian federal funding as well as EU funding. However, despite poor relative investments, the professional interest in nanotech has garners increased attention over the years, particularly between the years of 2004-2010 where the total number of private companies directly involved in nanotechnology increased from 20 to 85 percent. Additionally, the Third Italian Nanotechnology Census reported that as of 2010 there were 190 existent Italian research centres dedicated to nanotechnology and explicitly observed a growing interest in nanotechnology in Italian centres (Airi Nanotec 2011).

Nonetheless, problems are still persistent, primarily on account of the lack of private investments that other countries such as the United States possess as well as a unique severing between industry and relevant public research. Not only this, but a 2010 survey conducted by WIRED and COTEC reported that just 3.1% of the sample surveyed felt that they were 'well informed' of current nanotechnology with 72.8% reporting that they thought they were either poorly or not at all informed on the topic (Wired and Cotec 2010). Similarly, although research and development in the fields of nanotechnology in Italy continue, and more industry firms emerge, there is yet to exist a strategic government plan regarding nanotechnology in Italy, and as such, difficulties arise for citizens and researchers to learn about funding opportunities within the nation as well as statistics that clearly explicate the nation's actual state of development (Nanowerk 2013; Berger 2013). The third 'Census of Italian Nanotechnology' that was conducted by the firms AIRI/Nanotec IT and published in 2011 was the last of these official reports that gave an insight into the status of nanotechnology innovation in Italy. Coupling the information retrieved from the Factiva search regarding public dissemination of nanotechnology innovations as well as the current state of nanotechnology funding in Italy, we can begin to sketch some interesting correlative results.

## 5. Sketching the Severing

Firstly, there is a marked relationship between the quantity and character of the newspaper articles that talk about nanotechnology prior and post-2012. Prior to 2012, there are at least six articles that explicitly discuss future nanotechnology, with over 224 items that address nanotechnology more broadly. There is a marked drop after 2012 that correlates precisely with the definite shift in the research aims regarding nanotechnology. The scholarly debates that took place, more primarily in the jour-

nal Nanoethics, surrounded the value of speculative nanotechnology and dedicating resources to its dissemination (for specific articles on this debate see Roache 2008; Grunwald 2010; Nordmann 2007; Boenink 2009; Nordmann and Rip 2009). As such, there was no overtly expressed decision that concluded the debate, instead what resulted was a quite fizzling that ended with a near-universal moratorium on publishing purely speculative works on nanotechnology.[11] For this reason, there have been no marked works on purely speculative future nanotechnology in academic journals. However, it warrants mentioning that there do exist more recent scholarly book publications that explicitly discuss future nanotechnology, but never so in an exclusive or exhaustive capacity, but instead it is levied as an illustration of the effect of technological convergence and existential/catastrophic risk (Bostrom 2014; Torres 2017; see also Freitas 2016 who continues to self-publish articles on this topic at his Institute for Molecular Manufacturing).

As such, we can see how media outlets, in this case, Italy's three largest newspapers, has had a similar lack of publications on speculative nanofutures, that, at one point, help to construct the popular support that has enabled the base-level infrastructures to the now burgeoning Italian nanoindustry (as shown by those articles listed in Appendix B).

Another interesting correlation to note is not only is there a total lack of articles on speculative nanofutures in the search results post-2012, but there is a marked decrease in media coverage in general about broader nanotechnology. This severing can be attributed to multiple potential causes, none of which this paper aims to argue for. Such reasons can be: (1) a lack of academic research with future – nano-optimistic (i.e., revolutionary) – characteristics that the pre-2012 research possessed, (2) post-2012 literature no longer associates its research with its revolutionary origins, and (3) the very broad definition of what encompasses nanotechnology makes specific future applications nebulous (the latter is proposed by Drexler, 2013b). Regardless of which, if any, of the proposed reasons, are the cause of this severing is correct, one this is remarkably clear; the correlations between the academic moratorium on speculative research on nanotechnology is directly correlated with the lack of speculative media coverage on nanotechnology. The size of the Italian nanoindustry, because of its relatively small, yet growing, size makes this severing remarkably transparent, whereas the more extensive American nanoindustry and media outlets would make this Severing harder to discern.

## 6. Concluding Remarks and Further Research

By observing the coverage of both normal and speculative nanotechnologies in the Italian media, I have roughly discussed the relationship

between the academic discourses on nanotechnology and how that has co-constructed the media coverage of nanotechnology.

Firstly, the origins of nanotechnology, before material results in the field were produced, was purely speculative with either nano-optimistic or nano-pessimist anticipations. During this period of speculative nanofutures, the media played a critical role in the dissemination of these potential futures with similarly serious scholarly debate on the feasibility and ethics surrounding such technologies. This zeitgeist of speculative nanofutures began to pave the way for basic nanotechnology research that is argued to provide the fundamental building blocks for what was later to be called future nanotechnology such as the Drexlerian APM (O'Mathuna 2009; Drexler et al. 2007). New journals such as Nanoethics, with the aim to disseminate this new field of research and both public and private industry, centres Della for the R&D of nanotechnologies. Such institutions, like the NNI, profited much by the public support that was fostered by the news media in their speculative dissemination of humbler material developments (Tyshenko 2014).

However, a severing took place between 2007-2012, when academic research on nanotechnology became disinterested, and in some case, ideologically opposed to the dissemination of works of nano-speculation or anticipation, relegating them to a waste of research resources (Van Lente et al. 2012; Nordmann 2007, 2014). This is in specific opposition to works that argue that speculation on technologies provides an ideal initial exploration for the design and determination of values in directing potential futures (e.g., Alvial-Palavicino 2016; Foley, Bernstein, and Wiek 2016; Racine et al. 2014; Roache 2008). Thus, there are two severing at play, one that has emerged from within the academic discipline of nanotechnology research, one that is ideologically opposed to speculative works (the very types of works that founded and induced funding for the growing field) and another severing that is transdisciplinary; a severing between the merits of speculation/anticipation per se. The works produced through academic scholarship has genuine material consequences one what type of information gets disseminated, both academically and publicly. Similarly, can be said for the network of assemblages that the media influences as it relates to funding and support of academic research and ventures. Severings of this sort put a strain on what can and cannot be discussed in a sober and accountable fashion. As a result, questions of applied ethics come to the fore, particularly in being proactive for potentially transformative and disruptive technologies (e.g., NBIC technologies). Speculation, both in the media and in scholarship provide a means by which potential futures can be anticipated, and as a consequence, material steps can be envisioned to assess and direct desirable prospects. There is an extensive quantity of existing scholarship that disseminates the merits of proactive developments of transformative technologies instead of ex-post facto reactionary measures that often prove to be impotent (i.e., Davis and Nathan 2014, 2015; Roco 2011; Tait and Levidow

1992; van Wynsberghe 2013). To sum, this paper has taken up the specific case of speculative nanotechnology as a means to illustrate the relationship between the media coverage of nanotechnology and the academic scholarship on the topic. The Italian nanoindustry, because of its relatively small size and more recent birth, provides a novel, and unambiguous illustration for how the media coverage of nanotechnology changes before and after 2012, both in quantity and subject. Speculation on future technology, contrary to academic nanotechnologies, is not a fruitless endeavour. Similar research is currently being conducted in equally speculative fields of advanced artificial intelligence and biotechnology, and for a good reason (i.e., Armstrong, Bostrom, and Shulman 2016; Barrett and Baum 2017; S. D. Baum 2016; Etzioni and Etzioni 2016; Wiltshire 2015). Further research should seek to determine active ways to reinvigorate nanoethics, either in an ad hoc fashion or by informing a potential path from examples in the fields of speculative artificial intelligence research.

## Appendix A: Boolean search term used to gather articles from the Factiva database

(atleast3 nanotechnologia OR atleast3 molecular manufacturing OR atleast3 atomically precise manufacturing OR atleast3 nanotecnologie OR atleast3 nanoscienza OR atleast3 produzione molecolare OR atleast3 produzione atomicamente precisa OR atleast3 nanorobot OR atleast3 nanobot OR atleast3 nanosci* OR atleast3 nanotec* OR assembla*/N2/molecolar* OR fabbrica*/N2/molecolar* OR atom* adj2 fabbric*) NOT (bomb/N10/atomic* OR arm*/N10/atomic* OR central*/N10/atomic* OR bomb*/N10/nuclear OR arm*/N10/nuclear OR nanosecond* OR apple OR ipod or mp3 OR digest OR notizi*/N2/brev*)

## Appendix B: Complete list of articles from 2001 to 2012 that specifically mention future nanotechnology systems

| Publication | Article Headline | Date of Publication |
|---|---|---|
| Corriere della Sera | La riparazione dell'elica | 4 November 2007 |
| Il Sole 24 Ore | I menù e il futuro saranno a base di pillole nutrienti | 3 November 2006 |
| Il Sole 24 Ore | Prospettive dell'invisibile | 13 April 2006 |
| Il Sole 24 Ore | Per il Centro ricerche Fiat più atturato anche fuori dall'auto. | 24 January 2002 |
| La Stampa | Addio chiavetta Usb C'è il filo intelligente. Anche l'Europa si lancia nel business delle microparticelle di pochi miliardesimi di metro | 27 February 2008 |
| La Stampa | Nano macchine | 9 May 2001 |

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[1] Donal O'Mathuna (2009) coined the term "normal nanotechnology" in contrast to speculative or "future" nanotechnology. The term normal should not be confused with a Kuhnian 'normal' paradigmatic concept, but to refer to current or real developments in nanotechnology that are currently being developed or already ubiquitous. This is usually nanomaterials and nanosystems such as atomic force microscopy.

[2] Socio-technical assessments and evaluations such as this one can stem from various theoretical foundations. This paper provides a rudimentary empirical style approach as delimited in this section (S.2). Another mode of inquiry towards the sociology of expectations of socio-technical systems such as nanotechnology can take the form of sociotechnical imaginaries pioneers by Jasanoff and Kim (Jasanoff and Kim 2009, 2013; Jasanoff 2015; Jasanoff and Kim 2015). This is a principled methodology for determining the mapping of expectations and their real-world developments.

[3] The majority of the debate that took place in NanoEthics surrounded the value of conducting and publishing speculative works of ethics. Arguments against the speculative project mostly deferred to arguments about the opportunity cost of speculation that could have served more immediate interest (Grunwald 2010; Ferrari, Coenen, and Grunwald 2012; Nordmann 2007). On the other hand, arguments were made in support the value of speculative ethics in anticipatory rather than reactive governance strategies (Roache 2008; Swierstra et al. 2009; Rip 2007; Brey 2012)

[4] The Factiva search for all three news outlets encompassed both online and print databases.

[5] The terms chosen for the Factiva database search were used both in English and Italian to cover both of the possible language and nomenclature usages that are employed by the news sources. For a full list of terms and search, exceptions see Appendix A.

[6] Arnaldi (2014) explicitly excluded all search results by filtering out those that mention molecular manufacturing or nanorobotics. Given that these are fundamental concepts to speculative/future nanotechnologies, the original search date of 2001-2012 has been researched anew with the inclusion of these search terms in the Boolean string.

[7] See Appendix B for a list of articles from 2001-2012 that were collated that specifically mention future nanotechnology systems at least three times as per the Boolean search string conditions.

[8] The term 'nano-optimist' (as well as its opposite, nano-pessimist) was coined by (Arnall and Parr 2005).

[9] See Drexler, 2013b for a thorough discussion of how the NNI and similar institutions have arisen globally and have redefined what constitutes 'nanotechnology.' As such, the original promises of nanotechnology are very different from the current research that is globally being conducted.

[10] Whereas Italy spends roughly 100 million euros (as of 2010), The United States spends approximately 2-3 billion dollars publicly and an additional 4-5 billion dollars of private investment). Similarly, Japan spends nearly 1 billion dollars per annum, and Germany stands as the EU forefront in nanotechnology investment with a per annum approximant of 800 million dollars (Nanotec 2011; NSTC, COT, and NSET 2018).

[11] This is not only clearly visible in the lack of future nanotechnology literature post-2010, but it has also been clearly expressed to me by the editor of a top journal in the field and the cohort of reviewers who rejected a paper I had written purely because of its speculative nature. One reviewer regarded the article as being clearly something that is currently taboo, and more suitable to the pre-2012 discourses saying that "The submission reminds me of the early debate on nanotechnology more than 15 years ago. It is a reflection on the big issues of APM of which the idea goes back to science writer Eric Drexler (1986) and challenged by Bill Joy in 2000. My first impression was: the paper is about 15 years late. In the meantime, the nano-debate changed to a much more down to Earth mode, focusing, e.g., on ESH issues of nanoparticles while the more futuristic issues migrated to other fields such as human enhancement. Accordingly, my first feeling was: reject because the paper is out of time".

# Datafication from Below: Epistemology, Ambivalences, Challenges

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**Abstract:** The "imperative of data" seems to be at the core of current debates concerning relationships between technology and society, as well as the status of knowledge, freedom and identity. Departing from the plenary roundtable *Datafication and Technoscience from Below: Sharing, Moving, Opening* at the 7th STS Italia Conference held in Padua (June 2018), the authors go through different aspects of the sociotechnical process of datafication, emphasizing from complementary STS perspectives some of the most urgent and emergent challenges posed by the constant exploitation of data at an economic and financial level. Topics covered are ambivalences of datafication and their consequences for everyday life (Pellegrino); the epistemological consequences of the "race to the bottom-up" and fake news as ultimate drift of such a race (Söderberg); data-logies and grassroots epistemologies as conditions for possibility for a datafication from below (Milan).

**Keywords:** datafication; post truth; fake news; grassroots data epistemology; infrastructuring.

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## Inside "the Below": Ambivalences of Datafication and Infrastructuring of Everyday Life

*Giuseppina Pellegrino*

Contemporary social and daily life is increasingly subjected to a growing and apparently overwhelming phenomenon, that of retrieving, producing, accumulating, tracking and transforming into (economic and financial) value enormous amounts of data through specific technoscien-

tific infrastructures (also called "Big Data Analytics", see Mosco 2017). All this summarized as datafication – a complex and contradictory sociotechnical process – questions the boundaries, possibilities and conditions of knowledge, freedom, and identity. It is of interest that such a process, as typical in technology and media history, is subjected itself to a constant dichotomic and oppositive binary thinking (Sturken and Thomas 2014). On the one hand, the apocalyptic register of those framing technology (in this case, data) as coming exclusively "from above", tools to exert and impose power, namely the power of surveillance and the end of privacy as we used to conceive it. On the other hand, the more "integrated" approach viewing datafication as the trigger and the field of new opportunities, benefits and progressive futures "from below" (on the rhetorical figure "above *vs* below", see Söderberg in this issue).

This contribution frames the issue of datafication and that of "the below" through a long-term perspective, looking at their founding and underlying processes, namely the broader and structural condition of "becoming digital", to quote Vincent Mosco's book title (Mosco 2017). To put it differently, datafication could not exist without – and stays only within – the pervasive digitization of information, whose grounds were built up in the early age of Cybernetics and Informatics, under the flags of freedom and liberty (Kelty 2014). Such an "installed base" (Star and Ruhleder 1996) of data(fication) infrastructure carries out and brings about the distinctive characters of datafication, revealing at the same time its deep ambivalences towards the way organizations, groups and individuals act through dispersed sociotechnical networks where the "imperative of data" is at the core. Just to quote a few of them, data-intensive science, precision medicine, machine learning and artificial agents, open data in Public Administration infrastructures, and the emergence of a "quantified self" represent the high diversity of the forms datafication can take.

As any new technology or sociotechnical process (Marvin 1988; Sturken and Thomas 2004), datafication shows the persistence and durability of hopes and horrors as drivers of the public discourse on technology, a discourse regimen often inspired by presentification, obsolescence and revolutionary perspectives (Pellegrino 2015).

Therefore, while mainstream media concentrate on and fuel scandals concerning the treatment and security of data and information on social media, focusing on the risks of manipulation and cheating (e.g. the Facebook/Cambridge Analytica Datagate; Mueller's investigation on Russiagate), technoscientific infrastructures of data and datafication can and do act from below, in a myriad of sites, fields and circumstances (on "datafication from below", see Milan in this issue). Whereas the media discourse contributes to shape the public and rhetorical side of datafication, putting emphasis either on its dark and dystopic or on its bright and utopic dimension, practices from below, grounded in social movements as well as in everyday routines, are the field where concrete consequences, linkages and nuances in between the dark and the bright take form and

are brought to life. This contribution departs from digitization as the foreground and installed base of datafication, distinguishing the two processes and also comparing them. Then, ambivalences of datafication will be highlighted. Eventually, the concept of "infrastructuring of everyday life" (Pellegrino 2018) will be proposed as a key to go "inside the below" and look at the material as well as hidden texture through which datafication envelopes our lives.

## Datafication and Digitization

Data and information are not the same thing; the typical differentiation of the two is based on the concepts of "processing" and "interpretation", which precede data and make information possible. New epistemologies in Human and Social Sciences, as well as the postmodern turn, showed how data itself is not an objective construct, rather fully constructed, to the extent that the same concept of "raw data" is an idealization, if not an "oxymoron" (Gitelman 2013).

The phenomenon of Big Data (a buzzword as well) is pervading the debate in all of the sciences, claiming for a revolutionary approach and endless possibilities of quantification, aggregation and analysis; whereas quantification itself is not at all a new phenomenon, the "big" of big data concerns unprecedented possibilities linked with putting data in relation with others (data, individuals, groups, infrastructures, and so on). Actually,

> Big Data is notable not because of its size, but because of its relationality to other data. Due to efforts to mine and aggregate data, Big Data is fundamentally networked. Its value comes from the patterns that can be derived by making connections between pieces of data, about an individual, about individuals in relation to others, about groups of people, or simply about the structure of information itself. (boyd and Crawford 2011, 1-2)

In particular, with reference to spatial science, "two things that are making data suddenly big are the datafication of the individual and the geocoding of everything" (Cresswell 2014, 57). However, we could not understand the width of datafication without referring to digitization. It is crucial to recognize that it is through Information and Communication Technologies, namely digital technologies, that this trend towards accumulation and valorization of data has become more and more possible, as well as powerful and effective.

We could say that digitization is the general form which transformed the possibility to cope with data and information, through a crucial reduction of complexity: bits (of information) are an abstract, homogeneous, discrete and numerical formatting, enhancing the retrieval, transfer, cumulation of information through digital technologies and especially digital computing. Digital is more of a quality than a quantity, a relation

rather than a content (to use Palo Alto's axioms). It refers to signals, information, data, images, contents, devices, as well as the media.

Digital formats enable synthesis, comparison, storage and retrieval of information. At the same time, it increases exponentially production and makes selection more difficult (see Pellegrino 2018).

If datafication is the latest version of obedience to the imperative of quantification and purification which has so much marked the emergence of the modern world and modern science (see Latour 1993a), digitization is its precursor, as well as the "installed base" of data(fication) infrastructure (see Star and Ruhleder 1996). On the one hand, datafication goes far beyond digitization: data are treated, manipulated and mined (sometimes even "cooked", Gitelman 2013) through more and more sophisticated analytics techniques, not simply digitized. On the other hand, datafication depends on digitization and even more on the increasing convergence with advanced digital technologies, namely the Cloud and the Internet of Things which constitute the sociotechnical infrastructure of what has been named as "the Next Internet", an increasingly integrated system that is accelerating the decline of a democratic, decentralized and open-source Internet (Mosco 2017, 5).

From such a dependence it follows that datafication amplifies and enriches the multiple and diverse contradictions already present in digitized sociotechnical infrastructures, adding to them peculiar ambivalences.

## Ambivalences and Challenges of Datafication

As other modern and contemporary phenomena, datafication shows the significance of a classical category to analyze modern culture, that of Simmelian ambivalence: a quality which connects as much as it separates (individuals, groups, objects, and so on). In ambivalence, apparent and jarring contradictions co-exist, on the one hand connecting and on the other separating. In what follows some of these contradictions, considered as particularly challenging, are highlighted. They refer to trends which are not specifically born with datafication, rather emphasized and consolidated by it.

### *Exposure of the (Quantified) Self and (Co)Dataveillance*

Datafication infrastructure is deeply knotted to individuals' bodies and everyday life, due to the increasing level of quantification of human body parameters, behaviour and ordinary practices. Mobility and portability of the Internet connection, the pervasiveness of social media along with the expanding area of apps as proprietary platforms independent from the "mainstream" web, all contribute to personalize and commodify the act of quantification under the big promise to enhance life.

> However, just how much they enhance life is questionable, particularly in light of how constant, if not obsessive, attention to the quantities of life can diminish attention to its qualities or, even worse, reduce these qualities to a set of data points (Mosco 2017, 105).

In this respect, especially health apps can be both an ambiguous, if not controversial pedagogical tool and a new subtle medicalization engine (Maturo et al. 2016). All this adds to the massive and deliberate self-exposure strongly fuelled by digital media and social networks in particular, Facebook and Instagram *in primis*, which have marked the end of intimacy and privacy as pillars of the early modern bourgeois society. The (mass) media and the myth of the mediated center (Couldry 2012), with their emphasis on media celebrity, have been reinforced and amplified by digital media and social networks. On the other hand, the commodification of the individual as customer and consumer through the infrastructures of Big Data Analytics is also designed to advantage big corporations owning much of those infrastructures, namely the Big 5 (Google, Amazon, Facebook, Apple and Microsoft – see Mosco 2017). In fact,

> there is value in the things that are digitized and connected in the Internet of Things, but there is often more to be made from the data the devices generate, the valuable information that makes up the commodified self (Mosco 2017, 106).

Value extracted from and attached to data – a big field named as Big Data Analytics – is a real battlefield for business enterprises (Degli Esposti 2014), but also increases dataveillance, a much older term than datafication, coined by Roger Clark in the '80s (Clark 1988). It refers to mass surveillance through personal data systems used to monitor people's behavior.

What is changed with reference to dataveillance nowadays, is the pervasiveness and literal embodiment of such personal data system, along with the potential of horizontal and reciprocal surveillance based on datafication. In other words, as it happens with mobile communication, surveillance becomes coveillance (Rainie and Wellman 2012), a peer-to-peer phenomenon, more than a top-down process. The way we watch each other goes back to pre-modern ways of life, when the group (clan or tribal) dimension was very strong. But symmetry of control and surveillance is also linked to the concept of "below" and its epistemological consequences when such a symmetry is fully pursued, as in Söderberg's critical review of the "race to the bottom", and Milan's "datafication from below" overview (both in this issue).

### *Pervasivity of Algorithms and Fragility of Machine Learning*

Notwithstanding the size is not the most distinctive characteristic of Big Data, as already said, it is undoubted that the multiplication and increase of the quantity of data and information – often labeled as "data deluge" and "information overload" – represent one of the most evident consequences of digitization, due to its power of homologation. Reducing any piece of information to a binary digit (bit) means to make its (re)production and use easier and easier. At the same time, what has changed is the way such a massive amount is turned into (what is considered to be and validated as) knowledge, which of course is not the same thing as data and information.

> The algorithmic assessment of information, then, represents a particular knowledge logic, one built on specific presumptions about what knowledge is and how one should identify its most relevant components. That we are now turning to algorithms to identify what we need to know is as momentous as having relied on credentialed experts, the scientific method, common sense, or the word of God (Gillespie 2014, 168).

In other words, algorithms are the current compass to orient ourselves in the contemporary ocean of data and information, and especially in the Internet, becoming tools to define and build up public relevance.

Despite their controversial status, algorithms are entitled with objectivity and considered to be impartial, but as any (socio)technical piece of infrastructure they are imbued with negotiations, assumptions and biases, often purified in the public discourse which construct and re-affirms their very relevance. Amongst all algorithms, those devoted to feed Machine Learning predictive processes, show the fragility as well as all the contradictions, "impurities" and heterogeneity of emerging AIs. As STS have widely pointed out, there is nothing such as a neutral or pure technology. Therefore, it is not at all surprising that the various and increasing attempts to build intelligent agents manifest their limits, embedding and reproducing the messy, chaotic and contingent processes of learning and judging. The claim to improving human limits overcoming biases, prejudices and moral dilemmas is far from being reached.

Instead, intensive datafication and machine learning amplify and exacerbate those very limits, embedding them inside emerging sociotechnical infrastructures, as in the case of facial recognition technologies for law enforcement (Vincent 2019).

### *Increasing Data Manipulation and Scarcity of (Data) Literacy*

The "race to the bottom-up" (Söderberg in this issue) and the call for a generalized and extensive epistemology of symmetry have to confront

the persistence and emergence of asymmetries about skills and literacy in treating and making use of data in many contexts and practices.

Possibilities to manipulate and create (fake) data through AI-based technologies, as in the case of Deepfakes videos, pose unprecedented and unexpected ethical challenges, blurring the boundaries between truth and falsity, reality and fiction to extreme levels (Barber 2019).

This type of manipulation and other type of fakes are often oriented to achieve malicious goals, especially in the field of political consensus and electoral propaganda (it is notable that in occasion of the latest European elections Facebook removed over 200 fake accounts in the flood of fake-based far-right propaganda – see Lapowski 2019).

On the other hand, skills and literacy to face with data deluge, information overload and algorithmic editorial processes are neither promoted nor widespread at educational and societal level. An exception in this regard is constituted by the case of Chinese government recently pushing for special programs on Big Data and AI education at school (http://www.chinadaily.com.cn/a/201903/14/WS5c89bda6a3106c65c34ee983.html).

However, it has to be noted that delegation to non-humans widely pointed out by Latour and ANT is going to converge with the specific "autonomy" inscribed into machines able to learn and to be trained (not without biases, as annotated above) and aimed at generating new kinds of expert systems and validated (algorithmic-based) knowledge.

The ambivalence here is in the peculiar way new media technologies enter and sometimes disrupt older and more recent skills, practices and literacy.

Therefore, while new (information and data) literacy is needed, "older" types of literacy seem to be disappearing because of scarce exercise or insufficient education and training. Rates of functional illiteracy in adult population seem to be significant in many Western countries, and beyond (ELINET 2015). The frame is completed by very pessimistic studies like those carried out by the German neuroscientist Manfred Spitzer, which theorize the emergence of a peculiar form of cognitive decay and breakdown due to ICT overuse, called "digital dementia" (Spitzer 2012).

Such a perspective goes far beyond that of an anthropological transformation, assuming digital natives and latest generations growing up digital are losing terrain and domain with reference to brain development and evolution of cognitive and emotional skills.

To sum up, datafication questions the feasibility and adequacy of literacy and education systems, as well as the ethics (to be) embedded in tools, dispositive and infrastructures which mobilize new routines, new ways of doing things in our daily life, as well as new forms of knowing, judging and trusting our human and non-human companions.

## Inside "the Below": Infrastructuring the Everyday Life

Going inside "the below" (of datafication) means to recognize that the very techniques which can result into fake news as a drift of the "below imperative" and the principle of symmetry (Söderberg in this issue) can also constitute an infrastructure to emancipate and mobilize marginal groups. Various social and protest movements have built upon grassroots data epistemologies (Milan in this issue), to the extent of configuring peculiar forms of hybrid digital activism (Treré 2019).

Beside the challenges exposed above, however, datafication and digitization surround at both material and dematerialized level our daily routines, our practices and our sense making of what is real, true and trustable.

Therefore, in order to disentangle ambivalences of datafication from below, and what "below" itself implies and contains, this contribution aims to propose a further STS insight to data and their consequences. Such an insight consists of looking at everyday life as assembled through and shaped by infrastructures from which data, information and knowledge emerge as ecological relations with practices, contexts and boundary objects (Star and Griesemer 1989). In particular, the concept of everyday life as a continuous process of infrastructuring seems to be a consistent tool to frame the ecologies and boundaries of appropriation, care and maintenance of our digitized lives (see Pellegrino 2018). All of us, and not only activists in grassroots movements, are called to act from below, coping with and shaping the infrastructuring of our digitized everyday lives, a process which becomes routinized and black-boxed until breakdowns and doubts make it emerge again and again.

Being similar to ecological, fragile and highly diverse textures (Star and Bowker 2006), day-by-day infrastructuring processes allow to put at the center the relationship between visibility and invisibility, the role of doubt and breakdown, the installed base of knowledge, routines and common sense as well as the practices of care, maintenance and repair where innovation and renewal can emerge (Jackson 2014).

Coping with challenges of datafication means also acting from below *à la* de Certeau, resisting through interstitial spaces, including those of voluntary on line dis-connection and media refusal (Kania-Ludholm 2018). Deliberate interruption of digital ubiquitous communication can enact different practices of care and repair, as well as alternative sense-making of technoscientific infrastructures from below, where the below is our day-by-day struggling with humans and non-humans.

* * *

# Post-truth: The Epistemological Race to the Bottom-up

*Johan Söderberg*

In this contribution, I will reflect over the rhetorical figure whereby a "bottom" position is opposed to an "above" position, serving as a grid for normative and theoretical orientation in STS interventions. The same binary opposition can alternatively be spoken of as an "outsider" against an "insider", or a "lay person" against an "expert". The last couple of concepts gives a hint about the direction and the relevance of such a figure within the STS context. More examples of interest for the STS field are patients vis-à-vis doctors, as well as users vis-à-vis designers. In spite of the widespread prevalence of this rhetorical figure in the literature, it has not yet been rendered explicit and made into the subject of a sustained reflection. Typically, the binary opposition between the two – above and bottom – is taken as a starting point of the empirical inquiry. We are supposed to know intuitively what actor is on the bottom rung and what actor is on the top rung on the ladder. The lack of clarity about the criteria on which this judgment draws, is a growing liability in the study of science and technology. Every actor that has a message to sell to the public will try to pass it off as coming from the bottom-position, thereby laying claim to the legitimacy that has been invested in that position by society. This is most clearly demonstrated in the phenomenon of astroturfing (McNutt and Boland 2007).

My contention is that the above mentioned rhetorical figure engenders a 'race-to-the-bottom' that the predominant, theoretical and epistemological tenets in STS are ill suited to deal with, because those tenets cannot register cases when politically and/or epistemological weak actors are fronts for more powerful actors. New theories are needed that give guidance to inquiries into what kind of bottom-positions are really at the bottom and what bottom-positions are, on a closer inspection, much higher up in the hierarchy, when factual statements are being made. Lack of clarity in this regard is widespread in the literature, because it is rooted in some widely shared, almost foundational, philosophical and epistemological tenets. It is the deconstruction of actors' truth-claims, during the past forty years, that has brought about a corresponding overinvestment in the claims that actors are now making to be speaking from a margin. The normative significance of deconstructing scientific truth claims rests on the assumption that such assertions are welded by powerful actors in order to extend their epistemological authority over less resourceful actors. Hence, the symmetrical treatment of truth and falsity is generally taken to level the playing-field between more and less established actors (Ashmore 1996).

One explanation for the widespread appeal of this approach could be that it allows for a "have-the-cake-and-eat-it-strategy" within the scholarly community. A symmetrically conducted case study carries a normative load without requiring of the scholar to render his/her political views explicit. Hence, the scholar may honor the academic values of objectivity without giving up on being critical. The drawback being, however, that the position of the bottom acquires a foundational importance in the symmetrical-yet-normative inquiry. The discursive construction is put out of bounds of empirical scrutiny. If we, in accordance with the symmetry principle, exclude the possibility that a propositional statement refers to a corresponding state in the external world, by which we could otherwise have told apart a better from a worse statement, then we need to assign this discriminatory function to some other point of reference instead. There is no way of navigating in a commonly lived world without having some means of weighting conflicting, factual claims against each other. That would be to confine oneself to a state of eremitic isolation. A classic alternative to the correspondence theory of truth is to discriminate among the different claims on the basis of their internal coherence (or lack thereof). The known drawback is that this approach closes in upon itself, providing no leverage to differentiate between statements in relation to the external world.

The rhetorical figure of appealing to the actors' marginalized position in a hierarchical order seemingly resolves this epistemological quagmire, by shifting the debate from the epistemological level to a moral register instead. Now, moving in the moral register, it is possible to assess the validity of statements about the world by referring to the relative marginalization of the actors making those statements. That does not mean that whatever a marginalized actor is uttering is to be taken as true, reasonable and consistent. On the assumption that we have decided in advance to treat all knowledge statements as equally (in)valid, this ought not to be of any concern. It suffices to know that those utterances are not being given the same credulity in society as other statements that are supported by scientific institutions and expertise. This in itself justifies a preferential treatment of the marginalized actor's perspective over other perspectives. Although the point of departure of this argument is an idea about fairness, it can easily be aligned with one well-established notion of scientific objectivity. This interpretation of 'objectivity' puts stress on bringing the greatest number of different perspectives on a question. Hence, it is the very marginality of a perspective that makes it so precious in the efforts to tell the whole story and to give the full picture. In one stream of feminist STS, standpoint epistemology, this is known as "hard objectivity". It is opposed to the skewed forms of objectivity that, although abiding to the strictures of the scientific method, contributes to marginalizing women's perspectives in the sciences, hence rendering the sciences less objective than they otherwise could have been (Harding 1995).

This offers a compelling solution to the dilemma of how to discrimi-

nate between conflicting statements about the world without making assumptions about the truth content of those statements. It is so elegant a solution, in fact, that it exercises a gravitational pull even on theoretical positions in the STS community that are avowedly apolitical, such as in the ANT-and-after-tradition. Although authors in the latter tradition refrain from declaring normative commitments, their selection of problems for study such as, for instance, users (Woolgar 1990), patient groups (Rabeharisoa and Callon 2004), and disabled (Blume et al. 2014), is surprisingly consistent with the cases being studied in overtly political, STS traditions, as is showcased by David Hess' social movement approach to the sciences, or Andrew Feenberg's critical constructivism. The contention is that this outlook is commonly shared in both high church and low church STS schools.

Alas, if scientific validity has been shown to be constructed, then we should expect to find that the bottom-position is just as much of a construction. The emancipatory aspirations, associated with the deconstruction of scientific truth claims, hinge on the most often implicit assumption that constructions of the sort are the work of actors with power, money and prestige. This commonly shared assumption is underpinned by the Nietzschean/Foucauldian formula: "Power equals truth". However, if power can mask itself behind truth-claims, why could it not equally well dress up as being marginal? A more cautious starting point would be to assume, that Power takes whatever gestalt, depending on what kind of claims that society is putting its confidence in for the moment. In the positivist 1950s, it was the authority of the white-coated doctor that convinced the public to keep on smoking cigarettes. Nowadays, it is often better to call on the authenticity of a patient group, when trying to sell the same kind of messages to the public and to regulators. This change of mood, the *Zeitgeist* of our time, goes by the name "post-truth". It calls for a redirection of the deconstructive thrust. As much effort that has been placed into deconstructing actor's truth claims, needs to be put into deconstructing their claims to be speaking from an imagined below-position. One might balk at this proposition for good reasons. First, because of the nihilism that such an endeavor seemingly implies. If claims to victimhood are found to be as much of a construction as truth claims are said to be, then the moral fabric of society melts into thin air. Second, because the appeal to a "below" position was inserted to stabilize a scholarly discourse that was fatally undermined when the weapons of critique took aim at science, knowledge, and rationality, that is to say, when critique turned on itself.

This dilemma, although not entirely new, has been put in a sharper relief by the outburst of post-truth. As is known, the symmetry principle lays down that actors must be taken on their words when they claim to be the equal contenders of scientific claim-makers. Not to do so would be the same as assisting in the marginalizing practices of mainstream, scientific discourse. Differently put, the symmetry principle gives no leverage

for distinguishing between the benevolent outsiders (sheep farmers, indigenous people and disabled) and the deplorable ones (anti-vaccination campaigners, global warming deniers and intelligent design-proponents). Certainly, scholars have been perfectly capable of making that distinction anyway, but the criteria for passing those judgements were through-and-through intuitive. Until recently, nobody noticed it because the same intuitions were shared by everyone in the homogeneous, academic community. There was shared and wide agreement upon which outsiders were the good ones and which were the bad ones. The breaking apart of this consensus is part and parcel of post-truth. Hence the need for clarifying the criteria by which actors are claiming to be on the bottom rung on the ladder. It must be possible to assess those claims, asymmetrically, so that fake claimants (for instance, white supremacists being excluded from mainstream media coverage, or corporate sponsored climate change deniers being excluded from contributing to IPCC-reports) can be told apart from real ones (indigenous people being cornered out by a mining company, etc.).The criteria by which "fake" and "real" claimants can be distinguished in the above scenario, are the same principles whereby "false" is separated from "true". In order to determine whether or not an actor is actually speaking from that bottom-rung on the ladder, that he/she is laying claim to, the possibility of making references to factual states in the world is indispensable. The attempt to take foothold in a moral register, instead of an epistemological one, whereby the scholar can pass asymmetrical judgements on factual statements without violating the symmetry principle, has proven to be a dead end. It merely pushes the external referent one step back in the argumentative chain. Perhaps the referent has now been put out of sight from the analyst, but that just means that he/she presupposes a correspondence between his/her discourse and the world without accounting for it (Marres 2018; Hoffman 2018). The only move forward that is intellectually consistent is to abstain from making moral distinctions between self-appointed outsiders' statements, in lieu of making epistemological distinctions of those same statements. Differently put, the whole "basket of deplorables" must be given their full hearing. Steve Fuller (2017) is alone in "walking the talk". We should be grateful towards him for having clarified the price that is to be paid for adopting a through-and-through symmetrical stance on truth. That no-one else in the STS community seems to be willing to follow in his footsteps is highly significant.

## Conclusion

With post-truth has come the belated insight that the democratic promises that have hereto been associated with the levelling of all truth claims to a single, rhizomatic plane are bogus. Everyone from Latour (1993b)[1] to

Fuller (2019) are banking on this promise of the bottom-up, in order to denounce the arrogance and paternalism of the "critical critics", those who think they know better than ordinary folk. This is what I elect to call an "epistemological race to the bottom-up". What is typically understood by the expression "race to the bottom" is something quite different: a global, neoliberal order where nation-states are constrained to lower their welfare expenditures below that of their competitors on the world market, with the aggregated result of a world-wide reduction of welfare standards. I play on this expression to make the same point in relation to epistemology. When sociologists are being exhorted to give up on their theoretical pretences, in place of which they are asked to "follow the actors", especially those actors who are the least resourceful – epistemologically speaking, then this amounts to a call for contracting the analytical horizon of the social sciences. Astroturfing has brought home a point that an older generation of sociologists of knowledge were more sensitive towards, namely that the epistemologically weak actors are the ones least capable of fending off hegemonic worldviews, the ones most likely, in other words, to be "astroturfed" (Gouldner 1973; Merton 1973). This point has been lost on a whole generation of social scientists who, under the towering influence of Michel Foucault, Michel de Certeau, and others have subscribed to the promises of the bottom-up. Those promises where once forged out of a general disappointment on the left with the Leninist party strategy. The resolute counterpoise to the endless race to the bottom that goes by the name "post-truth", is to revive the old, discredited notion of the party vanguard, and start to figure out what theoretical and epistemological lessons it still holds in store for us.

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## For a Datification from Below

*Stefania Milan*

### The significance of grassroots data epistemologies

Datafication represents a novel, powerful system of knowledge which has altered the conditions under which we make sense of the world and act upon it. It constitutes an unprecedented paradigm shift (see Kitchin 2014), which amplifies the changes brought about by digitalization since the 1960s. With the automation turn, in particular, much emphasis rests

on the role of artificial agents and machine learning in decision-making. The belief that artificial intelligence solutions might know better than, for example, policymakers, is gaining traction also in popular discourse (see Helbing et al. 2017). With state agencies being often unfit for the challenge, or simply late in comparison to the corporate sector, users and citizens seem to have lost ground. The balance of power appears to have tilted for good on the side of large companies and, to a lesser extent, state institutions – the only organizations with the technical and financial capabilities to collect, process, make sense, and leverage ever-larger magnitudes of information. Meanwhile, however, individuals and groups increasingly engage with data and data infrastructure, fashioning new ways of being citizens in the datafied society (see also Hintz et al. 2018).

How does 'datafication from below' looks like? How can data generate citizenship and spur civic engagement? Building on a four-year sociological analysis of how datafication alters democratic practices of participation, this essay elaborates on the possibilities and conditions of a 'datafication from below' that can put citizens back into the game – both as individuals and collective agents. In the age of surveillance capitalism (Zuboff 2019), 'big data' have transformed the ways in which truth claims are made. Quantification, for one, have taken central stage, foregrounding new regimes of measurement (Espeland and Stevens 2008). It is often presented as a qualitatively superior, infallible way of knowing, which results in a push towards an objectification of the social world. But not only machines learn through 'big data'. Humans do as well, as we are increasingly exposed to narratives and ways of learning and understanding typical of quantification – regardless of how 'big' the data in question is. 'Living with data' (Kennedy 2018) and the emerging ways of knowing associated with it are so entrenched in the fabric of daily life to deeply influence our ways of making sense of interpersonal and spatial interactions – and, paradoxically, of social change as well. It is the emergence of grassroots data epistemologies (Milan and van der Velden 2016) and novel 'data worlds' (Gray 2018). Let us look at some examples. Quantification is progressively entering the repertoire of social movements across the globe. For example, the #NiUnaMenos (in English, not one [woman] less) mobilization in Argentina, a country ridden by high rates of gender violence, embarked in the creation of the national index of sexist violence, a database 'from below' documenting the assassinations of women in the country, in view of putting the issue on the public debate (Chenou and Cepeda-Másmela 2019). Black Lives Matter, mobilizing against systemic racism towards black people in the United States, has harbored 'Data for Black Lives', a group of activists, organizers and scientists producing data on, amongst others, racist violence and police brutality. They see "data as protest. Data as accountability. Data as collective action" and are committed to "using data science to create concrete and measurable change in the lives of Black people" (Data for Black Lives, n.d.). The Argentinian national index of sexist violence and the activities of Data for

Black Lives are instances of "counter-data action through community-collected data", serving the purpose of "provid[ing activists with] evidence" for "claims and experience (…) which in turn they could marshal as support for their concerted efforts" (Meng and DiSalvo 2018, 1; see also Currie et al. 2016).

To be sure, similar techniques of grassroots production of statistical or numerical evidence have appeared earlier in the social movements' repertoire, although for a long while they represented merely a tiny and somewhat hidden minority in the social movement ecology. 'Stat-activists', for example, used statistics towards 'denouncing a certain state of reality' in view of changing it (Bruno et al. 2014, 198), such as the post-1968 protests against unjust imprisonment practices in France (Salle 2014).

If counting is not entirely new amongst progressive militants, and it has historically allowed disempowered communities to 'count' in society and make their issues and demands visible (e.g., Gabrys et al. 2016; Rajão and Jarke 2018), the hype around the possibilities of 'big data' has revamped existing imaginaries around quantification and measurement. It has popularized – and eased, thanks to a wealth of accessible software tools – data-based interventions and campaigns. These have adopted a variety of tactics, such as crowdsourcing, mapping and data visualization (e.g., Meier 2015; Gutierrez 2018; Tactical Tech Collective 2013), and exploited different devices and platforms including citizen-built and citizen-operated sensors (see e.g., Marres 2011). Occasionally, they have questioned the mainstream narratives associated with data, producing their own original imaginaries (Lehtiniemi and Ruckenstein 2018) or opposing the mainstream imaginaries when these reproduced, for instance, colonialism (Ricaurte 2019). All in all, big data epistemologies and narratives, also when re-appropriated by citizens and grassroots groups, have progressively colonized the collective imaginary in a sort of performative and deeply ideological process in which the socio-cultural and political understanding of people is demarcated through their exposure to and practice of material artifacts such as data infrastructure. This should not surprise us: as neoliberal subjects, Beer (2016, 149) argued, we have a "cultural interest in numbers, and a culture that is shaped and populated with numbers". As a consequence, quantification has permeated both the activist and public discourse. A number of popular metaphors associated with datafication and big data (Stark and Hoffman 2019) have supported this process. For example, the phrase "We are the 99 percent", propagated by the Occupy Wall Street mobilization worldwide, is probably the most fortunate movement slogan of the last decades (Rogers 2012). A variety of actors have contributed to this development. The public administration sector, for example, making its data available as open data (see Ruppert 2015), partakes in the creation of empowerment imaginaries of civic engagement related to the role of data in making discourses. But what is of interest here is the process through which data becomes a collective story and, even more so, a story of empowerment and agency.

## Agency in the Age of Datafication

To grasp how social actors can exploit datafication to regain or reclaim agency, we ought to understand what (political) agency consists of and how it evolves under the pressure of novel data imaginaries. Sociologically speaking, agency refers to the process of "making sense of the world so as to act within in" (Couldry 2014, 891). It concerns "intentional, reflexive practice oriented to (political) action" (Couldry 2014, 891), in "domains in which action is both personal and informed" (Feenberg 2011, 1), thus excluding unintentional or routine acts such as breathing or buying a ticket before boarding a train. What's more, agency is not merely an attribute, nor is it given or static. Rather, it is best viewed as a process (Emirbaye and Mische 1988). More specifically, agency is "the temporally constructed engagement by actors of different structural environments – the temporal-relational context of action – which, through the interplay of habit, imagination, and judgement, both reproduces and transforms those structures in interactive responses to the problems posed by changing historical situations" (Emirbaye and Mische 1988, 970). Agency thus incorporates a fundamental temporal dimension: in other words, it both evolves over time, and it embeds and makes sense of various sequential levels. It is rooted in the past, as people continuously activate past patterns to order their universe and sustain identities over time. It is projected towards the future, as social actors engage in the imaginative generation of future trajectories and possibilities. Finally, it unfolds in the present, when individuals exercise their ability to make practical and normative judgements, and act upon them (Emirbaye and Mische 1988).

Is agency then altered by datafication, and how? If we adopt Emirbaye and Mische's definition, we can see how agency is not entirely re-written by the paradigm shift of datafication. It is transformed in at least three ways. Firstly, datafication alters what we may call the 'social epistemology' in which social actors operate, thus touching upon the informed and reflective components of agency. Secondly, it changes how we mediate and interact with each other, affecting the relational nature of agency. Finally, it alters how we experience and make sense of the world around us, modifying thus the situated character of agency. In other words, datafication has the potential to alter what Emirbaye and Mische referred to as 'imagination' and 'judgment'. Given these evolving conditions, how can individuals and groups reclaim their agency in the age of big data?

One way in which individuals and groups can articulate and reclaim political agency today goes under the label of 'data activism'. As I described elsewhere (Milan 2017, 2018), data activism embraces those social mobilizations taking a critical stance towards datafication and mass surveillance. It consists of a variety of sociotechnical practices and tactics

that, through the creative use, appropriation and/or generation of data and software, interrogate the fundamental paradigm shift of datafication. Examples include open data activism (Baack 2015), the creative generation of data for campaigning, through for instance forensic practices promoting a "disobedient gaze" (Pezzani and Heller 2013) or open source intelligence tactics (Deutch and Habal 2018), hacking data for the public good (Schrock 2016), and the development and adoption of counter-surveillance strategies (Gürses et al. 2016). Data activism is important for society today because it identifies and disseminates disruptive ways of making sense of the (social) world and interacting with it, actively counteracting the hyper-positivistic ethos and inevitability surrounding big data. It points to new roles for active citizens and contributes to the revitalization of the state-citizen relation.

We can distinguish at least two forms of data activism, positioned along a continuum. On the one hand, proactive data activism identifies practices of affirmative engagement with data, exemplified in the #NiUnaMenos database of gender violence or the efforts by Data for Black Lives. Proactive data activism takes advantage of both technological and legislative innovation and data. Reactive data activism instead seeks to counter the threats that come along with datafication, most notably mass surveillance and privacy infringements. Practitioners, for instance, try to popularize security tools for human rights defenders, while engaging in advocacy to ameliorate legislation and protect citizens. Although the boundaries between the two types of data activism are flexible and particularly permeable, proactive and reactive instances of data activism tend to embody distinct values and attitudes towards data and datafication, as well as distinct perceptions of, e.g., state institutions. Proactive data activists can be seen as tendentially reformist, as they try to marshal data to ameliorate the output of the state. Reactive data activists, on the contrary, tend to sport a distrust of institutions, seen as complicit in the extractive practices of surveillance capitalism. Yet, the two types are not antithetical: both posit information as a constitutive force in society with a direct influence on social reality (cf. Braman 2009). Interestingly, while traditionally confined within the sub-group of sufficiently tech-savvy political activists, data activism has been steadily expanding its area of influence over the last decade, signalling that the citizenry at large is becoming more aware of the possibilities and challenges harbored by datafication and data infrastructure. But what transforms data into political activism – or data activism, to be more specific?

## Data-logies and the Conditions of Possibility for a Datafication from Below

Where does data meet – and possibly becomes a driver of – political agency? The focus here is not on 'ordinary forms' of engagement with da-

ta by non-expert citizens, nor their experiences of datafication (for a detailed analysis of the "layers of conscious experience" in everyday forms of engagement with data see Kennedy 2018). The analysis instead centers on motivated – although variably skilled – individuals who consciously and deliberately engage in 'intentional, reflexive practice' (Couldry 2014, 891) at the interplay of data and social change.

We turn our attention to the meaning-making activities of individuals and groups approaching data and data infrastructure for social change. 'Meaning work', or the 'interactive process of constructing meaning' (Gamson 1992, xii) performed by social actors at the micro (=individual) or meso (=group) level is at the core of taking action in any kind of movement activity (see also Melucci 1996). However, in the case of data activism, deeply rooted as it is in the sociotechnical practices of first-hand engagement with data and data infrastructure, meaning work is entrenched in the specific materialities of the datafied society – and in the critical technical practices (cf. Agre 1997; Dunbar-Hester 2012) they nurture (that is to say, anything from programming to visualizing data to deciding the privacy settings of a smartphone). The peculiar articulation of meaning work and materialities typical of data activism results in original declinations of political agency, too.

I argue that data activism embraces and articulates radical 'data-logies', surfacing the singular meaning work described above. The neologism takes inspiration from the ancient Greek noun 'logos' (λόγος / λέγω), which means discourse: more broadly, it points to the act of telling (a story), relating (as in establishing relations), and narrating a reality. Data-logies, then, refer to ways of thinking about and making sense of data(fication), with the goal of 'acting on' (Kubitschko 2017; Milan *forthcoming*). They identify the oppositional and/or disruptive logics associated with data and datafication from the bottom up. Analytically, data-logies combine three elements, namely: i) the alternative epistemologies of data activism, with ii) the socio-technical practices of engagement with data – from critical technical practice to ordinary-people forms of engagement with data(fication), with iii) the materialities of datafication – from software to databases to new ways of measurement, categorization and automation. Data-logies emerge when and where the dimensions of the cultural (which included the 'habit' identified above), the moral (as in values subtending to collective action), the symbolic, and the emotional meet the sociotechnical practices of engagement with data. They are simultaneously individual and collective, but it is in their collective dimension that they best fulfil their empowerment promises and contribute to the process of redefinition (and revitalization) of political agency today.

What makes data-logies emerge, evolve, travel across groups and individuals, be re-appropriated and ultimately translated into action? We can identify at least three 'conditions of possibilities' for political agency in the datafied society. The first is critical consciousness. Inspired to the notion of conscientization (*conscientização* in Portuguese), indicating the

process of 'gaining consciousness' as the main outcome of the critical pedagogy proposed by Brazilian educator Paulo Freire (Freire 1968), critical consciousness is the result of an approach to education that enables subjects to become aware of the socio-material conditions of injustice they live in, and empowers them to translate this sense of injustice into transformative action. According to Freire, taking action is a constitutive part of any empowering learning process. Fast-forward to today, fostering a critical consciousness in the age of datafication is about disentangling the challenges individuals face in making sense and living with datafication and surveillance, including risks and opportunities. Understanding who and what hides in the data shadows is a key step towards transforming one's surroundings, exercising 'judgement' (see above) and fostering active citizenship.

The second condition of possibility we can identify has to do with data literacy – or the ability to find and evaluate critical information on data-related processes and risks. Data literacy concerns, for example, how to protect one's privacy on social media, or how to encrypt email communications. If opacity and complexity are integral features of datafication, on account of often obscure industry and state practices and the highly technical nature of most of these dynamics, data literacy opposes the sense of disempowerment that datafication harbors. In particular, it could serve the purpose of 'demystifying' the processes subtending to datafication – from algorithmic personalization to mass surveillance. The specific entanglement of sense-making and the material dimension that characterizes 'acting on' datafication, however, means that data literacy must include some sort of first-person engagement with data and/or corrective measures against surveillance and possibly making one's hands dirty with technical practice – from data analysis to visualization. This demystification can contribute to lifting the veil that surrounds the data hype and the associated narratives, ascribing the critical attitude to datafication to the 'habit' mentioned by Emirbaye and Mische. Last but not least, the exercise of critical imagination emerges as the *conditio sine qua non* for exercising citizenship and political agency in the datafied society. Critical imagination – a twist on the imagination evoked by Emirbaye and Mische – has to do with the ability to imagine alternatives with respects to immaterial risks (e.g., threats to privacy) and technical practice. Unfortunately, despite the numerous efforts of the digital rights vanguard (Aouragh et al. 2015; Daskal 2018), datafication-related issues have not yet fully entered the agenda of contemporary social movements. This brings us back to what Emirbaye and Mische termed the imaginative generation of future trajectories in relation to what people primarily care about: health care, tax, environment preservation. For critical imagination to spread, we need to articulate new, empowering narratives (as opposed to disempowering ones, such as those often adopted by anti-surveillance activists) able to help people to translate present (often frustrating) experiences in (empowering) future possibilities.

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[1] The supposed *khere* of Bruno Latour when he asked the question if "critique has run out of steam" is on a closer reading just a restatement of his old polemic against sociology, repackaged as a self-critique.

# Innocent, Guilty or Reluctant Midwife?
## On the Reciprocal Relevance of STS and Post-truth

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**Abstract**: The rise of post-truth has called into question STS, mostly in the defendant's role. A critique from outside, such as Lee McIntyre's, provides a debatable account of science deconstruction and its appropriation by "right-wing postmodernism". Within STS, post-truth has revamped discussions on the implications of the symmetry principle, or elicited a reiteration of arguments for more inclusive generation of public facts. Steve Fuller stands out as a dissonant, more intriguing voice. He praises post-truth for triggering and expressing an emancipatory thrust against elites and an institutional rearrangement of science, and blames STS for being too shy with its midwifing role. However, he also underestimates the import of ongoing changes. The struggle over truth has shifted to an ontological level, raising doubts on optimistic views. If STS is relevant to post-truth, the vice versa also applies. Post-truth indicates that STS has to equip itself for a socio-technical world ever-more distant from the one in which it has developed.

**Keywords:** post-truth; co-production; proaction; responsible innovation; precipitatory governance.

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## 1. Introduction

The rise of post-truth has thrown STS into the centre of the storm, generally in the defendant's role. In this paper, I outline some ways in which the relationship between post-truth and STS has been accounted for, outside and within STS, highlighting related limits (or what appear to me to be so). The larger space is devoted to Steve Fuller, as the dissonant voice in the choir: he praises rather than blames post-truth, and blames STS for opposite reasons to those advanced by others, namely for being too shy with its midwifing function. His claims about the present and

prospective social role of science are worthy of consideration, though it seems to me he also fails to take full stock of what is going on. In any case, as I argue, the post-truth debate offers STS an opportunity for reflecting on how to proceed in a socio-technical world ever-more distant from the one in which it has developed.

## 2. Post-truth and the Science Deconstruction Controversy

With the election of Donald Trump and the *Oxford English Dictionary*'s proclamation as the word of the year for 2016, post-truth has come to the forefront engendering heated debates, mostly building on the pejorative sense of the definition of the *Dictionary* ("relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief"). As for STS, post-truth has revitalized discussions concerning the legitimacy and implications of social inquiry into the production of scientific knowledge.

The sociology of scientific knowledge (SSK) had questioned (or, better, regarded as irrelevant to its purposes) the epistemic exceptionalism of science, raising for this very reason the problem of its own epistemic status. With the development of lab studies and related methodological perspectives such debate had seemingly settled. Yet, in fact, the topic never went out of sight; it rather changed in focus: from a discussion over the epistemic status of science studies to a debate over the effects of deconstructive approaches on science as an institution and the ensuing social and political consequences. Taking initially the character of an external attack (the "science wars" of the 1990s) and subsequently of a self-critique (Latour 2004), criticisms built to a significant extent on the claim that, more than supporting weaker social groups by exposing the hidden links between scientific authority, economic interests and political powers, science deconstruction may undermine the very possibility of contesting such interests and powers in the name of indisputable factual evidence.

The rise of post-truth has corresponded to a refuelling of these controversies. This time STS is under attack simultaneously from outside and from within. Debates over post-truth address a number of topics, including the impact of traditional and new media on public opinion and the state of health of contemporary democracies. Yet, in most accounts, post-truth seems to consist primarily in an undermining of the role long given to science in public affairs: from the privileged relationship, or elective affinities, between science and democracy theorized by Dewey and Popper to the crucial function assigned to scientific expertise in the policy process, thanks to its ability to "speak truth to power" (Wildavsky 1979). And if science delegitimation is at the centre of the post-truth debate, STS could hardly avoid being called into question.

## 3. Post-truth and the Critique of STS from Outside

As for attacks coming from outside STS, a good example is offered by the philosopher of science Lee McIntyre. He defines post-truth as an "eclipse of truth", in the sense of its growing irrelevance in shaping public opinion and decision-making: a "careless indifference toward what is true"; the replacement of factual evidence with "truthiness" (i.e. truth-feeling); its subordination to political points of view up to denying basic facts, hence challenging "the existence of reality itself" (McIntyre 2018, 9-10). Why is this happening? For McIntyre the main reason is "science denial": the delegitimation of the authority of science occurred in the last decades and the consequent growing possibility of casting doubts over factual evidence, from the health effects of smoke to climate change. And such delegitimation is an offspring of science studies, especially the "strong programme" of SSK, with its claim that "all theories – whether true or false – should be thought of as the product of ideology" (2018, 129). In its turn, SSK is an offspring of post-modernism, with its claim that everything can be treated as a text, open to interpretation, and that knowledge and power are to be regarded as interwoven, constitutive of each other. Postmodernists regarded their move as "emancipatory" from cultural and social hierarchies. What they did not foresee, says McIntyre, was the rise of a "right-wing postmodernism", that is reactionary forces who learned from post-modernists how to undermine unwelcome scientific evidence. Post-truth is an effective application of this lesson.

I find McIntyre's account problematic in various respects. First, he defines post-truth as both *disregard* for truth and *disbelief* in truth, which to me are different standpoints: one is compatible with straightforward realism; the other corresponds to anti-realism, either methodological (one cannot describe things "as they are") or metaphysical (what we define as real depends totally on our minds or conceptual schemata). Moreover, disregard for truth and disbelief in truth are equated to *perspectivism*, which in my view is yet another standpoint: one whereby, so to say, the shape truth takes is affected by the (historical, social, gendered…) point of access to truth. Second, possibly as a result of this conflation of meanings, McIntyre misconstrues both postmodernism and SSK. Neither of the two rules out the possibility of truth claims. Taking for example Foucault (one of the champions of postmodernism, according to McIntyre), his idea of critique (Foucault 2007) is based on a deflated account of truth claims, seen as building on socially and historically positioned perspectives, which however does not mean they consist in mere "assertions of authority" (McIntyre 2018, 126). Nor does the "strong programme" correspond to McIntyre's account. Symmetry is not an epistemic but a methodological claim, concerning how to approach science as a social field where the "truth, success or rationality of a given 'belief' [are irrelevant] in order to set up a social explanation of how it became ascendant

and why adherents continue to hold to it" (Lynch 2017, 595). Third, "right-wing postmodernism" does not necessarily deny or devaluate science; on the contrary, as the tobacco affair and climate change denial show, it may emphasise its relevance by stressing the lack of conclusive evidence in contrarian claims. Again, the problem with McIntyre's account seems that different phenomena are gathered under the umbrella-term of post-truth. One thing is making a case for alternative *interpretations* of facts, as with climate change denial; another is making a case for alternative (relevant) *facts*, as with the controversy over the health impacts of electromagnetic fields (can non-ionizing radiations have relevant effects? Of what sort? And how can we detect such effects?); yet another is making a case for alternatives *to* facts, as with Trump's political style. The alleged novelty and dramatic implications of the latter should however be gauged not so much against a fact-based "good old politics" – which has never properly existed, as politics has always been committed to going "beyond facts" (by prioritizing values against all odds, or by creating new facts through action) – but against the growing emphasis placed on "evidence" over the years, as a not-so-subtle ruse to depoliticize decision-making.

## 4. Post-truth and STS's Internal Debate

In sum, I do not find compelling or particularly well argued a critique of STS such as McIntyre's. What about, then, debates internal to STS? No doubt, the rise of post-truth has created some fuss. One can roughly distinguish three main positions.

First, we have those who, aligning with the Latourian self-critique, basically concur with McIntyre, blaming STS for having, if not exactly caused, at least eased the rise of post-truth. For Collins, Evans and Weiner, for example, "the logic of symmetry, and the democratising of science it spawned, invites exactly the scepticism about experts and other elites that now dominates political debate in the US and elsewhere"; hence "we have to admit that for much of the time the views STS was espousing were consistent with post-truth irrespective of their authors' intentions or their causal impact" (Collins et al. 2017, 581).

Others, such as Sismondo (2017a; 2017b) and Lynch (2017), reject such accusation, out of various considerations: that STS has never supported an "anything goes" approach, showing instead the hard work whereby scientific facts take shape; that the very definition of post-truth – as disconnect between facts and values, opinions, beliefs and emotions and the predominance of the latter, or as plain bullshit, casual dishonesty or demagoguery – has hardly anything to do with the type of work carried out in STS, beginning with how STS questions the obviousness of the very distinction between facts and beliefs or emotions; and that if anything, through its own work, STS helps to account for why "the emer-

gence of a post-truth era might be more possible than most people would imagine" (Sismondo 2017a, 3).

A third position is represented by scholars who are less interested in discussing the putative influence of STS on post-truth than in applying STS insights into the intermingling of truth production with power struggles, in order to analyse post-truth on these terms. Jasanoff and Simmet, for example, see in the emergence of post-truth the expression of "moral panics about the status of knowledge in the public sphere" (2017, 755), in itself not a novelty but in its present configuration the result of fundamental flaws in how truth has been used in policy-making: namely, failure in recognising that "debates about public facts have always also been debates about social meanings" (2017, 752). As STS outlooks on the "co-production" of knowledge and social order have documented, judgements of truth are always premised on judgements of worthiness. Then, against those who believe that "the only imaginable corrective [to post-truth] is to get more science and truth back into the public's uneducated, misled or distracted minds" (2017, 760), Jasanoff and Simmet's recipe sounds pretty much a reiteration of well-known arguments for a "deliberative democratization" of science: namely, to expand accountability for and inclusion in the selection of relevant concerns and generation of related public facts, with "precaution" working as a regulative criterion in between full scientization and full politicization of choices.

I find all three these takes on post-truth somewhat disappointing. On one side, holding STS as responsible (or otherwise) for the rise of post-truth is a question that cannot be resolved by discussing the "right" meaning of the symmetry principle or other features of STS approaches. To properly connect STS and post-truth one would need to delve into how, when, by operation of whom and to what extent STS outlooks have become integral to policy-making and political strategies; that is, to do something similar to the work carried out to account for how neoliberal ideas have spread in the academy and educational systems, the public administration and corporate management (see e.g. O'Malley 2004; Mirowski and Plehwe 2009; Lave et al. 2010). On the other hand, readings such as Jasanoff and Simmet's, perhaps because focused on the peculiarities of a particular political system (the US's), fail to notice that their reply to post-truth (more public deliberation, grounded on the precautionary principle) may and has indeed already become, in the hands of skilled political strategists and communicators, part of the problem. In this sense "right-wing postmodernism" is trickier to tackle than Jasanoff and Simmet seem to assume. Claiming that "endorsing the 'precautionary principle' can be seen as a first-order attempt to distinguish between worthy and unworthy objectives through politics, when facts are not available to resolve a dispute to everyone's satisfaction" (Jasanoff and Simmet 2017, 760) means neglecting that climate change denial, as the "war on terror" in Iraq, builds precisely on an application of precaution[1].

## 5. STS as Reluctant Midwife: Post-truth in Steve Fuller's Brave New World

Against this backdrop, Steve Fuller's contribution to the debate over post-truth – first with short interventions (Fuller 2016; 2017), then with a full-length book (Fuller 2018) – stands out as far more intriguing, deserving for this reason a closer scrutiny. The originality of Fuller's position lies in the fact that he both considers STS as largely responsible for the emergence of post-truth *and* celebrates the latter as a valuable achievement of society.

As the subtitle of his book states ("Knowledge as a power game"), Fuller takes sides with Jasanoff and Simmet on the basic assumption that knowledge cannot be separated from power, or science from politics, and on the role of STS in investigating this. A role, Fuller however stresses, which is more potential than actual, since "STS talks the talk without ever quite walking the walk" (Fuller 2018, 59). STS recoils from post-truth tropes – with special reference to the contingent, manufactured, negotiated status of consensus over interpretations, or what counts as relevant expertise – which it actually "routinized in its own practice, and set loose on the general public"; and it does so "whenever such politically undesirable elements as climate change deniers or creationists appropriate them effectively for their own purposes" (Fuller 2018, 59). For Fuller, STS fails to see how such very appropriation confirms the validity of the tropes, and confounds a political battle with a methodological one. STS, in other words, is a sort of reluctant midwife of post-truth. And if Jasanoff and Simmet consider post-truth as a novel variant of recursive moral panics about public knowledge, Fuller similarly regards it as "a deep feature of at least Western intellectual life" (Fuller 2018, 6). Yet, contrary to the former, he sees its rise to public relevance as a positive signal. Post truth is not an indication of the diseased condition of contemporary society, which reactionary forces turn to their own advantage, but rather of society's good health and dynamism. If elites can keep their position primarily by controlling the rules of the game, then post-truth shows that individuals and groups outside elite circles have "gone meta" (Fuller 2018, 3). They are increasingly able to question established rules, refusing to play accordingly and challenging the status quo that the elites try to preserve. In other words, people outside elites are increasingly able to exert "modal power", that is, "control over what people take to be possible" (Fuller 2018, 28).

To make his point Fuller borrows from Pareto the metaphor of "lions" and "foxes". "Both species are post-truth merchants. The lions treat the status quo's understanding of the past as a reliable basis for moving into the future, whereas the foxes regard the status quo as possessing a corrupt understanding of the past that inhibits movement into a still better future" (Fuller 2018, 2). Lions try to undermine the foxes' claims as

cognitively flawed and emotionally biased, thus failing on both epistemic and moral grounds. Foxes make their way in the cracks opened by flagrant disconfirmations of the lions' claims, which the latter's call for additional research is unable to fix. In this sense, foxes play a crucial role in social progress, exploring counter-inductive evidence and promoting counter-factual imagination.

The case for post-truth, Fuller notes, has already been made by Thomas Kuhn, with his account of truth as dependent on the framework of meaning by which evidence is elicited and assessed, and his portrayal of the "Orwellian" procedure whereby a new paradigm, once established, rewrites the past to make it match the current account of things. That post-truth is receiving so much attention, then, indicates that science – the most important field of play in the struggle over the definition of the actual and the possible – is increasingly consistent with its inherent democratic spirit, in both an epistemic and a social sense (Fuller 2018, 108-109). "The post-truth condition is here to stay, […] mark[ing] a triumph of democracy over elitism" (Fuller 2018, 181). Post-truth fulfils the democratic "right to be wrong" (2018, 151), showing people's growing willingness "to take personal responsibility [for decisions] whatever the consequences" (Fuller 2018, 13).

Fuller opens his discussion by addressing not a scientific but a political controversy, namely Brexit. He accounts for how foxes beat lions at their own game, taking advantage from the latter's own admission that there are problems with Europe and the institutional opening offered by the Parliament's right to call a referendum. Foxes proved to be both "more effective [and] perhaps more democratic and fairer to the people concerned" (Fuller 2018, 15) than their opponents. They replaced the latter's reliance on putatively objective yet actually flawed polling and survey work with profiling techniques based on correlation of a variety of data to reveal preferences, targeting communication to those segments of population whose orientation might switch to the desired direction. This, for Fuller, is no more – indeed arguably less – manipulative than coercing people to express their preferences. It is also in accord with Popper's vision of the open society as a living laboratory.

Uproar has recently been sparked in Italy by an immunologist, Roberto Burioni, who entered the controversy over the extension (to ten) of compulsory simultaneous child vaccinations claiming that "science is not democratic", in the sense that expert and laypeople opinion cannot be put on an equal footing. Fuller's book, then, ideally replies to Burioni, showing that post-truth concerns precisely the role of expertise, as "the most potent non-violent form of power available" (Fuller 2018, 161). Indeed, drawing on plenty of STS research, one can say that the breeding ground of post-truth is not mistrust in *science* but in science and science-based *policies*; not in *scientists* but in officially sanctioned *experts*. The latter are not engaged in a self-contained quest for knowledge, searching for answers to questions they pose to themselves, but in addressing issues

of public relevance, on which no one can claim to possess a comprehensive expertise. As Fuller (2018, 185) notes, in so doing experts tend to apply "scientific consensus" or "normal science" to defend the status quo from which their own rank depends[2].

Fuller (correctly, in my view) remarks that post-truth cannot be equated to anti-science. It rather indicates the acknowledgment that science plays a crucial role in one's life, hence cannot be left entirely in the hands of others. The risk is that in this way chaos prevails over order (Fuller 2018, 181), since "if the field of play in science is opened to all comers, then the rules of the game itself might change to become unrecognizable" (Fuller 2018, 6). Such risk, however, is for Fuller worth running, and indeed can be faced by applying quality control criteria to the production of truth in a reframed institutional arrangement, whereby science leaves its (alleged) ivory tower from which to dispense pearls of wisdom to the laity, to enter the marketplace, while university withdraws from its growing commitment to research to focus on teaching, that is on fulfilling its crucial historical role of breaking down expert hierarchies and elites, giving outsiders the instruments for challenging the status quo and taking new directions.

The above already indicates that the *pars construens* of Fuller's argument is far removed from McIntyre's plea for a return to (imaginary) "good old days" of ordered relations between science, politics and society, as it aims to offer a "project for the post-truth condition" (as the title of a chapter of the book reads). Such project can be schematized in three steps.

First, one has to recognize that there is a problem with the academic outlook on truth searching, which makes it "not obvious that left to their own devices academics will necessary explore, let alone, exploit, all that is knowable to the fullest extent" (Fuller 2018, 69). On one side academics tend to give more relevance to the journey than to the usable results they produce along the way. On the other, as testified by the difficulties of interdisciplinary work, there is a rent-seeking tendency whereby disciplines come to 'own' a field, controlling access to and use of related knowledge, leading to ostensibly large amounts of "undiscovered public knowledge" (Fuller 2018, 70). Outside academy, however, there are "academically trained and interested parties" (Fuller 2018, 7) provided with a "strong sense of success" (Fuller 2018, 81) and committed to unleashing the "Promethean potential" (Fuller 2018, 92) of such knowledge. Fuller calls these "the military-industrial will to knowledge" (Fuller 2018, 81), whose hub is represented by the corporate foundation and whose organizational form coincides with the "mode 2", "post-academic" or "triple-helix" model of knowledge production.

Second, in the post-truth world science is undergoing a sort of Protestant Reformation. It is becoming "Protscience", that is science "taken personally […] as a life-shaping form of knowledge", whereby self and world are rearranged "to enable one to live – or die, as the case may

be – with whatever one happens to believe" (Fuller 2018, 107). Protscience indicates that science is now "the target rather than the agent of secularization", as a result of its "increasing visibility in public affairs, [which] coincid[es] with the ability of people to access the entire storehouse of scientific knowledge from virtually any starting point on the Internet" (Fuller 2018, 108), their increased education and the acknowledgment that science is increasingly relevant to their lives. Thus, "in the age of Protscience, the public continues to fund scientific research [yet] without being bound to the scientists' own interpretation of their findings" (Fuller 2018, 118).

Third, consistently with the above, science has to become, and is actually becoming, "customized". Customized science "consists in idiosyncratic interpretations and appropriations of scientific knowledge that, to varying degrees, contradict the authority of expert scientists" (Fuller 2018, 7), building on the distinction "between what one 'knows' (that is, has learned), and what one 'believes' (that is, acts upon)" (Fuller 2018, 184). As a result, the relation between expert and layperson is reshaped in terms of a deal between manufacturer and retailer "so that, say, a doctor comes to regard a patient in her clinic as more like a client who needs to be sold on a treatment than a machine that needs to be fixed" (Fuller 2018, 110). Science *customers* are not necessarily science *consumers*; they can make any use of the knowledge purchased and "assume responsibility for their science-based decisions" (Fuller 2018, 120).

## 6. Critical Remarks

Fuller's case should be at this point sufficiently clear, and the reader familiar with this author may have recognised themes he has developed elsewhere. His outlook builds on a critique of academy, the subscription to the basic principles of liberalism (with or without the "neo" prefix it depends on how one assesses Fuller's plea for self-entrepreneurship and responsibilization and for the market as the social institution more capable of delivering public goods), and a strong leaning towards Schumpeterian "creative destruction", risk-taking vs. risk-avoidance, and proaction vs. precaution (see e.g. Fuller 2000, 2002, 2010; Fuller and Lipinska 2014). For him, taking responsibility for innovation means that, since "innovation is inevitable" (Fuller 2018, 179), one is to address it in a "precipitatory", rather than anticipatory way, that is, by building on the assumption that "some harm will be done, no matter what course of action is taken, and that the task is to derive the most good from it" (Fuller 2018, 175). The age of post-truth, then, sounds like a call for embracing this challenge and opportunity.

Fuller's take on STS and post-truth is likely to elicit controversy, if not outright dismissal by the "politically correct STS practitioner" (Fuller 2018, 59) he criticizes. However, one has at least to admit that his outlook

is refreshingly different from those largely dominant both outside and within STS, examples of which I discussed above; and that his critique of STS as "talking the talk without making the walk" may be crude but is not ungrounded. Then, some critical remarks may help further reflection on STS and the present and prospective role of science in public affairs. The first four points below address Fuller's argument without taking sides about its normative grounds. A last one, instead, is explicitly normative in character.

First, I think Fuller underestimates the role of power differentials in the struggle over the definition of the actual and the possible. It seems to me that the most effective use of post-truth is made not by the outsiders but by the elites themselves. If we compare, for example, those who contest the scientific (rather than commercial and organizational) grounds of imposing precisely ten (rather than eight or twelve, or whatever) simultaneous vaccinations with those who contest the existence or the anthropogenic origin of climate change, who has been more successful so far? Or, to stay within a same field, let's consider agroecology supporters and Big Pharma. The former make a case for putting on an equal footing farmers' on-field expertise and acquaintance with local conditions and biotechnologists' lab-focused and generalist insights. The latter makes a case for the simultaneous equivalence (to avoid specific regulation) and difference (to get property rights) of genetically modified crops, compared with non-modified varieties. Which of the two has been so far more successful? Isn't Big Pharma's strategy a textbook example of post-truth? The metaphor of the lions and the foxes is too schematic. Lions can be as astute as (or even more than) foxes, and the advent of post-truth indicates that they are increasingly inclined to behave accordingly. Like Jasanoff and Simmet, Fuller underestimates the resources of "right-wing postmodernists", which makes revolting against elite protection of the status quo more complex than showing that the king is naked. The illusion which Fuller seems to incur is that, once "gone meta", the game can be played on an equal footing, whereas it is likely that power differentials will reproduce themselves on such level as well. I can subscribe to the criticisms he addresses to expert gatekeeping and academy rent-seeking, yet the "democratization" of knowledge promoted by post-truth is less at risk of leading to chaos than to subtler forms of domination. To avoid being beaten at their own game, opponents of the ruling power – as the geographer Neil Smith once said (see Smith 2005) – should always be one or more steps ahead of their target: in our case going further meta, or maybe just stepping out of the meta race. In the same vein, the idea of science customization, its transformation into a relationship between sellers and buyers (that is the opposite to Jasanoff and Simmet's deliberative democratization), may lead the latter to feel they are lord of their own life; yet, such feeling is often likely to be more an illusion than an actual reality, as it happens whenever customers are given the impression of purchasing something they really choose and want. The market has its virtues, but it's

good to keep in mind also its vices.

Second, I am not sure that academy's focus on teaching may work today as a means for breaking hierarchies and challenging elite power. Academy's growing commitment to research is the outcome of a long historical process culminated in the affirmation of the "triple-helix" model and neoliberal regulatory interventions, with the ensuing obsession with performance indicators and fund raising, pressure of corporate agendas and use of low-paid precarious academic workers (Lave et al. 2010). Focusing on teaching might be a way for university to get rid of that, yet at the price of becoming a place where students are given textbook notions reflecting science totally produced elsewhere, according to choices which the market is unlikely to rank according to the interests and concerns of the less affluent segments of society.

Third, as in previous work (Fuller and Lipinska 2014), Fuller makes a case for proaction vs. precaution, risk-taking vs. risk-avoidance, or precipitatory vs. anticipatory governance, as if the latter term in each binary were presently the rule. Yet, the success-oriented notion of truth has not only been dominant for long (following the likes of Adorno and Heidegger, one should say it is inbuilt in the DNA of modern science), but has intensified to the point that, as Alfred Nordmann (2017) has stressed, current techno-scientific truth has little to do with traditional scientific truth. The guiding image of the former, Nordmann notes, is of a reality that lies not beneath but beyond detectable phenomena – a vanishing point of perfect control. Truth, in this framework, is no longer a matter of *archetypes* to be theoretically represented, tested, corrected and elaborated further, but of *prototypes* to be made, produced and introduced in the world. Truth, we could therefore say, has today less to do with Descartes, or Popper than with Giambattista Vico's claim that "the true and the made are reciprocal or convertible" (*verum et factum reciprocantur seu convertuntur*); that "the true is precisely what is made" (*verum esse ipsum factum*). Moreover, with the advent of neoliberalism, risk-taking (or hazarding) has become the default or recommended choice at any level, public and private, collective and individual. The uneven distribution of decision power and of the exposition to unwelcome consequences has been managed through the spread of exonerating clauses from liability for "unpredictable" events (what Ulrich Beck has called "organized irresponsibility"), under the assumption, which is a cornerstone of Fuller's standpoint, that innovation is ultimately beneficial to each and every one, including those negatively affected, hence risk-taking is morally sound. In this framework, one can agree with Fuller that there should be a correspondence between decision-taking and consequence-bearing, and the rise of post-truth might indicate a thrust in this direction, but I am less optimistic than he is that a fairer balance is under way. A clue comes from the EU-promoted "responsible innovation" approach, which Fuller reads as consistent with precaution whereas in my view it rather follows his idea of precipitatory governance. Gathering to-

gether social actors (say Big Pharma vs. consumer, farmer or patient associations) to discuss and decide how innovation is to be developed while leaving untouched the respective dramatic differentials in agency means amplifying, rather than reducing, "organized irresponsibility". The narrative of responsible innovation is: "we share the decision, we share the consequences". Yet, if power differentials are left as they are, neither of the two assertions is remotely likely to correspond to reality when the stakes are real (Pellizzoni, in press).

Fourth, Fuller develops his argument on an epistemic level, as testified by his definition of modal power as "control over what can be true or false, which is reflected in intuitions about what is possible, impossible, necessary and contingent" (Fuller 2018, 188), whereas it seems to me that post-truth implies and expresses ontological struggles. Any truth claim, of course, has ontic stakes, as it asserts something about the state of reality, affecting as a consequence the course of the events by rearranging, as Fuller says, the interface of self and the world. However, one thing is to say that reality can be detected and assessed in different ways, and that this produces real consequences; another that reality itself can be led to match one's knowledge claims. Modal power takes in the second case a properly ontological import. Due to space limitations, I will not expand on an argument I have developed elsewhere (Pellizzoni 2016), but suffices it to note that a vast intellectual movement, sometimes called "new materialism" (Coole and Frost 2010), has in recent years built on how, in a number of techno-scientific fields, traditional dualisms (subject/object, mind/body, knowledge/matter, real/virtual, living/non-living, organic/inorganic etc.) get increasingly blurred. This ontological shift, which involves both the natural and the social sciences and humanities, is not without consequences for the vicissitudes of truth, as it has entered influential narratives. When, for example, the champions of the Anthropocene maintain that "nature is us" (Crutzen and Schwägerl 2011) or that we are eventually "liberating ourselves from nature" (Arias-Maldonado 2013; Breakthrough Institute 2015), in the sense that nature can legitimately be reframed as an internal differentiation of society or technology which, as with so-called 'ecosystem services', can be 'let alone' to be put at work as such, they are shifting the post-truth game to a different level: one where there is no residual layer of 'hard' reality to hamper the appropriative thrust of powerful agents. Similarly, when one considers the rise of a form of anticipation, 'pre-emption', which is neither precautionary nor proactionary in that it does not follow a linear conception of time but one where past, present and future remould each other, then the idea of "retroactive truth" (Massumi 2007) takes a meaning that looks quite different from an Orwellian rewriting of history, as the past is not just *reinterpreted* but becomes a place where different things *have happened*, compared with previous accounts (Pellizzoni, in press).[3] From this perspective – as critics of post-truth claim, but for reasons that to my knowledge they do not consider – we may be faced not with an emancipatory thrust, but with

a season of ever-more nightmarish elitism and oppression.

Which leads me to the last point: a normative one, as anticipated, hence not amenable to agreement or disagreement on the same basis as the previous ones. As said, and as made clear also in his previous work, Fuller subscribes to the two interconnected driving principles of modern (techno)science: namely, that truth corresponds to success in transforming the world according to the needs and wants of an ever-expansive human subjectivity, and that for this reason innovation is always ultimately beneficial to all. Yet, to tackle the hardly unlikely scenario hinted above, time has possibly come to seriously reflect on these assumptions, challenging their TINA ("there-is-no-alternative") status. Once admitted that the eventual universal benefit of innovation may not necessarily come true, one might proceed with exploring the possibility of science and technology policies where "choosing not" (to do, make or achieve something doable, makeable or achievable) is really an option. Note that "choosing not" differs from applying precaution, since the latter corresponds to saying "I would like, but am afraid", while the former corresponds to saying "I prefer not", or "I am not interested". Along this way, one might also start wondering whether another science is possible, that is, one whose attitude towards the world, hence whose criteria of success, are of another sort, which is different from pretending, as it happens now, that "alternative" methods and practices have to pull off exactly the same material results as dominant ones (Hacking 2000).

## 7. Conclusion

This paper had no pretence to offer a comprehensive overview of the debate over the relationship between post-truth and STS. What should result, however, is that critiques from outside and from within STS such as those addressed either revamp supposedly settled discussions on the epistemic legitimacy and societal implications of science deconstruction, or reiterate arguments for a more inclusive generation of public facts that fail to take stock of how the situation has evolved. Fuller stands out as a dissonant voice for both his diagnosis (post-truth is not a disease of society but a sign of its good health, and STS should feel proud rather than ashamed of its midwifing role) and therapy (one is to draw from post-truth its full implications concerning the institutional rearrangement and the social role of science). However, he also fails to take full stock of the situation, and namely how the game of truth has shifted from the epistemic to the ontological level, reality being increasingly accounted for as fully conformable to the will to knowledge. In a society characterized by growing inequalities and power differentials, this means that the equation between post-truth, customized science and individual freedom and autonomy is a bit hurried.

From this perspective, post-truth may be regarded as fashionable top-

ic of passing relevance, yet it draws attention to an emergent challenge for STS: how to rethink itself to deal with a world where neither a further "democratization" of science nor a (re)turn to well-guarded cognitive fortresses is likely to guarantee progressive research and political agendas.

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[1] In the former case, the argument is that it is prudent to avoid drastic restrictions to extractive and industrial activities, which would entail giving up major benefits, before getting "sound" scientific evidence of their effects on climate. In the case of "pre-emptive war" in Iraq, the argument works in reverse, according a straightforward understanding of precaution: waiting to get full-blown evidence of weapons and of Saddam Hussein's hostile intentions would entail a dangerous postponement of reaction.

[2] I have elaborated elsewhere on the difference between the role of the scientist and of the expert (Pellizzoni 2012). Though Fuller does not make it explicit, his account of expertise seems to be in accordance with such distinction, as he notes that "expertise should be seen primarily in sociological rather than strictly epistemological terms, [… since] the expert's decision licenses a train of other judgements and actions that attempt to align the world with the decision" (Fuller 2018, 161).

[3] The textbook case remains G.W. Bush's (2002) claim that removing Saddam Hussein was the right thing to do, since in this way Iraq has become what justified such very action.

**A. Bourgoin**

*Les equilibristes. Ethnographie du management [The tightrope walkers. An ethnography of management],* Paris, Presses des Mines, 2015, pp. 308

*by Paolo Rossi*

**E. Caniglia, A. Spreafico and F. Zanettin (eds.)**

*Harvey Sacks: Fare Sociologia [Harvey Sacks. Doing Sociology],* Broni, Altravista, 2017, pp. 168

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*Custodians of the Internet. Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media,* New Haven, Yale University Press, 2018, pp. 296

*by Corinna Canali*

**A. Metzner-Szigeth (ed.)**

*Zukunftsfähige Entwicklung und generative Organisationskulturen. Wie wir Systeme anders wahrnehmen und Veränderung gestalten können, [Sustainable development and generative organisational cultures: How we may perceive systems differently and design change]*, Munich, Oekom, 2018, pp. 256

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*Mobilizing Knowledge in Healthcare. Challenges for Management and Organization,* Oxford, Oxford University Press, 2016, pp. 288

*by Alberto Zanutto and Enrico Maria Piras*

## Alaric Bourgoin

*Les equilibristes. Ethnographie du management [The tightrope walkers. An ethnography of management],* Paris, Presses des Mines, 2015, pp. 308

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I approached this review of *Les Équilibristes* by Alaric Bourgoin, somehow lost in a double translation between the French language used in the book and my Italian and between my Italian and the English used in this review. Something that is well known, and yet, this time such feeling was exacerbated by semantic issues related to one of the core topics tackled by Bourgoin: the idea that the main goal of the job of managing consultants – the profession on which the research is focused – is "value enacting", *mettre en valeur*, in the original French.

Such formulation does not refer to the production of value in economic and financial terms, although this is a relevant dimension of the notion of value. However, Bourgoin does not deal with the definition of the notion of value *per se*, being aware that this could be a sort of impossible mission. Vice-versa, he is interested in understanding how management consultants "enact the value" of their practices.

*Mettre en valeur* – here tentatively translated as "value enacting" – is a way to address, in French, issues related to valuation, an English neologism introduced by John Dewey, which does not have a French corresponding term. Rather than using 'valuation' or 'valorization' (the latter existing in French), Bourgoin has preferred to use *mettre en valeur*, which, in turn, does not have a translation in English. He has chosen this expression in order to stress the active, situated and relational dimension of valuation and, at the same time, to refer to what he calls "*the double tension of the object* at the heart of the value enactment of management consultancy" (p. 141, my translation), namely the fact that both the consultancy service and the consultant need to be transformed in objects of value.

The reference to Dewey's valuation is a clear indication that Bourgoin takes a pragmatist stand, common to many recent sociological approaches to economics, and particularly delved by the ANT derived approach to economics, as developed by Michel Callon, who signs the preface of the book, and by Fabian Muniesa, supervisor of the Ph.D. thesis from which the book is taken, who signs the forewords.

Pointing to the fact that I was lost in such double translation is relevant for framing the main thesis proposed by the book: the work of management consultants revolves around the notion of value in an emergent as well as polymorphic way. The value of the work of management consultants can be depicted as an achievement that emerges in various forms

and has several implications for their stakeholders: clients, consultancy firms, practitioners, scholars, researchers, etc. Therefore, the work of management consultants is both a performative practice that is embedded in heterogeneous organizational settings and a continuous (yet unstable) construction and reproduction of a repertoire of practice across different settings. In other terms, Bourgoin argues that is possible to identify both continuity and discontinuity – as well as improvisation – in the work of management consultants. Discontinuity and improvisation are due to the fact that the value of this work cannot be objectified, since consultants are not experts, who own a specific and codified *savoir* and provide to their customers a uniform and commensurable service. However, their activities are not mere 'ephemeral' performances, built on subjective abilities. In his view, the successful deployment of a number of socio-material practices in heterogeneous organizational settings is the basis for the foundation of the value of the activities of management consultants.

His analysis stems from a very thorough experience as management consultant. Bourgoin worked around two years for a large French consultancy firm. In this period, he simultaneously played two roles: on the one hand, he was employed as a consultant and, on the other, he was a researcher. As such, he had the opportunity to direct follow very complex projects of organizational design and restructuring.

Therefore, the relevance of the study carried out by Bourgoin – described as an auto-ethnography – goes beyond his investment in hours and hours of observation. The point is that his presence in the field was not limited exclusively to an activity of participant observation, since he actually worked as a consultant while conducting his research. As such, his research recalls the methodology of clinically inquiry proposed by Schein (2001), as well as a more 'traditional' action research approach. Being a consultant allowed him both to gain access to deeper strata of data (Coget, 2009) and to 'change the system' (Schein 1995). Bourgoin actually pursued both goals, even if he did not overtly declare to his clients that he was conducting a scientific research study.

It is important to stress another element that highlights the peculiarity and the complexity of his methodological positioning: he was able to explore several organizations, having the possibility of directly analyzing the relationship between consultants and clients in heterogeneous settings. He fruitfully exploited this opportunity and this allowed him to study the dialogical yet dialectical construction of this fundamental interaction. It is thus difficult to file the methodological position of Bourgoin under a specific category. Basically, he did not conducted a proper clinical inquiry, because he did not declare to the clients his engagement in a scientific research. However, his study cannot be considered a mere process of participant observation. It is important to underline that he was aware of his peculiar position and this led him to adopt a reflexive approach (Cunliffe 2003).

The familiarity that Bourgoin has acquired with this field and this profession can be caught in the structure of the book. Chapters are organized in a sequence that outline a sort of dialogue between empirical data and theoretical conceptualizations. In the introduction Bourgoin shortly outlines two streams of the literature developed by organizational researchers on the topic of management consultancy. These streams are presented as juxtaposed poles: a more traditional functionalist approach is confronted with a more recent critical approach. This juxtaposition is somehow a rhetoric construct for demonstrating the existence and the broadness of a space in-between that Bourgoin aims at filling emphasizing the processual and socio-material dimension of consultancy.

This space is explored in the first chapter of the book: an immersive journey in the work of a management consultant. Bourgoin presents an ethnographical account of one of the most important projects he has been involved. His experience is clearly very vivid and this allows him to lead the reader into the multiple layers of complexity of the work of a consultant. Reading this chapter, it is possible to notice the intensity of this job as well as its fragility: consultants are called by their clients to provide solutions, yet they have to legitimate their presence within the organizations they enter. As Bourgoin argues, this ambivalence comes from a persistent contradictory perception of their professional status. On the one hand, consultants may be considered as experts who are providers of a reliable support to organizations. On the other hand, they risk to be perceived as "charlatans" who play persuasive performances mainly oriented to legitimize their role and the effectiveness of their action. His account offers an in-depth analysis of the way consultants interplay between these contradictory interpretations of their work.

In the second chapter, Bourgoin proposes five practices through which processes of value enactment are carried out: a) the commercial formulation of the service; b) the graphical presentation of the diagnosis; c) the report of the activity; d) the situated development of skills; e) the production of the authority of the consultant. These practices are performed under a tension between the necessity of producing value and the necessity of being considered valuable.

Readers of *Tecnoscienza* will find particularly interesting the parts dedicated to two of the practices that clearly emphasize the material dimensions of this profession: the graphical presentation of proposals of changes and the construction of a report for accounting the amount of hours spent for a consultancy. The first practice deals with the use of a specific software (typically Microsoft Powerpoint). Instead of claiming the limits of the use of this technology for organizing and presenting data and information in organizational settings, Bourgoin describes the use of Powerpoint as a complex semiotic process (p. 169).

The production of a report of the time spent for carrying out a consultancy is an even more complex process. This is a practice that is purposed

to 'justify' the value of the work of a consultant. As such, Bourgoin argues that the presentation of a timesheet is a performative practice with several meanings that connects a micro-practice (the daily recording and classification of work hours) with a macro-practice concerning the allocation of resources within an economic transaction between clients and providers of consultancy (p. 197). According to Bourgoin, producing a timesheet conveys rigor to the professional action of the consultant as well as it 'disciplines' the clients. From this point of view, a timesheet appears a boundary object that connects two social words (Star and Griesemer 1989), developing a standardized representation of a commercial agreement. However, in spite of this standardization, the creation of a timesheet is a practice that reproduces the tensions that may emerge when the different ambitions of clients and providers of consultancy activities collide, both at the micro-levels and at the macro-levels of the interaction between those actors.

In the end, I can say I really appreciated reading this book. Firstly, it draws light over a profession that is scarcely considered by social sciences. Secondly, it is a brilliant representation of the socialization into a profession. I particularly appreciated the ability of Bourgoin to zoom across different levels of observation, connecting micro dimensions to broader issues of theorization, as suggested by Nicolini (2009). Overall, as readers of *Tecnoscienza* will also appreciate, the most valuable merit of this book is that, by assuming "a conception of value enacting essentially borrowed from STS" (p. 140, my translation), it stresses the material basis of the construction of a relational professional activity.

However, it is important to report some (very few) critical points. First, the work of Bourgoin presents a slightly weak methodological framework. The narrative construction of the book combines different sketches. While the first chapter is a dense immersion into a large and complex project, the following chapters are based on more and diverse consultancy experiences. This combination reinforces the solidity of analysis proposed by the author, but it provides a sometimes kaleidoscopic representation of the work of consultants. As a consequence, the possibility of identifying a pattern of practices for enacting value to these activities appears more critical and problematic.

This weakness is emphasized by a sort of feeling of 'closure' of the overall analysis. It offers a limited understanding of the diffusion of management consultancy across industries and companies, as well as it does not provide a critical reflection over the scalability of his interpretation in, for instance, smaller organizational settings.

Finally, The richness of Bourgoin's work could provide a valuable contribute to the debate about the tension between process of value enacting and the practice (as well as the procedures) for pricing economic activities. Although this a typical economical question and domain, economic sociologists are striving for providing a more sociologically orient-

ed analysis of this topic (e.g., Uzzi and Lancaster 2004; Beckert 2011). However, his choice of adopting an auto-ethnographical lens impels him to catching the possibility of bridging this analysis with this emergent field of research.

In spite of these comments, I suggest reading *Les Équilibristes*. In my opinion, it is a successful as well as enjoyable book.

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## Enrico Caniglia, Andrea Spreafico and Federico Zanettin (eds.)

*Harvey Sacks. Fare Sociologia,* Broni, Altravista, 2017, pp. 164

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The pioneering research undertaken by Harvey Sacks (1935-1975) is probably best known for laying the foundations of conversation analysis (CA), the transcript-based analysis of mundane conversational interaction. Despite of what its name may still suggest, and what is worth remembering, CA was initially developed with a sociological interest in view, namely to discover and describe the interactive production of social order as a recognizable phenomenon, as that phenomenon happened to be encountered, enacted, and expected by its participants. On the basis of audio recordings of conversations and their repeated inspection, Sacks and his close colleagues, Emanuel Schegloff and Gail Jefferson, described how participants spoke, took turns at talk, identified each other in the process, and manifestly expected (i.e., could be understood to expect) all this of each other. Over the last decades, and with the help of video cameras and transcription programs, this interactive production of social order has been captured, transcribed, and (re-)analyzed as a multifaceted phenomenon *in vivo*, involving verbal, gestural, and material components *in situ*, and thus giving rise to "multi-modal CA" (Deppermann 2013).

*Harvey Sacks. Fare Sociologia*, the book co-edited by Enrico Caniglia, Andrea Spreafico and Federico Zanettin, offers an apt opportunity to revisit the sociological interest of early CA, both for the Italophone reader and the STS scholar. Indeed, the book brings together Italian translations of four important texts by Sacks, each of which is briefly introduced by the co-editors and co-translators. The first part of the book gathers two translations of methodological statements by Sacks (1963, 1984), whilst the second part offers translations of two exemplary studies (1972, 1975). Where does the "sociological interest" of these studies lie? In a pivotal footnote to his first publication on methodology, entitled "Sociological Description," the 28-year old Sacks (1963, 8, n. 8). offered a concise answer:

> Having produced procedural descriptions of the assembly of a suicide classification[,] it may turn out that it is the category and the methodology for applying it that constitutes the interesting sociological problem.

In hindsight, this "informed guess" sounds like an ironic understatement. Indeed, the quoted passage does not only declare the heuristic interest of the methodological subversion (turning Durkheim's reliance on

official statistics and the categories drawn upon for "suicide classification" into a phenomenon), but it also suggests that declaration to be informed by actual descriptions (hinting at the possibility of a broader study of categorization methods). The two studies translated for *Harvey Sacks*, the presently reviewed volume, deliver such descriptions of categorization phenomena. "An initial investigation of the usability of conversational data for doing sociology" (1972) offers a systematic analysis of the category-based self-inquiry which, as it happens, may lead a person to conclude that (s)he has "no one to turn to." In doing so, the study turns the discursive articulation of lay sociological reasoning into an empirical phenomenon, discursive articulation which happens to be organized in terms of identity categories ("family members," "colleagues," "friends," etc.) and their reflexive application (as a speaker, eventually, may self-categorize as a "suicidal person"). The second study included in the volume, "Everyone has to lie" (1975), *inter alia* describes variously observed answers to "how are you" questions and, in particular, how these answers are differently designed depending upon the identity categories implied by speakers (e.g., when addressing each other as "friends"), their sequential sensibilities (e.g., to a negative answer and the extended sequence of explanation that it may entail), and other contextual cues. In offering empirical descriptions of identity categorization at play in conversation (what Sacks coined "membership categorization"), the two studies contribute(d) to investigating the unacknowledged common-sense procedures of sociological discourse. In doing so, the studies deliver upon ethnomethodology's promise to analyze "everyday life as a phenomenon," including professional sociology among other domains of expertise (cf. Zimmerman and Pollner 1970). For the Italophone reader, each of the translated texts, methodological or empirical, is introduced by a careful editor's note, which explains the sociological interest and continuing relevance of each text, as well as of the analytic project that they contribute to (for a related volume, see Caniglia and Spreafico 2011).

What might be the key lesson of early CA, and the discussed translation(s) in particular, for the STS scholar? In one of his lectures, Sacks (1992a) gave a bluntly dismissive answer to this kind of naïvely self-interested question, asked by one of his students (p. 472). Indeed, Sacks' observational approach of identity categories in action and interaction first invites us to describe how they are used, methodically used by whomsoever (including categories such as "the STS scholar", "the sociologist" and/or "the Italophone reader"). His approach affords us not only with an explicit and rigorous methodology, a fact which distinguishes Sacks' reported answer from mere arrogance, but also with subtle reflections on the internal relations between (conversational) phenomena, recordings, data, and analysis *from the very outset* (e.g., Sacks 1963; 1984; 1992a; 1992b). Despite or precisely because of Sacks' plea for a "natural observational science" of social ordering *in situ*, his legacy (see also, Fitz-

gerald and Housley 2015) is perhaps best read as a call for an unapologetically reflexive STS. To have reminded readers of this critical possibility, however, is only one welcome consequence of *Harvey Sacks. Fare Sociologia*, the book carefully co-edited by Enrico Caniglia and his colleagues.

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## Tarleton Gillespie

*Custodians of the Internet. Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media,* New Haven, Yale University Press, 2018, pp. 296

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Not everything posted on social media makes it to the public: some bits of content disappear along the way and who makes them disappear are the platforms themselves. Several times Facebook (but not only), has been under the spotlight for taking down or allowing specific content posted by their users. The latest episode saw Mark Zuckerberg's main platform removing a picture of the Venus of Willendorf, causing the outrage of the Naturhistorische Museum (NHM) of Vienna, where the Venus is physically located. After the episode was brought under public attention, Facebook restored the post and apologised (Dawson 2018).

Ever since they emerged from the fabric of the web 2.0, social media companies have always presented themselves as mere conduits of content, pushing afar every responsibility on what ended up on the spaces they provided. But such a portrait is contradicted by the moderating systems they apply on users.

After the breach opened by the unprecedented studies of Sarah T. Roberts, assistant professor in the UCLA Department of Information Studies, revealing the logics moving complex systems of social media moderation, Tarleton Gillespie in his book *Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions that Shape Social Media*, published by Yale University Press in 2018, engages in an extensive analysis of the platforms' thorough "governance mechanisms", as James Grimmelmann (2015) defined them. Gillespie, principal researcher at Microsoft Research New England and veteran in a research field that links media studies to technology and science studies (*see* Gillespie et al. 2014), tells about moderating systems in a way social media do not, i.e. with transparency. Kept confusing and mostly untold, such systems are enacted with users not even noticing them and totally incapable of accessing them. Through the words of Gillespie, the encounter with moderating mechanisms is finally made accessible and clear, brought to its very essence.

The book follows a rather linear path. Opening with the infamous removal of Nick Ut's photography known as "Napalm Girl" from several accounts of Norwegian citizens and politicians, Gillespie, wisely unfolds throughout his investigation, a detailed explanation of what CCM is, who and what are its main actors and why it is a very problematic mechanism. Revealed across eight chapters, what the author presents is a wide spec-

trum of not only technical and legal features, but most of all, of the reasons why the entire system of online moderation as it is now requires a deep change.

It is emblematic that such book begins recounting a debated removal. Content moderation, technically defined Commercial Content Moderation (CCM), is an untold and invisible system, moving platforms that independently define what is to be made public and what is not based on doubtful logics (Roberts 2016). Hidden behind unaccessible mechanisms, moderation is hard to spot. It reveals itself in the act of taking down user-generated content (UCG), exposing the power enacted by platforms providers. Meaning that, unless users are posting forbidden material, they will hardly even notice CCM at work. But this does not mean that they are not subject to it.

Content moderation is the infrastructure supporting and moulding social media spaces and, as for all infrastructures, its very nature is invisibility. It shows itself "upon breakdown", meaning that it becomes visible when it breaks (Star 1999). As Gillespie explains, despite being a fundamental feature infused in almost the entirety of Western-based social media platforms, it is still unknown to the majority of social media users. As said, using platforms as commanded by their regulating norms, users never encounter moderation at all. And those who do, are the ones that, acting against its commands, get cut out, silenced or, borrowing social media logos, banned.

"Custodians of the Internet" not only engages in an in-depth explanation of the system itself: it points out the various issues it generates. Every infrastructure unfolds specific narrations (Star 1999), and so does moderation. The core action of CCM is to allow or forbid pieces of content. And the judgment shapes what the platform is and what it is not. The list of prohibitions, entirely decided by the private companies owning such platform, changes at will, and empowers tech companies on deciding to set rules along the way.

In the first and second chapters, Gillespie presents evidence of both the inherited non-neutrality of social media platforms and the wider struggles to regulate the Internet that, already in the first 1990s, saw lawmakers and Internet *connoisseurs* facing the dilemma of setting boundaries to online activity without jeopardising users' freedom of expression. The norms regulating UCG are key elements in CCM systems and the third chapter focuses on their role. Presenting as case-studies analyses of snippets taken from guidelines regulating various platforms, Gillespie demonstrates the reasons moving them, how they are constructed and what are the similarities between different platform providers moved by similar motives.

And if so far the problematic aspects were only starting to surface, from the fourth chapter on Gillespie engages in a deeper explanation of the issues surrounding and emerging from attempts at moderating global

scale content. Starting from how both traditional and social media decide to moderate content, the fourth chapter presents forms of moderation and their interconnected issues. Shifting to the fundamental human labour shaping CCM, the fifth chapter analyses how moderators are trained and the working conditions they face. Furthermore, Gillespie questions the fairness of a global scale moderation managed by a small specific group of individuals mainly based in the Silicon Valley area.

Fairness concerns come back when, in the sixth chapter, the author moves from an analysis tackled from the perspective of platforms and their managers to the users' one. Presenting both (in)famous and less known evidence of how social media moderation can become a tool for discrimination, in this section the author wisely confronts female objectification and gender discrimination enforced through moderating systems. Using it to prove the tensions that arise when users confront platforms policies they can hardly appeal. Tensions that expose the total discretion of the platform on what/why/how to regulate. Gillespie uncovers the subjectiveness moving policies using as an example how Facebook, only after a long set of public contestations, tweaked its female nudity rules shifting from an absolute ban of depictions of female breasts to allowing them in restricted specific cases (e.g. breastfeeding).

The final two chapters begin presenting possible solutions to the problem, with the seventh chapter focussing on the question whether it is better to remove content or rather filter and hide it, giving actual examples of both approaches. Note that the book uses Tumblr policy as an example of alternative moderating systems, where adult content was filtered instead of removed altogether. But, by the time it was published, the platform's permissive policy was replaced by a stricter and more conformed one a few months after the enactment of the "Stop Enabling Sex Traffickers Act" (SESTA) and "Allow States and Victims to Fight Online Sex Trafficking Act" (FOSTA) regulation (see Romano 2018).

The last chapter explicitly looks at the nature of tech companies providing social media spaces, questioning the liberties that Western societies have allowed them and including the users' responsibility towards such allowance. The conclusory part of Gillespie's analysis presents detailed possibilities to improve social media starting from how, what and why they should moderate challenging how social media companies have positioned themselves both on- and offline.

Gillespie, through his attentive analysis, warns us of the dangers of such empowerment when he tells that our public culture is, in important ways, shaped and designed by the platforms we access. When the encounter user-technology happens, is the latter that pulls the strings. Users are constantly re-configured and educated, pushed into tight boundaries designed to preserve the perfected version of reality infused in the machine (Woolgar 1991). Whoever fails at conforming, is banned and silenced. And if users are the raw material to be (re)configured, norms are

the mould. Such massively frequented spaces are the tools used to "normatise" humans, through prototypical structures affecting all the non-conformed ones (Browne 2015).

*Custodians of the Internet* explains why we, active or inactive users, should question the promised impartiality of such powerful sites. Moderation, in this investigation, turns out to be not only an optional feature relegated to a few strict social media platforms. It is the central value proposition for all of them. Their very commodity subtly based on and used to shape users' engagement and participation, attracting or repelling investors accordingly.

Moderation is the core feature of online social networks and we should demand for transparency in the system. Designing systems to moderate user-generated material is social media companies' main occupation—only at Facebook, Inc. it involves some 30.000 individuals, half of which are moderators. Furthermore, users should engage in understanding and questioning such systems as they are actively part of it. As *Custodians of the Internet* explains, the "custodians" are not just (underpaid and unprotected) moderators directly or indirectly hired by companies. Anyone accessing and using these spaces is part of the process.

Step-by-step, Gillespie outlines a detailed and intelligent path through mechanisms of CCM gathering information from existing literature and filling the gaps in such pre-existing information enforcing his argument introducing evidence gathering news material, interviews and one-to-one conversations with the individuals shaping and enacting moderation. This is surely a necessary book to read, as the role of social media companies within social constructs becomes more and more controversial and debated. What Gillespie does, is a promising starting point to eventually access a structure that is, so far, kept out of view.

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## Andreas Metzner-Szigeth (ed.)

*Zukunftsfähige Entwicklung und generative Organisationskulturen: – Wie wir Systeme anders wahrnehmen und Veränderung gestalten können, [Sustainable development and generative organisational cultures: How we may perceive systems differently and design change],* Munich, Oekom, 2018, pp. 256

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This edited volume situates itself in the large, if not immense, domain of sustainability research and asks how change might be initiated, especially with respect to artistic interventions in organisational/entrepreneurrial settings. It also focuses on a specific aspect of sustainability, namely creating novel and durable arrangements for addressing the pressing challenges of our times, by dividing the term sustainability into two components: renewability in terms of conserving resources ("Nachhaltigkeit") and future viability in terms of creating enduring solutions ("Zukunftsfähigkeit"). In a nutshell, the book traces the possibilities of artistic interventions in order to create durable organisational changes with respect to sustainability goals such as health, equality or energy. It does so by zooming into this subject area through 15 chapters from 17 contributors. The first part of the book outlines the future viability of current societies on a broader scale. The second part questions in how far "generative organisational cultures" hold promising futures. The third part then collects examples where interventions from art or psychology have initiated dura-

ble changes in organisational cultures.

The narrative that frames the whole volume is that we currently live in a time of great challenges and necessary transformations, under pressing conditions of complexity and uncertainty for which established organisational solutions from management and consulting do not yield the desired results. Therefore, interventions from alternative domains are needed and organisational cultures that may cope with such conditions need to be developed. While this is certainly true, it is also a fairly standard exposition of problem and solution that we find in organisation, management or sustainability studies. The main thrust of the book subsequently lies in the practical application of artistic and other interventions and a managerial perspective on organisational culture. I point this out so prospective readers know what to expect and because the volume does not position itself specifically by drawing on or contributing to STS. Nevertheless, there are several connections that may be made and I will go through some of them while discussing the chapters in more detail.

As the editor of the volume, Andreas Metzner-Szigeth structured the book through a series of iterations that guide the reading of the book. The first iteration (chapter 1) figures as the introduction to the entire volume by sketching out how sustainable developments, generative organisational cultures and artistic interventions come together in the grand challenges and transformations of our time. According to Metzner-Szigeth, a key element to accomplish this task is to switch from reflective thinking to experimental action. This insight sits well with STS critiques of rationalistic modes of planning and an emphasis for situated modes of engagement. It also resonates with general pragmatist and praxeological perspectives on the need to focus on practice and practices rather than plans and principles.

The second iteration (chapter 2) unpacks the term sustainable development in order to distinguish the different interpretations it affords. Metzner-Szigeth argues for a move away from a simple understanding of renewable resource conservation towards a more complex issue of creating enduring solutions that are viable for future developments. In short, such an understanding requires a systemic understanding, creative solutions for complex problems, an openness to the unknown, an awareness for change, an orientation to serve life and not profit, the willingness to break up patterns, to change regulative ideas, and to create sensibilities for engaging in conflicts. The three chapters that follow take up this impulse in different ways. Armin Grundwald reflects on the difficulties of providing strategic knowledge for sustainable developments at the intersection of science and society (chapter 3). He points out that this kind of strategic knowledge is necessarily partial, preliminary, and subject to conflicting valuations. The chapter offers a systematic review of the multiple elements of the strategic knowledge for sustainable development and sketches out an integrative framework that acknowledges the narrow lim-

its within which it can be used for managing transformations. He concludes that this constellation provides strategic scientific knowledge only for experimental political action in which the societal and sustainable effects must be continuously monitored and evaluated. The following chapter by Michael Schwarz and Jürgen Howaldt discusses the potential of social innovation for sustainable developments. They emphasise that social innovations are indispensable for sustainable transformations and, similar to Grunwald, highlight the experimental, yet directed nature of social innovations. Unlike processes of undirected social change, social innovations require in depth praxeological social scientific knowledge of social practices to be more successful. Chapter 3 and 4 thus carefully take stock of the problems and promises of scientific knowledge for initiating and maintaining sustainable developments in more or less experimental forms of engagement. The last chapter in this section argues from a different angle. Michael Nippa and Dodo zu Knyphausen-Aufseß lay out the possible contributions form strategic management to sustainable developments. Their focus is on strategic, hence long term, management and adaptable organisational cultures as a combination of intentional and emergent decision processes. They critically engage mainstream economics as being too narrowly focused on profit from a micro perspective, while disregarding far-reaching problems such as climate change. I feel this chapter is somehow misplaced in this section, since it targets the issue of organisational culture in the next section much more than overarching societal issues. Chapters 3 and 4 are suited much better to serve as an exposition to the intricate problems of achieving sustainable societies.

The second part of the book on generative organisational cultures is again headed by an iteration from Andreas Metzner-Szigeth (chapter 6, 3rd iteration). In very brief terms, this section shifts the emphasis from experimental and emergent modes of engagement to questions how organisations might accommodate such changes. It focuses on issues of communication, coordination and cooperation within organisations. In my reading, it is also an attempt to push the concept of "generative organisational cultures" within the academic debate on sustainability as well as in applied domains. It builds on the distinction between pathological, bureaucratic and generative organisational cultures in organisational safety research and emphasises the need for open and flexible interaction within organisations to cope with dynamic environments. In chapter 7, Sonja A. Sackmann thus calls upon the executive personnel to lead the way in creating generative organisational cultures. Interestingly, this call is countered in the following chapter by Thomas Behrends, who argues that organisational cultures are too often conceived in terms of executive management. Rather, culture is ever-present in all parts of an organisation and innovative (or generative) organisational cultures emerge from the interaction of a sensibility for external and internal tensions, a sufficient amount of organisational slack and loosely coupled organisational struc-

tures. Thus, different configurations of organisational cultures may provide innovative or generative potential. Like in the first section, I feel that the last chapter in this section does not follow suit with the previous chapters. Christian Geßner, Verena Timmer, and Axel Kölle pose the question how suitability certifications might affect the development of organisations. They report on a certification standard they themselves developed and which has been applied in over 40 German organisations. However, the question how standardisation relates with generative organisational cultures is barely addressed. Out of the chapters in this section, I find that Thomas Behrends provides the most analytical approach to the relations of organisational cultures and sustainable developments, while the other contributions focus more on implementation and application. Personally, I favour the former, but this is matter of professional interest.

The third part of the book then closes in on concrete examples of initiating organisational change by artistic or psychological interventions. In the fourth iteration (chapter 10), Metzner-Szigeth calls for unconventional interventions as alternatives to established modes of consulting. Especially artistic interventions have the potential to disrupt and stir up organisational routines and to go beyond rationalisation and optimisation. Hildegard Kurt (chapter 11) develops a novel "muse of sustainability" based on the work of Joseph Beuys. It seeks to overcome bureaucratic and hierarchical structures by empowering all employees or team members to contribute to a common endeavour. Ursula Bertram and Werner Preißing (chapter 12) trace the desire of companies to tap into the creative potential of art by referring to a remarkable collaboration between a Swiss pesticide manufacturer and two artists in the design of a fly trap, eventually leading to an award winning product. A different angle is taken by Georg Müller-Christ and Romy Gerhard (chapter 13), who use the psychological concept of system constellation to uncover invisible organisational cultures and to facilitate, for instance, the successful construction of a hotel building or the (less successful) reorganisation of a regional bank. Ariane Berthoin Antal comes back to artistic intervention in chapter 14. She reports on an eight-year research program conducted at the WZB Berlin Social Science Center. Interestingly, she points out that it is not only economic enterprises who may have troubles with artistic interventions, but that academic management studies also have strong reservations against perceiving art as a fruitful intervention for executive management.

The last chapter and fifth iteration by Andreas Metzner-Szigeth closes the volume by revisiting the central arguments and providing some guiding ideas for the future. He situates the book within a larger trend towards more open organisational cultures and sees it as one element in the quest for a sustainable future. His main claim remains the call to re-think established routines of problem solving for being able to address the grand challenges and transformations faced by current societies.

In sum, I have mixed feelings towards this book. It resonates well

with two central concerns of STS, namely the issues of experimentation and cooperation. It also provides interesting insights into the manifold intersections between society, science, art, management studies and the economy. However, it does not relate any of these lines of thought explicitly to STS research, nor did it intend to do so. So STS readers who are interested in similar issues will have to draw their own conclusions. And, at least to my taste, the volume is biased towards an applied design/management/consulting perspective that falls short of a more analytic discussion and wider references to likeminded discourses in STS and beyond. Again, I see that this was not the aim of the book and while I acknowledge the need for such interventions, it is at the same time what limits its potential insights for me.

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**J. Swan, S. Newell and D. Nicolini, (eds.)**
*Mobilizing Knowledge in Healthcare. Challenges for Management and Organization,* Oxford, Oxford University Press, 2016, pp. 288

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The divide between knowing and doing is a central concern in organizational and policymaking debate. In the healthcare sector, where formalized clinical knowledge has become the cornerstone of the Evidence Based Medicine, filling the gap between research evidences and mundane practices is the object of several policy-led initiatives. From the perspective of organizational scholars this gap and the difficulties in addressing is a fascinating matter of concern. The book edited by Swan, Newell and Nicolini does not attempt to provide a conclusive answer to this issue. Rather, editors acknowledge that aiming for a grand unified theory or a recipe of knowledge translation would be pointless. Instead of attempting at describing how knowledge translation *should be done*, the book proposes several empirically-grounded analysis on *how it is done* in a domain where several working practices and knowledge domains intersect and overlap.

The overarching theme of all essays is the rejection of the model of linear transfer of knowledge in favour of its 'mobilization' which requires a shift, to put it with the words of the editors, from "accumulation and transfer of never-ending quantities of new evidence, [to] connections between people, ideas, and practices". The analysis of mobilization requires to be aware of the challenges of the overlapping of organizational, inter-

organizational, professional domains of knowledge and the complexities in mobilizing such knowledge across the boundaries of the various domains of healthcare are nested in each other. In this perspective, knowledge mobilization is not the results of managerial decisions but rather the outcome of the connection of several sites of practices.

The book is organized around four themes/sections: managerial practices of knowledge mobilization; organizational capabilities needed for knowledge mobilization; the networks of professions and practices across which knowledge is mobilized; and how knowledge travels across space and time. While each essay can be read separately, the editors are to be praised for the effort of highlighting the connection among them. Besides the usual general introduction, each section has its how brief introduction which guides the reader into a journey.

A short description of each chapter reveals the richness and breadth of scope of the book.

McGivern and colleagues reflect on how managers that wish to promote knowledge mobilization are influenced by a complex interweaving of norms, interests, cultural habits of the different professional communities. Korica and Nicolini address the issue of which practices the top management puts in place to deal with the uncertainty of knowledge for the decisions they have to adopt proving an ethnographic account of how a top manager of an NHS operating unit promotes knowledge mobilization in a situated context.

The second theme, organizational actions that can support knowledge mobilization, is addressed by Croft and Currie identifying three specific dimensions of this process: the role of systems, the role of socialization and that of coordination. The latter in particular appears as the strategic activity that can improve the mobilization of knowledge in the medical field given the complexity that characterizes this domain. Reay and colleagues discuss the role of the organizational space, considered as the dimension constituted by the relations that convey and change in relation to the knowledge distributed in the network among the subjects and to the organizational learning that follows.

The section about networks of professions and practices is opened by the work of Oborn and colleagues that, through three case studies, investigate the choices made by stakeholders to balance between creating and acquiring new knowledge from diverse partners and forms of knowledge with its exploitation in practice identifying some recurring traits in all cases. Newell and Marabelli describe the results of a longitudinal study developed in Canada aimed at understanding how a network of healthcare facilities set to mobilize the knowledge needed to manage children with complex health needs. D'Andreta and Scarbrough try to deepen these aspects by studying the reality of the National Institute of Health Research, which has a series of centers in Great Britain with branches in different areas of the country (Collaborations for Leadership

in Applied Health Research and Care). Following the contribution of the theory of social networks, they identify the mediation (meeting between different professional groups) and the closure (presence of small groups in which it has been possible to incorporate available knowledge and translate it into health care practices) as the key elements of this dynamic.

The fourth and last theme addressed by the book aims to explore the physical spaces that take a part in the mobilization of knowledge. This last part is introduced by Nicolini and colleagues, discussing the difficulty that innovations often have in propagating in the organizational fields. The accounts from the research field describe how patient safety has been affected by the raising anxiety about the dangers and the reassuring about the appropriateness of the choices adopted. The section ends with the contribution of Robertson and Swan with an exploration of health innovation in the commercial field. This chapter uses a case study that is approached longitudinally to examine how a drug is developed through a complex network work process that draws on specific knowledge mobilization practices.

Drawing mainly from the tradition of practice-based approach, the collection of essays provides a multifaceted perspective at how knowledge is mobilized in healthcare offering a clear illustration of the impossibility to reduce it to a simplistic linear transfer from policymakers or managers down the branches of organizations. Rather, the empirical cases illustrate how different actors have agency and how policies, institutional conditions, organizational forms, capabilities, and situated practices are all part and contribute to shape the complex ecology in which knowledge mobilization occurs.

The richness and variety of points of view offer the readers a perspective whose relevance cannot be limited to healthcare and which can be fruitfully applied to other organizational domains in which knowledge is produced and mobilized. A limit of the book is, in fact, a scant attention for the role of technologies in mobilizing knowledge in healthcare (with the exception for the chapter of Oborn and colleagues) or, maybe, to their role in limiting such mobilization. While exhaustiveness was not the purpose of the book, it is worth noting that leaving technologies and the knowledge embedded out of the picture is problematic. Indeed, Evidence Based Medicine goes hand in hand with the design and adoption of diagnostic and therapeutic technologies (not to mention ICT implemented to foster coordination of different actors across time and space) and such technologies, far from being neutral tools, are inscribed with programs of actions, visions, and preferences dictated by designers, vendors, and policymakers. The analysis of such domains would be important both pragmatically and, most of all, theoretically. It would be interesting to put to the test the overall approach developed in the book extending the ecology of knowledge mobilization to include the technology companies and their products. But this would require a book in its own right.

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## *Essays*



## *Crossing Boundaries*



## *Scenarios*



## *Book Reviews*