Technoculture and its democratization: noise, limits and opportunities of the "labs"

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The problem with techniques is that people love
to hate them and also hate to love them, [...]
so it is extraordinary difficult to get the right distance
with the mass of things they cohabit with.
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Abstract

The culture that emerges from the computational impact, *technoculture*, defines a huge innovation and change movement where the concept of *design* reaches very radical dimensions and consequences. New identities and institutions arise. Among the latter ones, the "Lab", has been used as a fuzzy descriptor of a multitude of actually rather different entities. It also has been identified as a space to accommodate and promote requests for the democratization of the current changes. This popularity of the “lab” requires some clarification, since the very concept of "laboratory" has exploded under the impact of “the digital”. We contrast these new laboratories with earlier forms of the lab organization. We compare them against technological practices and new forms of innovation and research that are specific to technoculture. This allows us to identify problems and shortcomings of these new “labs” with respect to their ability to contribute to the democratization of technoculture. It also helps us identify new research opportunities in the intersection between technology, design and the social sciences.

Keywords: digitization, code, computation, technoculture, democratization, technocapitalism, design, lab, living lab, hacklab, world wide lab, internet.

1. Introduction: from universal digital code to the softwariza of matter

"Everything that can be digitized will be digitized." This bold assertion by Nobel Prize Paul Krugman summarizes a common and popular belief (Krugman, 2005). The impact of *the digital* is perceived as an inescapable imperative. The perception of its universal urgency has invaded each and every area of our day-to-day experience. Krugman’s words, for example, appeared in an article about the consequences of digitization for the content industry. In fact, this is one of the domains where digitization is experienced firsthand by many. It is true that most people realized that digitization had arrived through their changing relationship with the consumption of content. Also, through their new patterns of access to that content (Internet, mobiles), new forms of interpersonal communication and new ways of building social relationships. To a lesser extent, digitization is also identified with a dramatic shift of the role of the audience in the *production* of content (Jenkins

2006). However, when Salvador Giner coined the concept of *Technoculture* (Giner, 1987), he remarked that this digitization was mostly a change in decision-making processes induced by digital technology. In particular, he assimilated digitization to the computational automation of these very same processes.

From the micro-decisions made in the computer rooms of the great financial offices every millisecond (Beunza and Stark, 2004), to simulations used to decide on issues such as climate change or to manage complex logistics chains, many decisions are made not by human actors but by autonomous interconnected computational systems. This is digitization understood not only as the digital representation and communication of information and knowledge, but as the replication of computational processes on many levels and at a large scale. When we say that everything is potentially digitiz-able, we are saying that everything is (binary) code, readable and amenable to transformation by other (binary) code. "Digital" means "programmable", "computational", "algorithmic". Wherever there is a binary digital code, there is the germ of an algorithmic process. That is, everything that is digitized becomes *potentially programmable*, and at the same time, potentially able to synchronize and coordinate itself with other equally programmable actors. Robots already build each other (Freitas, 2004). This assumption of the universality of computation, however, is not limited to the current systems: code is everywhere.

1.1 Computing does not only take place on silicon

Following the logic of total digitization, wherever there is a code, there is an entry point for the logic of computation and its design practices. For instance, when considering living organisms, it is no longer a question of “decoding” their genome. Since matter can be considered as code and code as matter, the latter also has become *programmable* (Ratto, 2010), (Sangüesa, 2009, 2010). The same algorithms that guide 3D laser printers in *FabLabs* (Gershenfeld, 2005) are used to "print" organic matter and build new human organs (Ringeisen, 2010). In a symmetrical move, living matter becomes the substratum of computing processes: living cells are interconnected to act as computers (Regot, 2011), (Bray, 2011). The boldest champions of the technocultural logic envision as very close the moment when we, humans, as digitized information, will be able to change our supports (a new body) and become "immortal" (Kurzweil, 2006). Without discussing the plausibility of this vision or what is hiding behind it, we should recognize this as yet another aspect of the unfolding of technoculture. This technoculture is based on the extremely complex interdependence of code on substrata that go well beyond silicon. These supports are increasingly autonomous and interact with each other and with us.

1.2 The recursivity of design in technoculture

Technoculture has been defined as a very specific *design culture* (Serra, 1992). We tend to think of designing something as the process of creating an object (however complicated or immaterial, as is the case of service design). However, through code, we can design ourselves via other entities that, algorithmically, perform design themselves (and, in that way, design *us*). This is a much more radical concept of design than we perhaps had anticipated. It also goes far beyond the type of design practiced by engineering cultures which are often associated with technoculture. There, the usual separation between designer and his or her design was much clearer. The interchangeability of code for design and designed code complexifies design *ad infinitum* and introduces an unusual reflexivity. The interconnection of multiple artificial agents (e.g. via internet) not only affects the practice of the designer but it also changes another category, that of the *user* and, in general, of social actors. The user cannot be separated from the system itself since agency is not exclusive to the human component. This latter view has already been explored in the social sciences, for example, in the works of Bruno Latour. When, in a reference to the financial system, someone says that "morality is in the machine" (Beunza, 2010) we are reminded of the consequences of this mixture. We cannot stop thinking about the, very real, effects of this advance. The promethean ability and prothean complexity of the new emerging systems challenge current design. Design, in this new cultural context, has to be approached in a “cautious and humble way” (Latour, 2009). In contrast, the program and the effects of digitization are totalizing, to say the least.

1.3 A repeated story

The dominant technocultural discourse, however, presents technology and its new concept of design as "neutral" entities and processes. It is significant that a recent book is entitled "What technology wants" (Kelly, 2010). Other recent texts portray technology as an autonomous entity that follows its own laws of evolution (Arthur, 2009). There is an analogy here with the way that the scientific enterprise has been presented previously, again, as a neutral process. This "neutrality" ignores the social shaping of digital technologies it did in the past with the social shaping of science and previous technologies. It suggests that there is no restraint to their deployment. Since the critiques of science and technology done by Marcuse to those of Habermas, Feenberg and others it is quite clear that technological things do not happen just because or just by being left to

themselves (Pinch, 1989). As in earlier situations, it seems adequate to develop programs for the democratic control of this overflow of technocultural design.

We can take Veak's update to Feenberg's democratizing proposal for science and technology (Veak, 2006) as a guide. It can help us in seeing how a project for the democratic control of digital technology could look like. We should ask ourselves what instruments are being built or could be created to carry it out. We'll contribute here with the experience of designing and studying some of them. In order to be able to perform comparisons against each other we will use categories drawn from Feenberg's and Veak's frameworks for democratization. Also some insights that come from organization theory and the history of organizations.

1.4 Programs and spaces for the democratization of technoculture

Feenberg's framework aims at opening processes for the public discussion of technology. This is in accordance with the program for the recuperation of the public sphere through communication and debate. Kellner (Kellner, 2000) remarked, however, an important shortcoming of this use of the concept of public sphere as a debate space. Digital technologies are, at the same time, *means of communication and means of production*. Indeed, the affordances of digital code include triggering actual processes of physical and symbolic production. They are not just communication tools for discussion. Under technoculture, other limitations of the concept of public sphere as a communication space become evident. They are related to the failure of viewing the public sphere just as an area for communication and debate. Reducing the public sphere to discussion fails to recognize the digital expansion of the "production" dimension well beyond media *contents*. We should acknowledge this and include in any democratizing framework the shift towards the digitization of materials, objects and systems. It would be the coherent thing to do in accordance to the expansion of the field of action of computational design. Also, this seems the correct thing to do given the multiple recursive interconnections among various levels and systems. More than the argumentative dimension, it may also be necessary to explore how technoculture shapes the ability to participate through collaborative activities of *shared digital design and production*.

In most proposals for the democratization of science and technology, democratization is equated to participation in decision making processes. In digital design cultures, this ability is obtained through the recognition of individual merit and competence by and within a production community. In technoculture, therefore, it seems that democratization and participation are linked

with the ability to become a digital, technological, technocultural designer not just someone that is able to communicate and debate without any experience of production. Worse still: one is tempted to say that in technoculture tries to impose on you that you cannot debate if you haven't shown your ability to produce.

Achieving decision-making power by first achieving competence in construction is a process that reminds us of the Open Source model (Raymond, 2001). Indeed, in these communities the capacity to decide is only acquired after showing competence in collective projects. This linking of decision making with practical competence also recalls the craftmanship tradition, i.e., the way in which, painstakingly, the apprentice becomes a master in the craft. Significantly, Sennett connects craftmanship with the practices of software programmers (Sennett, 2009)[2].

Since Feenberg links democratization with participation, the criterion of *increased competence* should help us in comparing the level of participation offered by several initiatives that pursue the democratization of technoculture. Their democratization ability would be akin to their ability in effectively increasing the public agency within or against technoculture. *This agency should perhaps be understood as the ability to implement or oppose digital design critically*. We should remember here how the ability to show autonomy and embark in decision making has been used to define the different possible levels of participation in general. Arnstein argued that this helped trace a progression in the role of any participant in an organization or project. For Arnstein, the minimum level of participation corresponds to education (assimilated to manipulation) and the maximum level to democratic decision making and control (Arnstein, 1969).

In Feenberg's terms, a *subjugated participan*t can expect, at most, to play the role of a learner or of a receiver, while a producer / manufacturer / designer can achieve the status of *strategic participant* and have his or her say in decision making. In this way, however, we have a very hard requirement with regard to the democratization programs of technoculture: one must reach competence in technoculture to be allowed to make decisions, i.e, to attain the highest level of participation. *To increase the number of competent participants, to raise their technocultural critical agency, then, should be the focus and the method of any democratization process related to technoculture*. In this regard, it is revealing that the more radical proposals for technocultural democratization are those that seek a participatory reconstruction of the Internet, which is, arguably, the most important infrastructural base of technoculture. It is also telling that these initiatives insist on affirming that this is the way to improve citizen control on the operation and growth of the Internet itself (Rushkoff 2010, 2011). In any case, actions pursuing the democratization of

technoculture require organizational forms that are commensurate with the goal of increasing the critical agency of the members of a given society. We will focus on two of these organization forms: the network and the "lab".

The form "network" has been hailed as the icon of the postindustrial society of the XXI[st] century (Castells, 1996). In fact, many initiatives for the democratization of technoculture can be identified more or less as self-organizing networks. As an organizational and democratizing form, the network has been studied at large and almost to the point of blurring the concept itself. I want to focus, then, on the other organizational form of the moment: the laboratory, the "lab"[2]. Interestingly enough, many initiatives that pursue the democratization of technoculture have adopted the "lab" as their preferred form of organization. It is not the "factory" or the "artist studio"; it is not "the company" or "the university", it is the "lab". Although the current form of this "lab" seems to sink deep roots in the scientific laboratories of the nineteenth and twentieth centuries, the processes that take place in them have a greater proximity to other forms of the laboratory that have almost nothing to do with science. Among them, we will highlight the *digital technology laboratory* and the *design laboratory*. We'll review each one of these forms trying to ascertain their capacity for democratization.

2. Landscape with ¨labs"

In order to contrast the "labs" of technoculture with other organizational variations of the lab, I will have to refer to four earlier forms of the lab. Three of them are pre-digital and the fourth one appeared with "the" digital. They are not pure forms. Instead, they have to be seen as organizing fields, as sense giving frameworks for those who participate in these labs. They differ in their objectives, working methods and processes of governance (which include decision making and accountability). However, all of them share a common core of processes of systematic work towards the construction of some knowledge that must be validated. This has been often seen as the lab's distinctive mark.

The three pre-digital forms are: the *scientific* laboratory, the *industrial* laboratory and the *design* laboratory. The fourth form is often identified with scientific or industrial laboratories but, in fact, it has different properties and it is at the root of the unfolding of technoculture. Let's call it *the digital technological* laboratory.

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s does not mean that "labs" cannot be organized in networks. See for example the description of this integration in the European project "lab2lab": http://www.labtolab.org/ labtolab ~ / wiki / index.php / Baltan_future_of_the_lab_publication.

2.1 The scientific lab

The scientific laboratory is a regulated space of systematic work focused on science research. It hosts research groups, it rarely is an individual enterprise. Research in these environments is a methodical approach towards obtaining new knowledge. The tasks and processes that take place in them are associated with the scientific method. Typical of it are the refutation of hypotheses and the creation and realization experiments aimed at this goal. A laboratory, then, works to establish a set of facts about a domain of interest and inquiry. Objective facts and scientific truths are always in a provisional state, depending on their eventual refutation.

Large research laboratories were typically associated with national research systems organized as a replication of the German research model of the nineteenth century. Their governance hold them ultimately accountable to the scientific community under the rules of this same community. These labs should respond to the society that gave them direct or indirect support since they were part of public research systems. Needless to say, this description has been deconstructed patiently over the years. The scientific enterprise is developed under the patronage and interests of other actors beyond the public. Scientific laboratories operate under private ownership in large companies, often in military environments or they respond to interests that involve more than one single national state, the LHC begin a recent mega-example. With respect to the knowledge-building processes that occur in a science laboratory, the studies of the everyday reality of the laboratory performed by Latour (Latour, 1986) or Knorr-Cetina (Knorr-Cetina, 1999) exposed the very complex processes of negotiation about the "truth" of scientific facts. This is common both in laboratories and the scientific system in general. nnects with processes of social construction of knowledge that call into question the canonical characterization of the lab and the scientific method itself.

2.2 A contrast: the industrial laboratory

Already in the nineteenth century, the alliance between science and capital put into the map the *industrial* laboratory. Classic examples are the laboratories of BASF in the field of chemistry or Siemens in electrical engineering, both created at similar times. "Applied research" is their trade mark. This brought into life a hierarchy between basic scientific knowledge, and applied

engineering knowledge[3]. It was considered that the industrial laboratory was not able to create basic scientific knowledge. The fact that these labs were oriented towards production and business implied a predominance of economic factors in their decision making processes. In these labs, knowledge is constructed by applying the scientific method but also by exploring and by reflecting on industrial prototypes, a previous step to production. This point is important because it introduces an element of practicality in the process by which knowledge is created in these labs. Efficiency and profit are the criteria for acceptance of the knowledge that is generated here. Of course, this description should be completed with the basic and fundamental contributions to science that have emerged from industrial research laboratories[4].

2.3 From Sweden to California: the design lab

The opening scene of the film "Kitchen Stories" takes place in a large room. There, a table is occupied by men and women who watch with concentrated expressions the evolutions of a woman in front of them. The woman handles a vacuum cleaner. She is wearing a mask connected to an oxygen bag on her back. This contraption allows her to breathe but it also measures the energy of each one of her movements while she manipulates the vacuum cleaner. The scene shows the arrival of a new type of laboratory: the design lab. Observation, in the film, is not addressed to the creation of new scientific knowledge but to the improvement of kitchens.

The improvement and innovation sought by design is, at its minimum, a functional, ergonomic and aesthetic one. The design laboratory, as the same film never stops reminding us, does not exhaust itself in the construction of technical systems such as the industrial lab does. Also it does not reject the use of scientific methods in order to achieve a good design. In the film scientific knowledge about physiology and materials is also very relevant. In addition, in these labs, the knowledge they use comes not only from the "hard" sciences but also from the social sciences as well. The study of human factors and of user interaction, for example, draws knowledge and methods from ethnographic research and psychology. Interaction with human subjects, who at the same time are the recipients of future designs and guinea pigs in "Kitchen Stories" (as in many design laboratories), introduces a very specific new category of participant, the *user*. He or she may

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[3] For a criticism of this division, it is interesting for example, to consult the book by Stokes “Pasteur's Quadrant: Basic Research and Technological Innovation".

[4] In opposition to the view that restrict the knowledge created in industrial labs to “applied research”. A case in point could be information theory that Claude Shannon developed at Bell Labs (an research environment owned by a private, industrial company).

be subjugated as a participant[5]. This is something very well suggested by the image of the masked and observed woman in the first scene of the film, for example. However, this relationship with the user has many more facets, that can get users closer to a more strategic level of participation. For example, if one tracks the socio-technical strand in design back to the Tavistock Institute in England and then connects it with Scandinavian participatory design, one can find richer, more nuanced relationships with the user. In this design tradition, users can have a more active role than just passive sources of information and knowledge. They are not treated as end consumers but as generators of ideas and adjustments in would-be designs. Also they may have some decision making capacity in the final implementation of the designs in which development they have participated. This approach reached new heights with the arrival of *user-centric* and *user-led* design. It is, perhaps, the design consultancy IDEO in California who have most actively promoted these other forms of design as a commercial strategy. In contrast with the Scandinavian participatory design tradition it is not clear whether their users are meant to have a great role in decision making and, thus, attain a high level of participation.

In the design lab, the creation of knowledge makes an extensive use of a mixture of the scientific method and the more general heuristics of *reflective practice* (Schön, 1984). *Prototyping* is also important as a subject of reflection and learning, as a source of new knowledge and as a means of interaction with users participating in the iterative design of the final product. Instrumental in the final validation is the opinion and feedback of the user. Validation also includes functional and aesthetic criteria, together with scientific and market considerations.

2.4 The digital technological laboratory

Between the Second World War and the “Sputnik scare” that shocked the USA sense of predominance in science and technology a newcomer appeared in the "lab" constellation. From the MIT Artificial Intelligence Laboratory (a true cradle of the hacker culture on the other hand), this new organizational form traveled to the West Coast. An example of it could be the very well-known Xerox PARC (Hiltzik, 2000) and other centers in Silicon Valley. Around Licklider, Engelbart and others emerged a way of doing that signaled the autonomization of some forms of knowledge creation from the realms of science or industry or design. This marked the start of new forms of knowledge creation that become typical of digital technology and its associated culture. These

[5] In fact, the plot of the film uses the observer-observed relationship to show that participants may be, if not strategic, surely not "subjugated" at all.

forms originated in but separated from the ones that were traditional in science and industry (Waldrop, 2001) and followed their own way.

The computer had a strange birth, as a mixture of mathematics and electronics under the look of efficiency but at the same time, the practice of its design shared with general design a reflective and exploratory component. It also introduced a high degree of reflexivity: programs were the prototypes of other programs. This is probably where the recursion of design that we have mentioned earlier, typical of the technoculture, appeared for the first time. It is also at this time when one can see points of contact with traditional design and its culture. Let's just compare the words of the famous designer Don Norman "Our knowledge is practical and thoughtful" with the ones of hypermedia founding father Douglas Engelbart: "We learn what we can build and explore what can be done with the tools we build" (Landau et al., 2009). It is through the development of telecommunications and through the new paradigms of interactivity that exploded around personal computing that the role of the user in digital design became increasingly important. Gradually, it is seems very clear, beyond the intuitions of some pioneers, that the real goal of the digital technology lab is to design socio-technical systems. And in this endeavor the "social" is becoming increasingly more important.

The organizational form of this type of lab responds to public and private institutional actors. In any case, it does not respond directly to the citizens. At most, it affects them through the market, as consumers or, through design, as users.

3. Democratizing variations

The previous three types of labs that we have just sketched above share some common points: the systematic construction of knowledge, its validation according to economic and scientific criteria and the cooperation between various groups of actors (designers, scientists, users). The variations in the three types of labs lie most significantly in their processes of knowledge creation, validation and final selection criteria of their products. That is, the means by which a group of relevant actors decide what is finally done and "sent out" to the world. The fourth laboratory, the digital tec  gy laboratory, introduced a mix of scientific and design approaches, both theoretical and practical, under digital plasticity. All these four forms are removed from participation and control by the public, so they don't seem to serve any democratization purpose. In any case, they may work towards this goal by publicizing some results either through typical

research publications or through the products of the lab themselves. But this assumes a passive model for the public, which is not connected with a high level of participation.

For our goals here, we need to track the succesive attempts made at the democratization of the practices that started at digital technology labs, which include the design processes of digital technology. In particular, we are interested in those initiatives that started right from within the technocultural field itself. Between the 60s and 70s there were frequent exhortations to open up to the public both these technologies as well as their associated design, production and decision making processes. The invasive explosion of digitization ever since has made even more pressing and evident the need for opening the new organizational forms of the lab (Raymond, 2001) that we have just presented. In the following we will describe four forms of the "lab" that hail themselves as instruments for the democratization of technoculture. We'll review them in, almost, reverse chronological to their historical appearance. Let's see, then, how the new forms of the lab are related to the democratization of technoculture.

3.1 Living Labs

Living Labs are a form of *lab* focused on the "democratization of innovation" (von Hippel, 2005) rather than of just digital technology or technoculture. However, innovation is becoming more and more dependent on digital processes. Moreover, one of the pioneers of the Living Lab concept, Bill Mitchell (Mitchell, 2003) gave an important role to digital technology in it. "The digital" was important for Mitchell's Living Labs not only as a tool for analyzing the activities of users via sensors and automatic processing of their data but also as a means to enhance user involvement in the development of digital technologies.

Living Labs often operate within a bounded territorial context (typically a city or a region) and are governed by a public-private partnership which involves relevant regional stakeholders. Nowadays Living Labs are an important part in the mainstream innovation policy of the European Union (EU, 2009). The EU has promoted the European Network of Open Living Labs (ENOLL) as it had previously done with a more commercially oriented version of the same lab form[6]. There are about 250 active Living Labs in Europe (a minority of them, however, are located in non-European countries). The academic publications as well as the official literature of the European Union about Living Labs relate them to the concept of *open innovation*, an innovation strategy that comes from the business field, originally formulated by Henry Chesbrough (Chesbrough, 2003). In the "Living

6 See its most recent evolution "Living Labs Global" initiated from "Living Labs Europe": http://www.livinglabs-global.com/

lab" form one can recognize components coming from the digital technology laboratory and from the design lab. The first one is related to the development of technological objects in Living Labs. The second one, to methods for working with users in the same environment.

The concept of a Living Lab, however, has gone through several transformations (Niitamo, 2006) (Pallot, 2009). It evolved from simple "testbeds" where products and systems were tested with users in realist environments and sent to production, into more complex forms of collective interaction that deployed sophisticated infrastructure and processes to capture ideas from users, to analyze the associated data and to advance trends. Dutilleul et al. (Dutilleul, 2010) identify three related meanings for the Living Lab concept:

a) A *physical environment* to perform "live" experimentation on social systems: it corresponds to observational environments where the actions of the public are analyzed.
b) A *process of innovation* and of product development that "involves" users.
c) An *innovation system*.

Regarding the true role played by Living Labs in the democratization of technoculture we could say that, within the scale of participation of Arnstein, they seem to be closer to the bottom of that scale than to its top. To start with, it is not clear whether they promote or not a concept of *agency* related to the ability to perform digital design. The works of Dutilleul and his coauthors also remark that it is impossible to find any representation of citizens in the management structure of the consortium of the European Living Labs, which doesn't seem to indicate a high level of citizen participation as decision making goes. The same authors state explicitly that in most Living Labs, the role of the users is closer to that of *subjugated* participants then to *strategic* ones. This criticism can also be found in other studies (Mensink, 2010). Dutelleil et al. also remark the contrast between the official rhetoric that presents the European Living Labs as instruments of participation and the comments of other active participants in Living Labs who almost portray the advantages of this model only in terms of business benefits. An example of this approach is the one that presents Living Labs as a way in which companies can reduce the risks and costs associated with innovation (Almirall,2009). Also, some authors remark their advantages in terms of competitiveness for the businesses participating in Living Labs (Columbus, 2009). Risk is reduced by first testing innovations conceptually and practically within a Living Lab, which gives a competitive edge to the businesses involved. In addition to the inability of citizens who participate in Living Labs to have any role in goal-setting and decision making, it is not clear, in general, how their contributions are recognized. It is also difficult to find clear examples of how they can share economic returns, if any,

of the products or services developed in the Living Lab where they were participants. This tension is typical of the new porous participation forms that involve some contribution or work from the public (Scholz, 2010). Democratization in this setting seems only to be connected with the fact that Living Labs give an opportunity to users to act as sources of ideas and feedback within the design process, a process that is decided and led by other actors who also benefit economically from it.

3.2 The citizens' lab

A *Citizen's Lab* (Serra, 2010) is an organization whose predecessors can be found, for example, in the French concept of "Maisons de Connaissances" and other early initiatives addressed towards promotion of the digital culture through the facilitation of access and the training of users in the functionalities of different digital tools. The Spanish idea of "Telecentros" (JoCeco, 2010) could also be seen as a predecessor of these type of environments. We can also trace back the citizen's lab idea in the organization of *medialabs* which were focused on digital content creation and their connection with the goal of expanding the culture of new media. Finally, one can also find precursors of this model in the movement of *community networks* that sought citizen empowerment through training in digital technology and its connection with civic activism.

In general, we could say that this is an organization focused on citizen empowerment through learning activities related to digital technology and design. Learning, in order to remain true to the technocultural approach, should take place by processes of shared production, replicating the well-stablished tradition of "learning by doing" that one can trace back to several of the cradles of digital culture. Learning in this setting is, then, eminently practical. Citizens learn how to create and build adaptations of technology that respond better to their needs. This may result in new products and new knowledge about the process of creating these adaptations, an idea that is fully aligned with the practice of design in technoculture. A Citizens' Lab shows some components of the science research laboratory, however, with respect to the study of methods of innovation and of technology development. Also, it could support research on models of collaboration. It shares also some components of the digital technology lab with respect to digital design.

The concept of Citizens' Lab has often been identified with the "Citilab Model" (Sangüesa, 2010, 2010b). As it was designed in its original configuration, Citilab is complex and open (Serra et al., 1998). It has mechanisms for receiving ideas from citizens. Also for turning them into joint projects that could involve other players (public bodies, companies) around the lab itself. These projects would eventually "send out" of the lab the results of what has been learned and developed

inside it. However, the way that projects are “sent out” differs from science, research or design labs. Exploitation of results is meant to be done jointly with businesses that operate in the lab’s environment, or by new startups that might be created by the citizens participating in a project or, last but not least, through other forms of exploitation of the common knowledge created in and around the lab. In this original formulation, each project becomes a learning opportunity, through the knowledge created in the project as well as through knowledge about how to facilitate this type of processes. In the initial model of Citilab each project gathered around itself a certain community of actors who either contributed in its development or learned from it, or did both things simultaneously. The role of the Citizens’ Lab staff is to accompany and facilitate this process of collective learning. In sum, a Citizens’ Lab would be a complex evolutionary system that splits or merges groups of participants and projects and distributes and implements their results in a continuous fashion. It would be a living organism that would let grow around itself production networks, i.e, networks that produce knowledge, services and products. To some extent, it replicates some of the strategies of "bootstrapping" and "scaling up" from Douglas Engelbart's program for collective intelligence (Landau et al., 2009).

In terms of organization, management and governance, the Citizens’ Lab model should incorporate management practices specific to the culture of digital innovation. It also requires practices of intense community participation and open participatory design. This should be made evident, on one hand by a dynamic management and by introducing management practices focused on detecting opportunities between projects and promoting the sharing of the common knowledge generated by them. On the other hand, it should promote shared decision making by the citizens involved as participants in projects. The interaction between these two practices in management (opportunistic planning and facilitation) is known to be not without its tensions.

In fact, if citizens should become able to act in a new technological environment and learn through practice, then either they already have a good perception of the relationship of digital technology with the topics that interest and affect them, or someone in the lab (staff or other) should be very good at listening and translating the claims and ideas of citizens and connect them to technoculture. It is difficult to see how the first ones could increase their agency otherwise.

There are partial examples of these two strategies at play in Citilab. For example, the *SenseTinta* (“Without Ink”) or *SportTic* projects could be seen as examples of the first and second strategies, respectively. In the first project, *SenseTinta*, a group of people without any knowledge of digital technology, become part of a platform for designers of digital communication: a digital

magazine organized around their interests. In *SportTic*, a teenager soccer team is invited to use digital technologies (video capture and internet live broadcasting) and become digital news editors and journalists themselves. In this way, their complaint of their soccer exploits “being invisible” to mainstream media is solved by their own increase in agency in digital media production. In both cases, although there is some training in the processes of digital design and production, we could still see these projects as operating in the communication sphere, that is, in an increase in agency in communication trough new media. In a way, we are closer to the paradigm of democratization as participation in the communication sphere than to participation in the production sphere, that is closer to the technocultural reality. In this regard it is interesting to consider a project where children created an animation TV series using the programming language Scratch: at the same time they developed a narrative by programming it, they learned to communicate and learned to produce code at the same time.

In a similar fashion, the *UrbanLabs* project, tried to transfer these digital design and production skills to specific projects in urbanism, trying to start a trend of change in the way that urban planning and its associated decision making is performed.

In its current configuration Citilab, however, offers no mechanism to connect these new learned skills to the management and decision making process of the lab itself. Decisions about which projects are supported by Citilab do not follow an open process. Instead, they remain closed and reserved to the lab’s appointed management. Moreover, citizens have practically no voice nor vote regarding where the projects are going and how resources are allocated. As for resources, instead of acting under the logics of innovation management, they are managed in a bureaucratical fashion through rigid annual planning, although opportunistically reacting to the different national and European official calls. This is interesting as a way to get resources but can signifiy a severe drift from the purposes and needs of the community around Citilab.

It is interesting to compare some of these dimensions with other already existing "labs" who have a strong civic orientation. For example, Medialab Prado in Madrid (Medialab) has articulated from its beginning very open project management and decision making practices. Medialab Prado sticks to a number of areas of interest but it opens up calls for projects as well as collaborators for each project, sharing leadership and decision making in each project area. At the same time, it has established a clear policy for the management of the commons as well as a joint research programme on the commons themselves.

The citizens' laboratory model is still evolving. The examples that we currently have at hand are relatively few. Depending on the evolution of a lab's environment, these labs oscillate between the four corners of a square that pull them towards organization forms with a lower or higher impact on the increase of technocultural agency for participants. These four corners are:

- *Telecentre*: when the initial emphasis on training of citizens is done from the perspective of the "deficit model" and other learning methods –more horizontal and egalitarian- are abandoned. We use the name "Telecentre" to connect with previous initiatives based on access and training of very basic digital skills, that used a passive model of users instead of seeing them as engaged producers of their own learning. In this organization there is little emphasis on the promotion of digital design skills.
- A *laboratory for experts*: when digital design projects are put in the hands of those who are "already in the know" (companies, *hackers*, research groups) and are not connected with the needs or opportunities that provide clear leadership to users.
- *living lab*: with the shortcomings with respect to democratization that we already have outlined in the corresponding section.
- *Business Incubator*, when the role of the companies within the lab is just to be there to use its resources and infrastructure, creating little or no collaboration with the citizen groups and other users present in the lab.

In any case, the design of citizen laboratories is still a work in progress. Experiences such as Citilab, Medialab Prado[7] or some other ones within the European project "Lab2Lab" are good opportunities for doing research and refine the model. The fact that these institutions work *with* and not just *for* the public is perhaps their defining aspect and where the research should focus on. The organizational research component is very important since the original citizen laboratory model is on the edge of new concepts of networked organization models where porosity between the organization and its environment is greater than usual (Granovetter, 2011).

3.3 The lab of the hacking culture: *hacklabs*

There are other "labs" with a different origin to the previous two ones. Instead of coming into being from the initiative of governments, universities, business or mixed public-private partnerships, these other labs of technoculture emerged from the actions of groups related to the *hacking* culture. Their corresponding lab is the "Hacklab" (also known as "Hackspace" or

[7] About what a Medialab could be, see (Sangüesa, 2011)

“Hackerspace”). Hacklabs (Taylor, 2005) are places of action organized around joint work. There, people with common interests in technology meet to collaborate on their own projects. Hacklabs can be seen as open work labs where resources and knowledge are shared in order to develop projects that are of interest to the group that meets there. Jarkko Moilanen, who has researched on "hacklabs" and "hackerspaces", has shown that one of the main activities that take place there is learning together by "building things together" (Moilanen, 2009). This learning dimension has also been remarked by other studies that define hacklabs as places where "people can learn science and technology outside the confines of work or school" (Farr, 2009). In addition, Raikon (Raikon, 2009) pointed out as crucial the fact that the type of learning that happens in Hacklabs is mostly constructivist and constructionist learning. These are two learning strategies that are seen as "brands" of the design culture associated with technoculture (Cavallo, 2001). In a similar vein to some traditions of design and craftmanship, the strategies of learning that are used in hacklabs are connected to learning by doing and peer learning. Although the peer dimension is important, hacklabs set aside a special role for the experts, to the hackers recognized within the community as “masters”. This reminds us of the master-apprentice relationship in the crafts. Also of the recognition of competence in Open Source (with witch the hacker culture has a strong overlap) and its associated connection with attaining decision making power within the community.

There is some discussion going on in the hacker community about whether these definitions, that refer only to the idyosincratic learning proceses that take place in hacklabs, provide a proper characterization of these spaces. Many of them originally fulfilled a critical and political mission with respect to the democratization of technology (Taylor, 2005). For some, if these dimensions are missing in a hacklab then it is not a “real” hacklab. It seems, however, that the perception of these goals has been diluted through the succesives "waves" of hacklabs (the first one begun in the late 70's and the latest in the last decade) in favour of other characterizations connected just to learning, but to a learning devoid of direct political goals. In this interpretation one could say that the hacklab has been *gentrified* by other users and interests. In fact, one can see in more recent hackerspaces that still present themselves as hacklabs a turn towards the economic exploitation of the knowledge that is created in them, and little else or nothing in terms of activism. For example, in a recent visit to "TechShop" in Mountain View, Silicon Valley, its founder showed us two phones connected directly to the U.S. Patent Office. Any member of this hackerspace could use them to initiate a process to patent a development made at the TechShop. This is a behavior that probably would have been considered at odds with the goals of the more politically-oriented "hacklabs" of the 80s. For an extended discussion of the evolution of the motivations and identities of "hacklabs" and "hackerspaces" consult (Moilanen, 2009).

It is also interesting to compare the initial motivations of hacklabs with other currents such as *makerspaces*. These seem to be, in many cases, more oriented towards individual economic performance of capitalist entrepreneurs typical of, say, Silicon Valley than it previously was the case for hacklabs. These movements are related to the DIY ("Do It Yourself") and the "Makers" movements too (Anderson, 2010), (Doctorow, 2010). The goals of these other variations are not limited to the development of software and physical objects.

Within the fabrication domain one can find organizational variations that are very open and that strive to create a knowledge commons (this could be the case of *Fablabs*, perhaps). They tend to focus on creating a commons of technological practical knowledge. In this way, they indirectly contribute to the democratization of digital technology. For a discussion of the various types of distributed manufacturing labs (*FabLabs*, *100kGarages*, *Makerlabs* etc.) and their relationship with different mechanisms for the sharing of knowledge and results, see (Troxler, 2011). Some also point towards the design and critical appropriation of new media and collective spaces such as the city, see (Ratto, 2010). However, there is a mix of goals and procedures, that sometimes go in the direction of fabrication for economic profit, without other ulterior motives.

The critical and counter-cultural traditions that some hacklabs had adhered to are now perhaps coming up again in a more recent wave of hackspaces. *Biohacklabs* are related to the idea of the programmability of matter. They are focused on biotechnology and genetics. Some would associate them with *biopunk* (Wohlsen, 2011). A similar wave in terms of political action comes from other initiatives supporting the feminist critique of digital technology started by Haraway and her definition of the *cyborg* (Haraway, 1991). Arguably they are much more political in their goals than current digital (software and electronics) hacklabs.

The management and governance models of hacklabs vary very much. They span from an open culture focused on creation of knowledge commons to others that are targeted towards more traditional forms of obtaining economic results, although reached by intense collaboration by peers within the hackspace. The level of participation varies depending on the agency acquired and the weight that the creation of new tecnology has in granting recognition and decision making power to participants. However, there is a general tendency to favour open and participatory governance processes.

3.4 Closing the loop back on Science: the world wide lab

The three types of labs that we have just discussed exist in specific physical spaces which, in some cases, required major investments. Space is one of the resources shared by the people participating in labs. Sometimes, this participation also grants them a role in the management of the corresponding physical space. At the same time, all these labs may have an intense life in virtual space through networks. They use them to collaborate with other spaces. In an interesting twist, the methods and processes of technoculture go back in time and also end up affecting the lab that "started all labs", the scientific laboratory, the root of the whole genealogy that we have been retracing all along. Both scientific research and its privileged space, the scientific laboratory, are being increasingly virtualized. In this process they are exposed to the pressure of the cultures that are typical of the other lab forms.

Bruno Latour summed up this transformation of scientific research through virtual means with the expression "World Wide Lab" (Latour, 2004). There, the work of science, and not only of the so called "hard" sciences[8] is not limited to the closed space of the scientific laboratory. Not that in earlier times science always took place within the walls of the lab: "field research" has a long tradition both in the natural and social sciences. "Field data" eventually ended up in the lab to be analyzed. However, the connection of the scientific lab to the outer world is much more direct and widespread in the "world wide lab". This is happening not only in terms of the objects of attention of science but also with respect to its connection with the public.

To start with, the scientific laboratory itself uses the Internet to locate and remotely control its instruments for data collection[9]. On the other hand, and as stressed by Latour, projects on current problems are much larger than the ones that could fit in the limited space of a lab. Global warming is usually one of the most cited examples of such problems. Moreover, experiments with the captured data are done remotely in the simulated environments of supercomputers that, in turn, are becoming less monolithic and more distributed. Online collaboration between multiple, individual labs is another feature of this emerging "World Wide Lab".

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[8] See, for example, FutureICT for new networked configurations for new research projects in social sciences. http://www.futurict.ethz.ch/FuturICT

[9] See the WISEBED project that integrates open and interoperable European networks of sensors: http://www.wisebed.eu/

Interestingly enough, laboratories favour the remote participation of citizens as voluntary lab assistants or as a fellow scientists, through the so-called *Citizen Science* initiatives. For example, by sharing networked personal computers the several thousands of players of the *Foldit!* game (Cooper et al. 2010) not only participate with their play in performing protein-folding calculations but they actually have discovered new strategies to improve protein folding. In the typical scientific tradition, they have published their findings in scientific journals. This reminds us of Bruno Latour writing in "World Wide Lab", "one no longer needs a doctorate to become a researcher." The degree of participation in this case goes well beyond the level of education in Arnstein's participation scale. There is an effective sharing of the knowledge creation process and, more important, this sharing is done *through practice* which is a distinguishing trait of design cultures. The level of decision making that citizens have or can have in these type of initiatives is something still to be clarified, however. One is tempted to affirm that in cases such as *FoldIt!* the professional scientists who created the plaform and invited citizens' participation still have the upper hand as decision-making is concerned. So, citizens still play in the subjugated participant category[10].

Some scientists see value in these participatory processes as a way to return their work to society, beyond the diffusion of the knowledge they have created through "papers" and classical Science Communication programmes. For example, the director of the Science Commons project sees additional value in these initiatives. He values them as a mechanism to spread research and innovation capacities throughout society. For him, it is also a way to put citizens in the position to eventually share the associated decision mechanisms (Willibanks, 2010). Representation, however, remains subject to the oscillations of merit and voice that have already been observed in other initiatives of a similar open and massively collaborative nature.

4. Discussion: noise, limits and opportunities of the current models

We have used the concept of "laboratory" and its variants in order to explore some mechanisms for the democratization of technoculture. Such instruments for democratization can be seen as a means to oppose the overflow of a technodeterministic discourse inextricably linked with advanced capitalism and its power structure. "Labs" take many forms and offer different ways to increase the agency of citizens.

We have shown the importance of *design* in the development of technoculture as well as its new nature. The new design starts from previous forms of labs, most notably the digital technology

[10] In contrast, Latour gives in his article several examples of research decided by the citizens.

research lab. The new design practices reinforce technoculture and viceversa. We have argued that creating practical ways to increase critical agency in digital design could result in an increased level of citizen participation and, consequently, democratization.

We have identified the origins of three types of "labs" of technoculture: the *living lab*, the *citizens' lab* and the *hacklab*. We also have commented on their virtual variation, the *world wide lab*. We connected these new forms with the, earlier, stablished forms of the lab: the scientific, the industrial and the design lab. We tried to show how the arrival of "the digital" altered the definition and organization as well as the nature of the knowledge creation processes taking place in laboratories. We did so by singling out the digital technology research laboratory. This seems to be the one that is specific to technoculture. It also started the acceleration and dominance of technoculture itself.

The classical organization forms of the lab were closed organizations, i.e., organizations removed from public scrutiny and public participation. Their governance is related to the scientific community, to private interests or to the market. At best, they respond to the general public indirectly. Each one of these type of labs, thus, contributes very little to the goal of creating a democratic process to control and share the knowledge created within their walls.

In contrast, the new lab formats show varying degrees of openness, and different levels of citizen participation. Their degree of openness, inclusion and participation can be used as an approximate guide for comparing their democratization potential. The more agency they promote and the more participation in decision making they offer, the greater democratization they can, in principle, create.

From the mixture of mechanisms originated in the democratization of innovation and user-centered design, we have identified *living labs* as environments of low participation. They live in tension between the use of citizens in innovation and the private exploitation of the resulting products.

From the perspective and tradition of civic action, community networks and *medialabs* we could define a *citizens' laboratory* model. It seems to live in constant tension between the replication of the "deficit" and access models, interference from private and government interests and other more participatory forms of empowerment and exploitation of knowledge.

In *hacklabs* we have found autonomous spaces with high levels of participation, empowerment and civic action. However, these spaces are being transformed into “learning through production” environments that are not always oriented towards the creation of a knowledge commons or towards activism. Increasingly and with some exceptions (most notably in the “bio” world) they are moving towards entrepreneurial capitalist initiatives, although based on open models. Hacklabs have been shown to easily replicate elitist practices by remarking the role of those who know against those who don't. Sometimes this has been done by the non-meritocratic use of the very same mechanisms for recognition and decision-making of the Open Source and hacker cultures (O'Mahony, 2007).

Finally we have seen how digital connectivity has induced a virtual variation of all types of labs, most notably the scientific lab. This opened up scientific practice to strategies such as crowdsourcing with its ambigous relationship to exploitation of free labour (Scholz, 2010) and the replication of the hierarchy of knowledge between those who know (scientists) and those who don’t about science (citizens) under the excuse of democratization of scientific practices. In most cases there is participation in work but not in decision making. Latour (2004), however, identified some cases of “World Wide Labs” where citizens were actually setting the agenda for research.

Some aspects of all these developments are blurred by the noise created when their motivations and objectives are communicated. Thus, "democratization of innovation" initiatives are presented as participatory spaces for citizens. In fact, this strategy is connected with business processes, such as Open Innovation, that are not aimed at increasing citizens’ agency at all. If any, agency in these models can be obtained by citizens that gain economic independence after becoming entrepreneurs through business innovation. The official rhetoric about the European Living Labs is especially ambiguous, too. Although there are frequent appeals to the participatory nature of Living Labs, their actual practices result in a limited democratization. A similar comment can be made about some types of citizen’s labs. In both cases there seems to be a lack of citizen participation in decision making, and, consequently, a limited empowerment of citizens. Participation without real access to the shared ownership and exploitation of the knowledge and the products generated by a community puts into question the democratizing effect of these models.

The opportunities are great, though. There is a lot of research to be done. A critical point to be explored is, for example, the notion and role of the "user" from the perspective of democratic critical agency in digital design. In that respect, the *user* -a category shared by design, market and innovation- is changing a lot. The complexity, reflexivity, multiplicity and autonomy of actors that

operate at different levels in the different labs pose serious problems to the traditional methods of design when the *users* are considered. Wilkie (Wilkie, 2010), from a perspective that combines design and ethnography, has remarked, for example, that in complex design processes (specially in digital design) the user and the result of the design process cannot be considered as separate entities. In fact, one creates the other in an evolutionary fashion. Tellingly enough, Wilkie's contribution, "user assemblage", is proposed as an adaptation of Latour's concept of *assemblage*. Other possible research areas to explore are the ones that fall within "metadesign", a field of action where this recursivity of the design and the user is taken as the basis for the design process itself. In metadesign, participation happens *in the process of designing ... the process of design*. In this framework a broad set of actors is involved and, as a result, empowered (Fischer, 2006).

The design that characterizes technoculture is essentially a digital design with social consequences. To connect competence in the design of sociotechnical systems with the democratizing ability of the *labs* seems a natural way to view and strengthen their mission. That is, citizen empowerment should be connected with an increase in the ability to gain criticial agency, with respect to the socio-technical systems of technoculture. This goes well beyond merely training people in techniques such as web design, programming, robotics or new media production. In this sense, it is certainly useful to explore new design methods that are focused on creating critical designers / users / participants of complex sociotechnical systems. "Critical Making " (Ratto, 2005) is an interesting variation of contributions originated in "Critical Design" (Dunne, 2008) and in the ethnography of Critical Design (Barab, 2004). The link between design practices and design education is also a field to explore through the lens of critical democratization. For that, it is worth having in mind some precedents coming from the technocultural attitude (Cavallo, 2000).

Finally, in many of these new institutions some type of commons is created. This may collide with private interests of some actors participating in the very same space of the lab. Such a reality forces us to extend current research on organizational models for open value creation (Troxler, 2010), (Benkler, 2007). We must recognize from the very beginning the co-existence of conflicting models of value creation: state, market, commons (Bauwens, 2005) that are projected on these new lab spaces. There is much research to be done in the corresponding legal, economic, organizational and political aspects. The field is enormous. However, democratizing technoculture is an endeavour that requires special attention. Its relevance in the existing correlation of forces in our society cannot be taken lightly.

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