Bricolage as collaborative exploration: transforming matter, citizens and politics

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Introduction

There is today a range of alternative spaces in which innovation takes place: hackerspaces, fablabs, makerspaces, DIY biology labs. Innovation in these spaces is to be decentralized, distributed, open, and collective, often concerned with wider social and public problems. In this paper, we focus on two such alternative sites: hackathons and biohackerspaces.

Hackathons are short-term marathons where developers, designers, and entrepreneurs work together in order to produce a material response (software or hardware) to a social challenge. Hackathons are hybrid events where hackers meet experts from other fields, social activists from NGOs, entrepreneurs or lay citizens. In a similar way, *biohackers* (also called 'do-it-yourself biologists') try to develop new ways to do and tinker with biology. Bringing together people from various backgrounds, such as science, art, bioinformatics, and amateurs, biohacking aims to democratize and render science more accessible to lay people.

The paper explores the transformations that these spaces and activities afford. First, we will analyze how material and property is transformed. When building alternative 3D-printers, civic mobile applications, PCR machines or microscopes, hackers use, reuse, and transform various kinds of material and data. They use 'creative workarounds' to circumvent established and standardize products.

Second, hackers also aim to transform citizens: from passive users to active contributors; from consumers to producers; from normal citizens to so-called 'sensor-citizens' (Goodchild, 2007). This new citizenship is not necessarily a form of opposition to existing power, but an alternative, trying to complement and fill the gaps of traditional politics and institutional science and technology production by engaging users, local communities and hacker networks. Individual hackers depend on other people, including non-technical experts, on the sharing of information, the circulation of objects, internet platforms, emails, donations, etc. Thus, hackathons and hackerspaces are interesting examples of network-generating ecosystems.

A third transformation concerns politics. Hackers aim to create a new, collective and open economy of technical solutions and applications and render expertise more accessible to citizens. Tackling current social problems such as pollution, resource scarcity, corruption, or urban violence, hackathons aim to produce new, distributed and decentralized forms of citizen participation. Building upon an ideology of Open Source and Open Knowledge, hackathons and hackerspaces aim to transform the politics of intellectual property, knowledge-production processes and institutional boundaries of expertise.

The remainder of this paper is structured as follows: in the next section we look in detail at the emergence and constitution of DIYbio and hackathons. We provide a genealogy of both and discuss them in their wider socio-cultural context. Thereafter, in section two, we examine in detail two projects developed in the two fields respectively. The first project, called *W. Afate*, aims at producing a 3d-printer out of electronic waste in Africa; the second project is called *Amplino*, and aims to provide a cheap and transportable tool for malaria diagnostics.

Hackathons

The term hackathon (from “hack” and “marathon”) first appeared in the open-source community the 4th of June 1999, during an event where coders worked on a cryptographic software. 10 days later this very term was chosen to name a competition in coding on Java language. Since the mid 2000s, hackathons became significantly more widespread and have move beyond the community of developers. A hackathon is a short competition (usually a 48hours-marathon) of programmers engaged in the coding of software applications, often responding to wider social or political problems. The form of the event being largely ritualized, using elaborated and standardized scenarios, we can distinguish three big organizational patterns that require different kinds of efforts from organizers and participating teams. We can call a hackathon “*issue-oriented*”, when participants have to deal with a particular challenge or a list of challenges proposed by organizers or problem owners. A *tech-oriented* hackathon supposes the development for a particular operational system, for example, Android-only or iOS-only hackathons, or usage of particular languages, for example, Html5. And finally, during *data-oriented* hackathons the teams have to use one or several datasets proposed by the organizers.

The entrepreneurs and venture capitalists found in this form of event see a potential for finding new ideas for business and development of existing companies. Governmental institutions, especially city councils and local powers have also started to use this form in order to reform their structure, renew their methods of functioning, and attract the attention of developers. One of our interviewees, an OpenData journalist and expert in organizing hackathons, claims:

> “The Region (Ile-de-France) now wants to create for itself a kind of electroshock by organizing this meeting with people from outside of the governmental institutions to make them develop new ideas: look what data we have and what

you can do with it. It is kind of outsourcing a part of the work that the institutions must do, to the citizens and developers"[1].

Indeed, the hackathon seems to become a multipurpose method for facilitating innovation, as they are used even within biomedical science[2], neuroscience[3], media[4] and so on. The hackathon has become a common name to design "*focused innovation efforts*". Since 2009 this form has been appropriated by political and social activists, first in the context of the Open Government program of the Obama administration. This form was even institutionalized by Obama's administration, when the White House published an official handbook that establishes the rules of organization of such contests[5]. By opening governmental data, they insisted on the necessity of "co-production" between citizens and government, a practice that has not only ethical and political outcomes, but also provides an economic profit for the authorities, as the contest presupposes a substantial part of unpaid, voluntary work.

Given these economic and social advantages, civic hackathons are developing all over the world as instruments of coordination and innovation for humanitarian, volunteer, and/or activist organizations. We chose here the term of "civic hacker" borrowing it from the American "coding for democracy" movement. The expression has become, in a sense, cemented: indeed a National Day of Civic Hacking has been organized on the 1st and 2nd of June 2013 across the whole USA10. The organizers of the event define a *civic hacker* as follows: "Civic hackers... are technologists, civil servants, designers, entrepreneurs, engineers - anybody - who is willing to collaborate with others to create, build, and invent to address challenges relevant to our neighbourhoods, our cities, our states and our country. To us, a hacker is someone who

1 Interview with K. Bastien, datajournalist, expert in OpenData, founder of "WeDoData"
2 BioHackathon, since2008. http://www.biohackathon.org/
2 BioHackathon, since2008. http://www.biohackathon.org/
3 BrainHack http://www.brainhack.org/ , HumanBrainMapping Hackathon http://www.humanbrainmapping.org
4 HackThePress http://hackthepress.net/
5 "Guidance on the Use of Prizes and Challenges to Promote Open Government", http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-11.pdf

uses a minimum of resources and a maximum of brainpower and ingenuity to create, enhance or fix something"[6].

Two aspects from this quote deserve out attention here, as they help explaining two crucial features of the civic hackathon movement. The first one is about the *experimental character* of this event: the word "hacking" in this sense relates to the practice of "*bricolage*", as it is defined as a creative and innovative process that involves both amateurs and professionals who can produce spontaneous and original ideas without expensive materials and using what is near at hand. The second aspect is about *collaborating* and creating heterogeneous, *hybrid* networks involving multiple expertise. In this sense, hackathons can be called *trading zones* as defined by Galison (Galison 1997) where technical and non-technical experts develop a common contextual "pidgin" language in order to create an efficient communication. Hackathons aim to question the boundaries between experts and non-experts, and organizers have been experimenting with new formats of team-building or judging. For example, during the NASA Hackathon "Space Apps Challenge" in Paris the role of the coordinator during the final presentation of projects was delegated to... a 9-year-old boy named Virgile. The boy decided of the order of the presentations by pointing out on different persons without knowing to which teams they belonged, and after each presentation he had a right to ask questions, so that the teams were obliged to adopt a very pedagogical position and find an easy way to explain difficult technical issues.

The open and heterogeneous character of hackathons was institutionalized in 2009 with the creation of Random Hacks of Kindness (RhoK), an international network for civic hacking, whose activity extends to over 30 countries. The RHoK call themselves an "*ecosystem*"[7] as they have managed to involve in their network different actors: besides the 5,500 developers and innovators coding for the RHoK, there are 300 small enterprises and global partners such as Google, World Bank, Microsoft, Yahoo! that have become sponsors of RhoK's hackathons. RhoK have organized 7 international hackathons under the slogan "hack for humanity", developing software solutions for a wide range of social challenges from water crisis in Africa to the inequality of women

6 http://www.hackforchange.org/blog/what-civic-hacker

participation in political life in Asia. A civic hackathon is, as Blondeau and Allard (2010) state, a source of inspiration for social movements that can bring attention to their causes from the publics that have not been politicized before.

The format of the "civic hackathon" is thus interesting for NGOs as it helps, with little resources and without using the aid from the state, to create appropriate conditions to work on a social challenge, to develop software and hardware solutions and to create a sustainable community or ecosystem of technical and non-technical experts, lawyers, activists and citizens that would work on these problems for a *longue durée*.

While serving as a launch pad for NGOs and small enterprises, hackathons can also become a source of renewal and inspiration for big governmental organizations. Thus, during our fieldwork we have been observing for 48 hours NASA's hackathon "Space Apps Challenge", organized in Paris from 19 to 21 April 2013. This international hackathon has, according to the official data of NASA, assembled over 9000 persons and 484 organizations in 83 cities from 44 countries of the world. About 58 challenges have been proposed by the organizers and 770 solutions developed by the teams (applications, websites, hardware). For the organizers, as they stated in their official letter to the participants, this event has become an "electroshock" helping to accelerate the advancement of NASA research and activities: "this weekend demonstrated the true potential of participatory exploration and what can happen when a government agency like NASA takes a chance on engaging the untapped, unexpected, and uncharted know-how of thousands of passionate citizens around the world". The citizen science and citizen expertise are seen here as key features of the open innovation ideology, where, as Michel Bauwens, the founder of P2P Foundation states it, "the intelligence of each becomes property of everyone".

7 http://www.rhok.org/about

Biohacking

Whether it is in Copenhagen, New York, Paris, or Singapore, there is today an increasing number of enthusiasts who, in rudimentary laboratories created in garages, kitchens, or basements, experiment with molecular or synthetic biology. At the time of writing, there are more than 30 community laboratories dedicated to this kind of activity across the world. This 'garage biology' or 'do-it-yourself biology' raises a number of issues and has caught the attention of several commentators and science journalists (i.e. Ledford, 2010; Sawyer, 2011; Wohlsen, 2011; Wolinsky 2009). Do-it-yourself biology is often praised for the potential it holds for democratizing science, for fostering a 'citizen science', for the empowerment of ordinary people and for its educational, economic and socio-cultural value. For instance, it is argued that do-it-yourself biology is more than just a hobby for 'it democratizes science and gives people access to their own biological data in the most direct way possible' (Wolinsky, 2009: 684). Its practitioners are said to be 'creative proof of the hacker principle' (Ledford, 2010: 650) and do-it-yourself biology therefore represents an 'example of a direct translation of free software and hacking practices into the realm of cells, genes, and labs' (Delfanti, 2010: 108). Delfanti writes: "DIYbio embodies very different faces of hacking such as openness in data and knowledge sharing as well as openness of the doors of scientific institutions, but also rebellion, hedonism, passion, communitarian spirit, individualism and entrepreneurial drive, distrust for bureaucracies". (p. 109) But concerns about these new forms and places of biology are also raised: tinkering with biology outside scientific institutions is a potential threat for national security, people's safety and for the environment.

The origins of do-it-yourself biology are multiple. In fact, a thorough description of do-it-yourself biology would need to focus on its close entanglement with hackerspaces, synthetic biology, the open source movement, do-it-yourself, etc. (which is beyond the scope of this article, but see e.g. Bennett et al., 2009; Delfanti, 2010; Kelty, 2010; Roosth, 2010). Let us briefly mention the links between do-it-yourself biology and the open source and hacker movements. Do-it-yourself biology is part of the broader open science movement, a movement itself inspired by the open source movement that has developed since the 1990s (see Ledford, 2010). For some years

now, the open source movement has been developing in the world of biotechnology and the question often asked is whether the effects will be comparable to those in the computer field (where open source software is now common) (Hope, 2008). Also, there is a close link between the hacker movement and do-it-yourself biology: the tools and physical spaces of hackerspaces and do-it-yourself laboratories are often shared; on a semantic level, we have seen hybrid terms such as 'biohacker' or 'biopunk' emerge; and the ethics and practices of hackers (i.e. favouring access, sharing, collaboration, decentralization) are similar to the ones discernible in do-it-yourself biology.

While Carlson argued in 2005 that 'The advent of garage biology is at hand' and while terms such as 'garage biology' and 'do-it-yourself biology' subsequently began to appear in articles, it wasn't until 2008 and 2009, that these terms were circulated more widely. The first formal association dedicated to do-it-yourself biology, DIYbio (Do-it-yourself Biology), was created in the Boston area in 2008. The first meeting of the group took place in an Irish pub in Cambridge with around 25 people present (including engineers, students and professors) (see Roosth, 2010). There has been a steady increase in membership and DIYbio now has more than 2000 members. Over the past few years, associations dedicated to do-it-yourself biology have been established 'all over the globe' (DIYbio website): in India (Bangalore), Denmark (Copenhagen), the Czech Republic (Prague), the UK (London, Manchester, Newcastle), Belgium (Namur), the Netherlands (Amsterdam), Spain (Madrid), France (Paris), Austria (Vienna), Canada (Toronto, Vancouver, Victoria), Singapore, Israel (Tel Aviv), Germany, Ireland (Cork) and Australia (Sydney). Most do-it-yourself biology groups, however, are located in the US (Atlanta, Baltimore, Boston, Brooklyn, Cambridge, Chicago, Houston, Los Angeles, New York, San Diego, San Francisco, Seattle, Sunnyvale). In Asia, do-it-yourself laboratories and hackerspaces have recently been set up in Singapore, Japan and Indonesia (Kera, 2012). And at the time of writing, the creation of a European association of do-it-yourself biology is underway (a first 'kick-off' meeting took place in Paris in December 2012). The reasons for creating a European community for do-it-yourself biology are that, first, European practitioners feel there is a difference between the US and their approach to the field and, second, because they want to create a structure for facilitating collaborations, networking and funding amongst regional do-it-yourself groups.

People who engage in do-it-yourself biology come from many different backgrounds and have various interests and motivations: tinkering, having fun, creating, experimenting. They may be biologists, computer scientists, bioartists, students, university professors, etc. (Delfanti, 2010). As in the field sciences, practitioners are heterogeneous, communities are open, and members join networks with varying degrees of intensity (Kuklick and Kohler, 1996: 6). One activity that is widespread amongst DIY biology practitioners is what they call the "hacking" of yoghurt: the genetic re-engineering of yoghurt to make it taste differently, or produce new substances like fluorescent proteins, vitamin C or Prozac. Out of the long and heterogeneous list of activities and projects, let us further mention: the DNA barcoding of plants, the production of bioreactors (i.e. to produce biofuels), the development of safe home-brewing kits for the public, genetic testing using one's own DNA, bio-art projects (i.e. using bioluminescence), molecular gastronomy, the production of biosensors to detect pollutants in food (i.e. melamine) and in the environment, and various other outreach activities and workshops.

It must be noted, however, that even if the associations and networks dedicated to do-it-yourself biology highlight the fact they are open to 'amateurs' and 'citizens', in practice, many of the people involved already have a strong, often professional, interest in science. We frequently find that they are students or researchers in biology. For example, one of the founders of La Paillasse in Paris is a PhD student in synthetic biology; Madlab in Manchester is collaborating with researchers from Manchester Metropolitan University; and one of the co-founders of DIYbio is the director of PersonalGenomics.org at Harvard Medical School. Do-it-yourself biology is thus not yet an already established 'amateur science', but rather a 'promised' amateur science, a citizen science 'in the making'.

Part 2. Case studies

To further examine hackathons and biohackerspaces as new arenas of collaborative exploration, we now concentrate on two case studies. We are interested how these innovations can be conceived as experiments with materials, with citizenship and with the politics of science-making. Indeed, in both examples, hackers and makers address important social challenges, trying to open up the innovation process to new publics and adapting existing technologies to new, more accessible materials.

Example 1: "W.Afate", an e-waste 3-d printer

The first case-study that we would like to present is a project that we first encountered during the hackathon "Space Apps Challenge" presented above. The project is called "W. Afate" and consists in building 3d-printers out of recycled electronic waste. This example is particularly relevant for our research as it is the fruit of an open and hybrid collaboration between hackers and non-technical experts, such as anthropologists and geographers, who have acquired new skills during this 9-month long experience. Moreover, it engages a heterogeneous public from France and Africa in a perspective to share the hardware and expertise and to adapt existing technologies to a new context of developing countries.

The project "W.Afate" was born before the hackathon "Space Apps Challenge", during a collaboration between Julien Deprez, a specialist in 3D Printing from the French FabLab "FacLab" at the University Cergy-Pontoise, and the "WoeLab-Togo"[8], the first Fablab in Togo, Africa. According to the founder of WoeLab-Togo, anthropologist and activist Sénamé Kaffi, its mission is to spread "technical democracy" by providing equal access to the most recent innovations, assisting and co-creating with non-experts and artisans from the neighbourhoods, thus moving from the "Do It Yourself" to the "Do It Together" ideology.

8 http://wlab.weebly.com/

The name “W. Afate” has been chosen to honour Afate Gnikou, a young geographer and maker from Togo, who has entirely designed the first prototype of a recycled 3-d Printer, who has been the core figure in the elaboration of the prototypes and now continues working within the project and engages new publics by sharing his skills. The idea to build such a device was born during a competition of developers and makers in design, hardware and architecture called “ArchiCamp 2012”. Afate took part in the assembling of a standard *Prusa Mendel* 3d-printer, the kit being brought by the FacLab from France. Eventhough the 3d printer seemed to be an open-source innovation available for a large public, Afate realized that the main problem for developing 3-d printing in Africa was the difficulty to deliver the kits and details from Europe. The principle of “RepRap” - the possibility to produce details for a 3d printer with another 3d printer - is usually considered as a positive feature facilitating the reproduction and access to these devices. However, Wafate wanted to outdo the dependency on the “RepRap” cycle in order to render African makers autonomous on the market of 3d-printing, with the lowest costs possible, and to “transform Africa from a passive spectator to an active contributor to the collaborative research on the 3-d printing”. Together with experts in anthropology and ecology, Afate developed the idea to work with electronic and computer waste, or the so-called “e-waste”. The challenge was at the same time technical, social and ecological.

In fact, the suburb of Agbogbloshie in Ghana’s capital, Accra, has in recent years become an enormous waste disposal for computers and electronic waste from Europe and the US. They are broken apart, mostly by children, to salvage the copper, hard drives and other components that can be sold on[9]. According to the data provided by WoeLab, there are 515 tons of e-waste sent to Ghana and Togo every year. 93% of the waste is burned, and the pollution due to the smoke affects 35 cities around the site. Because of toxic products such as hydrochloric acid, dioxins, phosgene, benzene and others, there are 160 new cases of cancer detected every year[10]. The idea to use the recycled materials is thus not only helping to reduce costs for assembling 3-d printers, but also contributes to a larger ecological and social project. It forms part of action plan to clean up the electronic waste, and also bring technology within the reach

9 http://thenextweb.com/africa/2013/07/17/how-mobile-technology-is-transforming-africa/
10 http://fr.ulule.com/wafate/

of ordinary people, promoting the usage of 3d-printers and recycled computers in African schools and social centres. As Sénamé Koffi, creator of the WoeLab, puts it:

> "this is a project inspired by the ideal of technical democracy, in the sense that it aims to put everyone on the same level of access to this new technology of 3D-printing. We can imagine that tomorrow other communities would be able to build up their own 3D-printers without waiting a kit sent from the West, but just reusing the pieces that they have at hand"[11].

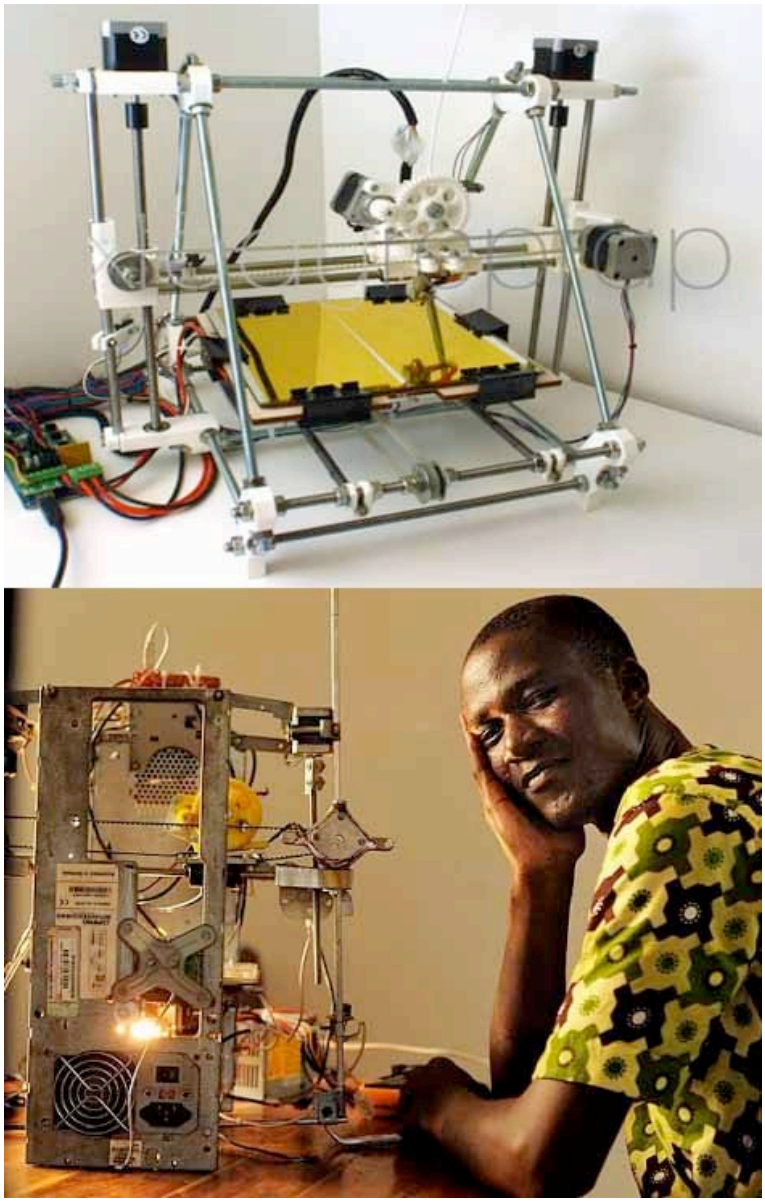
The hackathon "Space Apps Challenge" was, for this project, an important test bed and an opportunity to provide a visibility for this innovation by presenting it to experts from NASA and to the dozens of developers and activists from all over the world. The team of W.Afate was very heterogeneous, including an architect, an anthropologist, a geographer, a biologist, a designer and mechanical engineer. During the competition, part of the team was working in Lomé, Africa, and they were connected to their French partners via Google Hangout. Moreover, all the Parisian teams were able to benefit from the W.Afate printer and ask the team to print out a small object for their presentations. This ideology of sharing highlights, once again, the idea of the organizers of the "Space Apps Challenge": not to compete but to collaborate. "W.Afate" was eventually one of the two projects to win the "SpaceApps Challenge". They received support from a Parisian startup and from coworking communities and launched a campaign of crowdfunding on Ulule where they had successfully gathered the needed sum to develop the project.

The whole process of creating the structure and architecture of "W.Afate" was an experimentation, often demanding to adapt the initial plan according to the characteristics of the available materials. Finally, the PCU (mainframes) of old computers were designed to serve as a frame for the machine, the rails and the motors of old printers and scanners were designated to be axes and moving parts of the printing mechanism. The role of the core, or the "brain" of the machine, was played by Arduino, an open-source electronic prototyping platform allowing to create interactive

11 Interview with Sénamé Koffi, translated from French

electronic objects. Thus, all the details were chosen for their accessibility and adapted in order to match as far as possible the functions of the original Prusa Mendel prototype. This example perfectly illustrates the principle of *LowHighTech*, promulgated by the WoeLab, which consists in the reuse of wasted, cheap materials, finding an unexpected but appropriate place for them within the initial functional system of a device.[12] The Prusa Mendel 3d-printer, normally seen as an “open” innovation, was paradoxically treated by Afate and his team as a black box, as the details of this printer were not easily accessible for African makers and the plan of its assemblage was only appropriate for these original details. So they had not only to “re-open” this “open” source, but also to translate its design.

12 http://wlab.weebly.com/



Picture 1: on top: model of Prusa Mendel printer; below: the W.Afate printer and its creator

The design and testing of "W.Afate" is a good example to illustrate the idea of "citizen science in-the-making", as it is based on permanent adjustments. Thus, when presented during the SpaceApps Challenge, the W.Afate 3d printer was not entirely made of the e-waste. Some of the key parts of the machine were, at the beginning of the process, taken from the Prusa Mendel printer, offered to the WoeLab by the FacLab. This was the case, for instance, for the *extruder,* the part of the 3-d Printer that helps to melt the plastic and then to push it through a die to form the detail (on picture 1 it is situated under the yellow gear-wheel). But, soon after the SpaceApps Challenge, in

September 2013, Afato posted on youtube three videos where he demonstrated his latest invention – an extruder entirely made of the recycled parts of a simple printer – and showed the printing process and the printed details[13].

Since the presentation of the project at the "SpaceAppsChallenge" hackathon and till the latest successful tests of the W.Afato printer, the work on this device has been a constant testing and bricolage. Building a device out of used and recycled components presupposes constantly adapting the initial idea to the particularities of the material (Akrich, 1998). However, the ethics of "technical democracy" and humanitarian mission of the project obliged hackers to find solutions to make this bricolage process easier and more accessible to other developing countries. "If we have successfully made all this long work of experimenting, we must now share our results with others, so that they don't have to make the same long and hard way"[14]. Thus, one of the long-term goals of this project is the "standardization" of the process of designing and assembling the 3D-printer to make it usable in other countries without too much difficulties.

Apart from the "W.Afate" project, many other Do-it-together-hardware innovations are being developed within the WoeLab, for example the "Jerry" project, imported from France and aimed at building computers out of jerry cans with the usage of recycled e-waste materials. Thus, the "LowHighTech" ethics promoted by the WoeLab is about providing solutions adapted to African conditions and reality. The collective efforts of WoeLab and FacLab to standardize the spontaneous "bricolage" practices has given birth to numerous handbooks and clear and easy-to-follow instructions, helping non-experts from different groups of African society with the possibility to build their own machines.

13 http://www.youtube.com/watch?v=0TlqoQY6qnU
14 Sénamé Koffi

Picture 2. Do-It-Together science in making: a workshop with local participants dedicated to building a W.Afate printer.

Example 2: Amplino

Biohackers have developed quite a wide array of 'hacked' equipment. In their review of the field, Landrain et al. (2013) list a total of 25 pieces of equipment. One example is the Open PCR machine, an open source alternative to a conventional PCR machine (a crucial piece of equipment to do experiments in molecular biology). Another example is the Dremelfuge, an alternative to a conventional centrifuge. Both these devices, and other devices that biohackers have built, or are trying to develop, usually share a number of features: they can be produced at low cost (roughly 10-100 times less that conventional equipment) and their blueprints and build-instructions are made available freely on dedicated websites.


ARDUINO

Picture 3: prototypes of Amplino (above: a "shoebox" design; below: a design based on using laser cutting techniques).

Let us have a look at one particular piece of equipment in more detail here, a device called *Amplino*. Amplino is being developed by three do-it-yourself biologists from the Netherlands since the year 2012. Their aim is to produce a portable and low-cost device that can identify various strains of malaria - the idea is to use this in developing countries which often lack scientific equipment and medical infrastructures. The device is described as an "affordable, mobile, easy to use, diagnostic tool for malaria". The technical procedure is as follows: a drop of blood is taken from a patient's finger, which is then put into a cassette, which, in turn, is put into the device and after around 40 minutes the result is shown (if the person has contracted malaria or not). Here is how the project is described:

> "Malaria is a preventable and curable disease that affects almost half of the world's population and causes over 1,000,000 deaths per year, mainly young children in Africa. Amplino develops a novel diagnostic device that empowers local entrepreneurs to save hundreds of thousands of those lives. Through our device and business model, those in need of tests are monetarily incentivized to buy one. This ensures early diagnosis, so patients are treated quickly and avoid over-use of medicines, crucial in the preventive drug-resistance strategy of pharma companies and NGOs. The device is cloud-connected enabling monitoring of how the disease spreads, so national governments can operate more strategically in eradicating the disease".

This description ties together the three features that we want to highlight in this paper: the materiality, sociability and politics of bricolage. First, there is work on a material level: compared to a conventional medical device, Amplino is being developed as a lighter and more affordable device. The material work done by the three developers aims to develop a device that has been simplified, that is not heavy, that is quite small and thus, in general, to favour its circulability. This feature of the project is described as follows: "Amplino brings the gold standard in molecular diagnostics from the high tech lab to the field"; "a molecular biolab in your pocket".

The transformation imagined by the designers is, according to their vision, also a social one. They believe that people and governments can be "empowered" and they want their device to "make a real impact on the world". Our argument here is not whether this vision is realistic or not. We are rather interested in the ways in which a piece of equipment that is tinkered is also described and articulated with a political and moral vision. The moral vision is, in comparison to other DIY projects traditionally focused on western markets and laboratories, overtly humanitarian and focused upon the third world. It is presented, in essence, as a "good" in itself. This makes the device a political device as national politics and more open and 'lighter' economies of medical care, are all entangled.

The project has received positive feedback. In the press, for instance, the project has been hailed as "the ultimate garage project" (Byrne 2012) and the Guardian listed the device in an article titled "*Top 10 malaria innovations*" (Scott 2013). The *New Scientist* featured the device in a piece (Reardon 2013). At the first DIYbio.eu meeting in December 2012 it was presented as one of three examples of innovations in the domain.

Soon after the project was launched, the three developers won a prise (52.000 dollars) in the *Vodafone Mobile for Good* competition. And in June 2013, the project won the *YES!Delft Launchlab* competition. However, despite positive reactions and its relative success, Amplino has also received some criticisms. The main critique concerns the fact that the device will be sold and that the three developers have created a small company, called Amplino. The current estimate is that the final product will cost about 250 dollars. This has trigged some discussions within the biohacking community. For instance, in a Google discussion group on DIYbiology a lively discussion about the cost of the device took place. Here are some of the comments posted:

> "*I dunno if I buy that as being DIY. […] if a venture-backed company counts as DIY, doesn't that make all the pharma techs and Big Bio also DIY? That wouldn't make sense to me*." (20/09/2012)

"*that is not DIY. Call it DIT (do it together) or something*." (20/09/2012)

"*We aim to commercialise it for the purpose of making a robust device that can work in local conditions in Burkina Faso (or other malaria endemic areas). Also in larger quantities, so at that point I agree it is no longer DIY*." (21/09/2012)

"*I was debating this […], saying that one of the big "sells" of something like Amplino is not only the good that can be done through foreign aid, but the fact that someone in an affected region could *make their own* if they needed to. That, to me, is one of the most important parts of the open-source biology movement*". (21/09/2012)

Concluding remarks

Our starting point was that collaborative exploration is interesting materially, socially, and politically: materially, for it is based on material devices and practices that allow a circulation and redistribution of the means of innovation; socially, for it produces a novel social form of innovation and new hybrid networks; and politically since it aims to empower citizens and opens up science and technology. Biohacking and hackathons aim to produce and encourage "convivial tools": tools that are much less expensive than the equipment that professional scientists and technologists use, and that are more easily accessible, more mobile and often smaller. This equipment cannot be untangled from its "immaterial" aspects. Open source ethics, internet websites, hackathons, DIY and developer communities are part and parcel of the constitution of these objects - of their conception, production and circulation. Even more so, their "conviviality" is not only fostered by making them "open", but also by allowing them to be modified and improved. As Delgado (2013: 67) writes, we see a combination of "a sort of individual craftiness and self-determination *to do* things with a praxis in which things are left open, waiting for the next realization". The two case studies presented in this paper are open-ended stories: the two devices will most likely be further developed, transformed, redesigned and hacked.

Having said this, there is an interesting tension to note. On the one hand, there is a politics of opening up innovation; an emphasis on accessibility and redistribution. In its most positive articulations, hacking is presented as producing a "*public good*" and rendering expertise and technical equipment more accessible and mobile. On the other hand, though, we see that market logics and that business ventures are also present. The most critical comments see some of the developments as not conforming to DIY or hacker ethics. Projects that start as open and collective exploration might, we see, evolve into a more closed and individualistic exploitation of emerging markets.[15]

For instance, in our interviews and surveys of several French and Russian hackathons, we found that one of the key motivations for the participants to stay up and code for 48 hours was the possibility to make themselves known in the field and among the network of IT. As hackathons are always sponsored by one or several big IT-companies, it often becomes for young developers an opportunity to find a potential employer or to build a start-up.

Moreover, while we have focused in this article on two projects that have received quite some media attention and that have been relatively "successful", it must be noted that often projects are abandoned. For instance, "civic applications" projects are often aborted once the hackathon is over; without finding necessary institutional support, financial resources or motivation to develop and implement them in practice, their future development seems fragile. As for the Amplino project, the device has yet to be turned into a workable product. It seems that, the most successful humanitarian or civic innovations are made by teams that are heterogeneous, including not only software developers but also "problem owners" or "subject matter experts", the activists who have themselves experienced the problem in question, as we've seen it in the case of "W.Afate". In this case, the role of fablabs framing the work of both French and African parts of the team was crucial, as it helped to concentrate the collective efforts within a common space.

15 On the distinction between exploration and exploitation see i.e. Doganova 2013 and March 1991.

While the “open culture” is traditionally viewed as a culture of sharing, of promoting the ideal of technical democracy, there is however a place within it for a competitive exploration. Offering prizes to participants, developing a system of evaluation of projects, organizers not only stimulate contest-driven innovation but also participate in the creation of a network of peers, based on recognition, reputation and contacts. Hackathons and biohackers can, as we see, develop into a distinct form of the hacker culture, giving a new, “economic” turn to the ethics of open-source.

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