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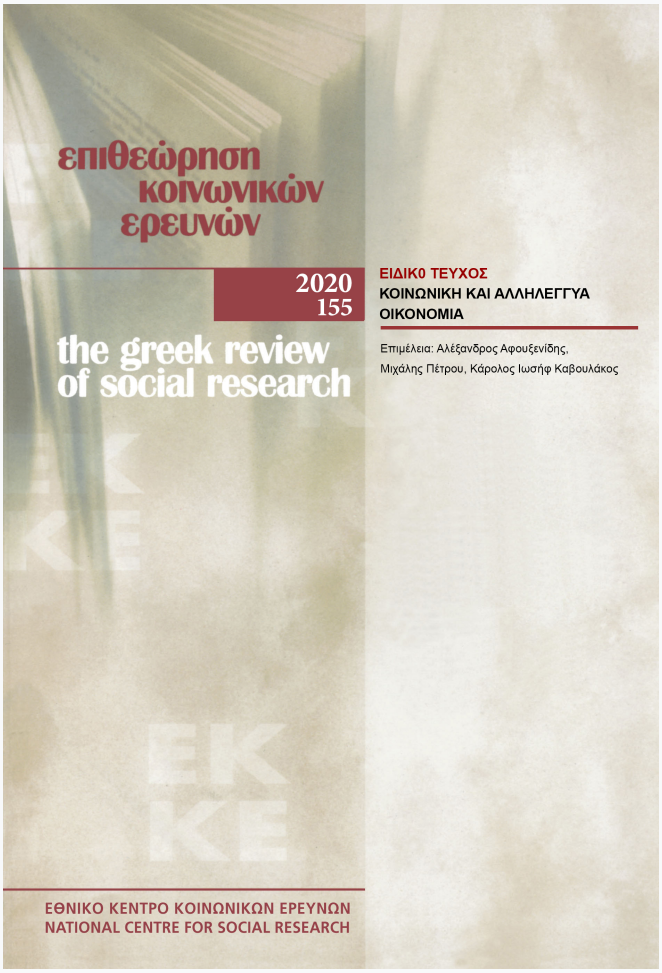

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Tools from below: Making agricultural machines convivial

ABSTRACT

This paper explores Commons-Based Peer Production (CBPP) and the democratization of knowledge and technology in the field of agriculture. While most existing academic work mobilising these notions focus on the digital world, our two case studies – a legume-harvesting machine and a tool for hammering fencing poles – examine what happens when those notions are operationalized for hardware production. Our case studies take place in the context of Design Global, Manufacture Local (DGML) and look at the micro-level of practices, and the explicit and tacit knowledge that are mobilised when using open-source technologies to produce tools for the primary sector. We argue that the process of "open-sourcing" tools needs to be better theorised, and we show how this process mobilises expertise, experience, and engagement, connects various localities, and relies on representational practices. Our article aims to provide a better understanding of how digital commons interact with distributed physical manufacturing, what processes can lead to open-sourcing hardware and making technology convivial, and inform future research and policy proposals.

Keywords: *technological sovereignty; open-source; agriculture; commons-based peer production; grass-roots innovation*

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Εργαλεία από τα κάτω: Κάνοντας τα αγροτικά εργαλεία συμβιωτικά

ΠΕΡΙΛΗΨΗ

Αυτό το άρθρο διερευνά την ομότιμη παραγωγή και τη δημοκρατικοποίηση της γνώσης και της τεχνολογίας στο πεδίο της γεωργίας. Ενώ οι περισσότερες υπάρχουσες ακαδημαϊκές εργασίες που ασχολούνται με τις παραπάνω έννοιες εστιάζουν στον ψηφιακό κόσμο, οι δύο περιπτωσιολογικές μελέτες μας –μια θεριστική μηχανή για όσπρια και ένα εργαλείο πάκτωσης πασσάλων περίφραξης– εξετάζουν τι συμβαίνει όταν αυτές οι έννοιες λειτουργούν για την παραγωγή υλισμικού. Οι μελέτες περίπτωσης αναπτύσσονται στο πλαίσιο του Σχεδιάζουμε Παγκόσμια, Κατασκευάζουμε Τοπικά (DGML) και εστιάζουν στο μικρο-επίπεδο των πρακτικών και της ρητής και άρρητης γνώσης που κινητοποιούνται όταν χρησιμοποιούμε ανοιχτές τεχνολογίες για να παράγουμε εργαλεία για τον πρωτογενή τομέα. Οι παρατηρήσεις και η ανάλυση που παρουσιάζονται στο άρθρο αυτό στοχεύουν στο να παράσχουν μια καλύτερη κατανόηση τού πώς τα ψηφιακά κοινά αλληλεπιδρούν με την κατανεμημένη φυσική κατασκευή, ποιες διαδικασίες μπορεί να οδηγήσουν στο άνοιγμα του υλισμικού και στη δημιουργία συμβιωτικών/φιλικών προς τον χρήστη τεχνολογιών και να πληροφορήσουν τη μελλοντική έρευνα και τις προτάσεις πολιτικής.

Λέξεις κλειδιά: *τεχνολογική κυριαρχία, ανοιχτός κώδικας, γεωργία, βασισμένη στα κοινά ομότιμη παραγωγή, καινοτομία από τα κάτω*

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1. INTRODUCTION

In this paper, we focus on people who build their machines. We are interested in farmers who, due to necessity and/or conscious choice, do not buy commercial equipment to work their lands, but invent, create and adapt machines for their specific needs: for harvesting legumes, for fencing their land, for hitching tools onto tractors. Moreover, these people actively share their inventions via the Internet, thereby enabling other groups to do the same. The machines are thus just one part of the story, and the article will talk about the entanglements between people, tools, and knowledge that render the making and reproduction of these machines possible.

The material we present and discuss in this paper has been gathered through active involvement with practitioners. The first author (AP) is working on the convergence of convivial technologies, commons, and non-formal education, coordinating the socio-technical pilots of the COSMOLOCALISM project.[1] He has been involved in social movements while building a community of farmers and setting up a makerspace called Tzoumakers[2] in rural northern Greece. The second author (MM) has been working on – and with – L'Atelier Paysan,[3] a 10-year-old cooperative that builds open-source tools for small-scale organic farming. In particular, he has been involved in a collective research project (L'innovation par les usages, un moteur pour l'agroécologie et les dynamiques rurales) that ran from 2015 until 2018. Within this framework, he has participated to common reflections, supervised students, carried out empirical research and co-organised various conferences and meetings. In sum, both authors do not consider themselves as researchers that analyse open-source tools from a distance but as embedded and engaged researchers who closely collaborate with the actors in the field practising participatory action research.

Our paper is structured as follows. In the next part, we provide a theoretical framework by mobilizing and discussing texts about Commons-Based Peer Production (CBPP), Design Global, Manufacture Local (DGML), and convivial technologies. In the second part, we focus on two case studies: the construction of a legume-harvesting machine and the construction of a pole-hammering tool. In our conclusion, we discuss what the opening of a tool looks like in relation to the DGML concept, what such processes require, and how they can be reinforced.

1. https://www.cosmolocalism.eu/
2. http://www.tzoumakers.gr/ Tzoumakers is a commons-based peer production community initiative that brings together small-scale farmers and entrepreneurs to build and modify open-source tools and machinery with the purpose of fostering sustainable farming under the principles of design global, manufacture local.
3. https://www.latelierpaysan.org/English

2. LITERATURE REVIEW

2.1. *Commons as a mode of production*

Harvard professor Yochai Benkler introduced the term of commons-based peer production (CBPP) more than a decade ago, in the aftermath of the establishment of Creative Commons and Wikipedia in 2001. Benkler depicted in his book *The Wealth of Networks* (2006) how information technologies enable new forms of collaboration that can transform society and the economy. In the following years, Bitcoin as a virtual currency was launched, and Android operating systems based on open-source became widely used in mobile phones and other devices. Commons-based projects differentiate themselves from traditional business models with their less hierarchical and more decentralized structures, and by sharing the roles and tasks among participants.

In the same vein, the term "peer production" gained traction. It refers to goods and services that are produced or built by self-organized communities with the purpose of a shared outcome. The basic pillars of peer production are the openness of its outputs, decentralized organizational structures, and participant-driven work (Benkler, 2006). There are various successful examples of CBPP in the digital world in virtue of technological developments following the expansion of the Internet (Wikipedia, Apache web server, Linux operating system).

As a new way of value creation and knowledge dissemination, CBPP can be situated within the wider ecosystems of commons-oriented communities. CBPP infrastructures are generally equipped with open-source technologies. Thus its participants can communicate, organize themselves, and create collectively without competition (Bauwens, 2005; Benkler, 2006). CBPP is a community that shares resources to produce and manage a "common property". This common property – or the "new commons" to use Benkler's term – comprises all the knowledge, codes, and designs of the community. We consider this process as a CBPP ecosystem (Bauwens and Pantazis, 2018, p. 304; Bauwens et al. 2019).

The transfer of successful experiences of CBPP from the digital world to the physical world emerged only recently in the form of what has been called – among others – Design Global, Manufacture Local (DGML) mode of production (Kostakis et al., 2015; Kostakis et al., 2016) which took shape in places like makerspaces, fablabs, etc. (Niaros et. al., 2017). The present paper aims to contribute to this recent focus on peer production in the physical world by examining open-source technology processes in the field of agriculture.

2.2. *Democratization of knowledge and technology*

While the notion of peer production has emerged as an important reference point, there is a

variety of other notions and movements that have risen to prominence over the past few years and also call for the democratization of knowledge and technology as well as new forms of organization and concerns for the environment. Some of these terms include the world economy and thereby aim to requalify and rearticulate it: i.e. the circular economy, the blue economy, the sharing economy, or the social and solidarity economy. For example, the old model of agricultural and farmers' cooperatives is often confused with the Social and Solidarity Economy (British Council, p.81) but the former can have a great role if modernized under the SSEs' vision and practices. Other terms render explicit the wish to open up knowledge and involve citizens in the design and making of technology: i.e. do-it-yourself, prosumer (producer and consumer combined, see the similar usage in Bruns, 2008), open-source, hacking, making, and, of course, peer to peer.

Our paper is situated in these wider dynamics by exploring the sharing of knowledge and technologies in the domain of agriculture. However, in agriculture, these trends have not been much researched: most academic work has so far focused on open-source in the fields of computer hardware, software, and science (Kelty, 2008; Coleman, 2012; Söderberg, 2015).
Another notion, often associated with the above terms is the notion of "conviviality" and "convivial technology". In his book *Tools for Conviviality*, Illich (1973, p. 11) writes: "I choose the term "conviviality" to designate the opposite of industrial productivity. I intend it to mean autonomous and creative intercourse among persons [...], convivial tools rule out certain levels of power, compulsion, and programming". Elaborating on conviviality, he notes that "a durable-goods economy is precisely the contrary of an economy based on planned obsolescence. [...] Goods would have to be such that they provide the maximum opportunity to "do" something with them: items made for self-assembly, self-help, reuse, and repair" (Illich, 1971, p. 63). In *Deschooling Society* (1971), Illich argues that sadly we often confuse education with learning, medical monitoring with health, watching TV programs with recreation, and speed with effective transportation. Illich uses these parallelisms to highlight the contradiction when we confuse broader concepts like health with hospitals as the latter often exhibit many problems. We also confuse the multifaceted process of learning with western educational institutions. In the same vein, we tend to confuse technology with industry. Technology is not developed only in industry, and by confusing the two terms, we deprive our thinking capacity, already from the conceptual stage, from being capable of imagining a different technology that will not be a black box occurring in a vast, cold factory. Thus when equating technology with industry, we drift away from any possible alternatives of a humanized and democratized technology.

In a similar vein, the notion of appropriate technology captures some of the same

dynamics and ideas. As Vetter (2017, p. 2) argues: “appropriate technology proposed an alternative path to development using locally adapted materials and technologies that can be built, maintained and repaired without foreign experts”. What Vetter describes is that different types of technologies entail different underlying logic, world views, and therefore social imaginaries. Instead of being neutral, technologies are an ambiguous battlefield indivisible from social competition and power dynamics. Technology, when considered neutral can be “painted” Green more easily. However, when considered ambivalent, it opens up a whole spectrum of critical thinking that can help us to steer better the ICT revolution and our social reproduction model towards one that can be more socially just and less environmentally destructive.

Delving into the processes of making technology convivial, we aim to reveal patterns and practices that can help in further developing such notions. Thus, we will see people creating representations of tools (images, photographs, plans), manufacturing prototypes of tools, testing and adjusting devices, sharing information about tools, and organizing manufacturing workshops. To put it differently, it is only after a process involving transformations, dis-assemblages, and re-assemblages, translations, and representations that tools become open-source and convivial. We hold that open-source tools can be captured as a process in the making. At the same time, they can also be seen as a form of positioning – or even political statement – concerning forms of knowledge production and technology development that are problematic for various reasons: patents, technological lock-in, or monopolies. In agriculture, this tension between open-source tools and mainstream industrial tools has been explicitly addressed (see, i.e. Oliveira et al., 2014; Nicolosi and Ruivenkamp, 2013; Aoki, 2009). According to Boettiger and Wright (2006, p. 47): “open-source agriculture is more a restoration than a revolution. To agricultural scientists, [open-source] offers a promise of a return to the scientific environment of decades past, where materials and ideas were exchanged with greater fluidity and today’s preoccupation with intellectual property rights that was absent”. Rephrasing Boettiger and Wright, open-source agriculture when seen through the DGML lenses is more an evolution than a restoration: rooted in the natural commons of the past and blended with the momentum of the digital commons of the 21st century, creates something new.

Taking it further, Lemmens (2010, p. 144) talks of “a deproletarianized agriculture, in which farmers can take control again over the means of production and “be in charge” again of agricultural innovation”. He further writes that deproletarianization is “explicitly aimed at the reconstitution of autonomy and independence of farmers, who should become active innovators again instead of passive receivers and users of technologies designed outside of

their use-context, supplied with a technical code tailored to the imperatives of the corporate food system'' (Ibid.).

The cases examined in this paper can be understood through the notions and dynamics just discussed above, even though terms like open-source or conviviality were not necessarily used by farmers in the initial steps of some projects. L'Atelier Paysan is one of the few formalized collectives specialized in building open-source tools for small-scale organic farming (another notable collective being Farmhack)[4] and explicitly using terms such as open-source, appropriate technology, or common goods (Giotitsas, 2019). L'Atelier Paysan has developed a range of practices for ''liberating'' the technology of agricultural tools: construction workshops, video tutorials, a website and an online forum, books, and open-source plans of machinery. In their article, Chance and Meyer (2017) have analyzed L' Atelier Paysan by retracing their history and form of organization, studying how they enact the principles of open-source in agriculture, and by describing their tools within their economic and political context, creating different sets of capabilities for farmers in France and beyond.

Similar examples exist in Greece but at a much smaller scale. Melitakes[5] and Tzoumakers, the two groups examined here, only recently initiated a process of reappropriating technologies for the primary sector. This difference can be understood when focusing on the Greek economic and political context. Ethnographic research of the socio-professional profile of Greek farmers reveals various constraints. For example, Petrou (2014) argues that the tendency to return to the Greek countryside and engage with agriculture professionally is not efficiently promoted through institutional structures. Instead of supporting the whole process of socio-professional integration systematically, these structures tend to produce uncertainties, personal insecurities, and fears. The two initiatives examined in this article attempt to reduce those uncertainties, enhancing technological sovereignty, and thus empowering small-scale farmers.

3. CASE STUDIES

3.1. *A legume-harvesting machine*

In the village of Pyrgos (southern Crete, Greece), there is a small group of people called Melitakes (the Cretan word for ants) interested in seed sovereignty and agroecology. It is a group engaged in organic farming, trying to form a small food production and processing cooperative. One of the things the group does is to plant legumes in between olive-trees or

4. http://farmhack.org/
5. https://melitakes.gr/

grapes, a practice called “co-cultivation”. While olive trees are abundant in Greece, the land in between individual trees is usually not cultivated due to the distance necessary to avoid shading and foster the growth of the trees. So the idea was quite simple: exploit the unused land for planting vegetables that have lower light needs. However, the members of the group soon faced a specific problem: it is hard to harvest legumes by hand and there are no available tools to get this backbreaking job done in a narrow line between olive trees. On the market, there are big tractor accessories, suitable for such a job only for large monocultures. That is why the group sought the help of a friend in a nearby village, a machinist, to help them out. He liked the idea and started to develop a tool (picture 1). At that time, there were no concrete ideas or discussions of “open-sourcing” the tool and of “do-it-yourself” (DIY) practices. The situation was rather a pragmatic one: there was a need for a machine that does not exist on the market, a person was able to build it and a group was already there to initiate, guide, and support the process. So, a small legume-harvesting machine was built by combining the knowledge and experience of the machinist and Melitakes group members. At that period, students from a French environmental high school were on a trip of agroecological interest to Melitakes. Two of the students decided to make the design of an ant in a template and in this way the logo of Melitakes was made and printed on the machine.

Picture 1: *DIY legumes harvesting machine by Nikos Stefanakis and the Melitakes group*

Source: Alekos Pantazis.

Before continuing our story about the legume-harvesting machine, a few more details about L' Atelier Paysan are useful. L' Atelier Paysan is a cooperative that was created in 2014 and builds upon construction workshops that have been taking place since 2009. The methodology of L' Atelier Paysan consists of several practices: doing tours to make an inventory of peasant innovations; developing tools via testing, prototyping, upgrading, and realizing workshops; and "liberating" the collectively-validated tools via the publication of detailed plans and tutorials on the Internet. One of its most prominent tools is the quick hitch triangle (picture 2), which replaces the usual three-point linkage between a tractor and the tool to be fixed behind it. For the quick hitch triangle, L' Atelier Paysan has produced a 10-minute video, taken many pictures, issued a 47-page booklet, and drawn several plans – all of which are freely available on its webpage.[6] It is important to stress a key feature: it is not L' Atelier Paysan that develops new tools from scratch "in house"; rather, they actively look out for farmers' innovations. Only thereafter, through collective construction work, after testing the tool in the field and various processes of representation (plans, pictures, videos), are the tools released. Put differently, while user innovations are already there, "in the field", the role of L' Atelier Paysan is to collect, improve, formalize and disseminate these innovations.

Picture 2: *Construction of the quick hitch triangle*

Source: L'Atelier Paysan.

One of the authors of this paper (AP) took part in a 5-day workshop organized by L'Atelier Paysan in France in March 2018 to build two tools for organic grape crops. He gained several kinds of knowledge via the workshop: practical knowledge on working with metals (e.g. cutting and welding); theoretical knowledge (e.g. the organizational and financial structure and the problems faced by L'Atelier Paysan); and knowledge about how to run

6. https://www.latelierpaysan.org/Le-triangle-d-attelage-38

workshops. When AP got back to Greece, he visited the Melitakes group. He explained how L' Atelier Paysan works – its practices, philosophies, and ethics – and the various tools that have been designed and built. While thinking about the future development of Melitakes' tool and its possible diffusion by open-sourcing its design and using some of the standards developed by L' Atelier Paysan, the collective faced a new problem: none of them was a mechanical engineer. None of them could thus illustrate the design of the components of the legume-harvesting tool, not even the talented machinist who built the machine without plans, based solely on his experience. Yet, this was a crucial step for digitizing the design and making it accessible online. So, after being unable to find a mechanical engineer or designer willing to pay a visit to this remote village, they sought the instructions of architects for how to best illustrate each part of the machine. Subsequently, they dismantled the tool, took photos of each component (more than 300 photos in total) in the correct angles (90 and 180 degrees), and with a tape measure visible on each photo. They also used big sheets of paper to make the imprint of some complicated tool parts (picture 3). Moreover, they started looking for people who, based on the pictures and imprints, would be able to draw the mechanical design of the tool digitally and thus remotely support those two groups. They finally found a designer and enthusiast of the Tzoumakers group who was willing to help and thereby participate in the vision of sharing knowledge globally and enhancing farmers' tools sovereignty.

Picture 3: *Imprinting of some complicated parts from the DIY legume-harvesting machine made by Nikos Stefanakis and the Melitakes group*

Source: Alekos Pantazis.

The objective, at the moment of writing, is to draw the plans of the tool, render them open-source by publishing them on the Internet under a Creative Commons license[7], and then organize workshops to teach people how to build it. So, while the full story about the legume-harvesting tool has yet to be written, some features can already be told: a practical problem has been translated into a technical tool instigated by motives different from profit maximization; this tool has been disassembled and photographed in order to become "drawable" and thus available via the Internet. The hope for the future is that a lot more people, in many more places, will be able to build this tool, further improve it and share the improved design with the global community. But alongside the tool, something else will travel and be reinforced: the principles of agroecology and the practices of open-source culture.

3.2. *A tool for hammering fencing poles*

A common concern for farmers of the broader region of Tzoumerka in Northern Greece is that animals, especially wild boards, often damage their crops by entering their fields, and eating and destroying their crops. As they try to avoid the high costs incurred by having specialized fencing technicians involved in such a task, they fence their land themselves. This frequent task requires two individuals and is usually made by using barrels instead of ladders to get on the top of the pole and heavy-duty sledgehammers to nail it in the rocky, mountainous ground. This practice is difficult and risky because the land is usually not plane, so the use of ladders – let alone barrels – entails the risk of falling, and using a sledgehammer in such conditions entails risks for the assistant that stands underneath, holding the pole in a vertical position.

This is why the farmers and makers of the Tzoumakers community (named so by combining "makers'' and the "Tzoumerka'' region) got together. They first discussed the problems they faced and then mapped and prioritized their needs. Then, they proposed a set of solutions that they use, know, or have heard about and started sharing their experience. At the same time, the members more familiar with modern technologies searched the web looking for solutions to their pressing problems that people or groups like L'Atelier Paysan might have solved and shared before them. The appropriate solution for the fencing problem finally

7. Open hardware licenses are, at the moment, rather a niche and an emerging area of interest.

emerged from within the local community: a beekeeper and an owner of a nearby mountain shelter had used in the past a simple tool for hammering fencing poles. The tool does the job without acrobatics and risky moves being necessary, making it possible for only one person to hammer the poles while standing firmly on the ground (picture 4). They explained the logic of this tool to the rest of the Tzoumakers community and altogether set up a plan to build one.

Picture 4: *Testing the newly constructed tool for hammering fencing-poles from the Tzoumakers group*

Source: Alekos Pantazis.

A workshop was therefore organized in May 2018. The first preparatory step for the workshop was taken within the informal core community: a group chat and a coordination document was created and shared between eight people. After a face-to-face meeting and webchat discussions, the group created a list of tools and raw materials that would be needed to build the tool and each of the core members got the responsibility of bringing some of them to the workshop since the equipment of the Tzoumakers makerspace was not yet there (such as metal welding tools, angle grinders, metal tubes, pieces of solid metal, even a working bench). After this list was established, the workshop was advertised more widely via Tzoumaker's Facebook group, emails and phone calls to specific members of the mapped community that might be interested, and via a poster placed in nearby villages and local agricultural associations.

At the workshop, several explanations were provided to the participants including: the underlying logic of the tool; why it is more practical than a traditional tool; how the total weight of the tool should be calculated; and how much will it cost. Moreover, to ensure that the making process could be reproduced easily, participants kept records of various elements on a whiteboard (picture 5): the sequence of the steps needed for constructing the tool; the points to be welded; the required tools, materials and their prices; and some other useful details and observations. Also, a wooden device that helped the parallel alignment of the two grips during the welding of the tool was made and photographed. In other terms, the whiteboard functioned as a material representation, user guide and reminder of the "ingredients", and the temporality of the workshop.

Picture 5: *Presenting, explaining and recording key information to make the pole hammering tool at the Tzoumakers makerspace*

Source: Alekos Pantazis.

It is frequently argued that open design allows improvisation and circularity. During the process of making the tool, it became clear that a heavy piece of metal was needed to serve as the top of the new type of sledgehammer. Instead of buying one, this part was made out of a scrap truck axle that a member of the core community brought and that was cut into pieces. Such a process could have never taken place if a new tool had been bought readymade. Therefore, open-source local manufacturing enables the use of local materials and the re-use of scrap, significantly reducing the ecological footprint of a tool and enhancing circularity.

While the set aim was to build the tool, during the workshop, there was an element that surprised the organizers. At some point, the participants said that they wanted to inscribe "Tzoumakers'' on the tool. In other words, they showed that they cared not only about building a tool, but also about the collective identity that enabled them to create this tool. The inscription "Tzoumakers'' became a means to make explicit a sense of collective and common identity, similarly to what happened in the Melitakes group. By providing the means for building a tool for hammering fencing poles and inscribing a signature on it, the workshop enabled a close entanglement between the Tzoumakers and a tool: it became *their tool*. This "ownership'' also became evident at the end of the workshop, when a funny video was spontaneously made by one of the participants. The participant played a salesperson who praised the tool as if it was part of an advertising spot, saying for instance that "with this tool, I was saved! I fenced all whole village and now I can sleep peacefully''. After the sales pitch, another participant underlined that the tool was produced by Tzoumakers, while another one added that it is a "clever tool''. Even if this anecdote mobilizes fiction and humour, it nonetheless reveals pride and a sense of achievement in a moment of collective enjoyment. This sense of community was also established on a more serious level by developing ethics of contribution and reciprocity in the use of the tool. For example, while discussing the lending process of the tool with anyone who might need it regardless of whether he/she participated in the construction process, the idea of asking for a voluntarily small donation in the form of makerspace consumables gained ground. In this sense, the community is in line with the expression popularised by Stallman (2015, p. 3) "Think free as in free speech, not free beer".

It is important to note that several versions of the tool were created: a light version of 9 kilos that was also slightly shorter and a heavier version of 12 kilos. This had to do with both the size of the pole that was to be nailed and the body type of the user, thus inclusivity was embedded in the tool design process. The women users who are often excluded from design processes were taken into account in the design and production of this agrarian tool. Another adjustment was discussed two months after the workshop: an idea for improvement was to

place the handles of the tool vertically rather than horizontally so that the movement made by the user gets more ergonomic and less painful. This adjustment is to be implemented in the next version of the tool. The coexistence of several versions shows that what is at stake is not only the *reproduction of* a tool but more importantly, *experimentation with* a tool by its users, which involves testing, improving, and adjusting. During these phases of experimentation, the tool has to go through certain "tests" in the field. For instance, the tool not only needed to be able to accomplish a specific task, but it also had to pass an "ergonomy and physiology test''. The tools need to be built in such a fashion that they can be used smoothly, naturally, taking into account the variability and contingencies of human bodies. This represents, for the Tzoumakers, a form of inclusivity and conviviality, and the stated aim is thus to create a sort of "library" of different models both physically and digitally.

At the time of writing, the two-pole hammering tools that have been built at the workshop are in the hands of farmers of the Tzoumakers community. One tool, for instance, was used for the construction of a greenhouse that was funded by a state subsidy for young farmers. Moreover, pictures and videos of the workshop have been uploaded, and a designer is willing to produce a detailed documentation of the tool (including ideally also filming). So, the next phase, after the prototyping of the tool, will be the design of a booklet that will include detailed presentation, an explanation of the usefulness of the tool, a list of all the equipment and material needed, instructions for building the tool (and the risks thereof), drawings and pictures. To sum up, we see that the open-sourcing of a tool not only involves experimentation and construction/reproduction, but that documentation is also crucial.

4. DISCUSSION

The building of tools within local communities is a practice that is usually experienced as positive and empowering. Yet, a model like the one from L'Atelier Paysan cannot simply be copy-pasted to another country and another context unmodified: a thorough understanding of both realities is needed. For instance, about 30% of L'Atelier Paysan's turnover comes from public funding streams. L'Atelier Paysan is recognized as a leading network of agricultural development by the French Ministry of Agriculture and its adapted machinery method and self-build principles are adopted in the "Law for the future of agriculture" by the French National Assembly.[8] In Greece, aside from agro-industrial oriented subsidies, there is minimal public funding for small-scale agricultural activities, whereas there is no similar statutory legislation as in the French case. Apart from these political peculiarities, socio-cultural

8. https://www.latelierpaysan.org/Our-economic-model

characteristics also differ. For example, farmers' skills are different in the two countries (e.g. the level of digital literacy or the local farming knowledge), and the collective memory from building cooperatives in Greece experienced a harsh crisis in the recent past (Papadopoulos and Patronis, 1997; Rakopoulos, 2014). The conditions under which people can cooperate have their local "flavours" rooted in distinct habits and social imaginaries. There is no doubt that there are concepts and practices that can act as reference points globally. Yet other aspects need to be adjusted through continuous local observation, experimentation, and feedback, looking into everyday habits and processes up to regional and national policies.

In addition to this wider political and socio-historical context, our paper showed that natural, social, and geographical specificities needed to be taken into account. The kind of plants cultivated, the morphology of the soil and even the morphologies of users call for specific, locally adapted tools. In the case of the pole nailing tool, we witnessed the inclusion of different body types and gender by the making of tools with different weights and lengths. In the case of the legume-harvesting machine, we witnessed the influence of local geomorphological conditions: the machine has to be small and stable enough to move in the mountainous landscape between olive trees.

To conclude, we would like to emphasize two points. First, our case studies show all the work that goes into transplanting ideas, machines, practices, and knowledge between and across members of communities. This is not a simple move, it is not just a matter of copy-pasting an idea, a practice or a technology from one place to another, from one peer to another. Ideas, practices, and technologies are not immutable objects (unless patents convert them into such), but they are, in a sense, ‘‘quasi-objects’’. For ideas and technologies to be transported and shared among people, they need to be represented, disassembled, and reassembled, translated, adjusted, transformed, and immersed into the local context. It is only by various interlinked actions – imagining, testing, photographing, drawing, theorizing, sharing, rebuilding – that objects can travel and multiply, that they become *common* objects. Also, for technological devices like the ones described to be low-tech and convivial, they need to be opened up not merely technologically but in several ways. This opening up is both a technical practice and a social endeavour. Connectivity, accessibility, adaptability, and conviviality of technology is a manifold issue that requires specific practices supported by specific social forms and processes, as well as political reinforcement. Our stories are thus not only about the practices of rendering agricultural tools convivial, but also about the (geo)politics, ethics, aesthetics and collective dimensions thereof.

Our second point concerns the way we might perceive the spatial dimensions of DGML. Peer production in open-source software has strong global aspects. Producers can

globally coordinate the production of software, later download and run it anywhere across the globe (given the necessary equipment and infrastructure). Yet, it seems that peer production in the realm of hardware entails some differences from its digital equivalent that call for more examination. Is a globally designed hardware equally easy to be manufactured locally? Will it be made identically in different places? How do manufacturing and social context affect practices and norms? What makes materiality different from the actualization of a solely digital item? These are some of the pressing questions to be further examined.

Through our participatory action observations, we have seen that DGML is not only something that relates two dimensions (global and local) but connects a whole range of sites in between them. For example, the designer that offered to draw the plans of the legume-harvesting machine lives in northern Greece and has never visited Melitakes group in southern Crete. The geographies of open-source agricultural machines cannot be subsumed to any neat divisions between global and local, or international and national. Various kinds of localities and spatialities are connected in our case studies: makerspaces, workshops, small communities, cooperatives, regions, national and natural contexts, etc. Different levels of localities emerge, and within and across these localities there are different levels and forms of engagement and different representational practices that potentially contribute to the process of "open-sourcing'' a tool.

Our case studies have shown that tools are not necessarily or easily "born" open-source. Making them open-source and convivial requires a lot of work and mobilises a variety of interlinked actions involving various types of expertise and levels of localities. Similarly to Bollier and Helfrich who prefer the term commoning instead of commons (Bollier and Helfrich, 2015), we should refer to open-sourcing rather than open-source in order to emphasize the process rather than the notion. By experiencing and observing the processes of DGML in action, we have tried to trace the patterns and sense what pieces of the puzzle are still missing. This could help practitioners find and create communication and collaboration protocols that will make scaling up possible in the same way that the social and solidarity economy needed to develop its norms, processes and organizational structures to establish itself as an alternative kind of economy (Nardi, 2016). DGML needs to develop its own norms and processes to be recognized as a new mode of production. In a nutshell, our case studies have demonstrated that the social, material, temporal, and spatial dynamics of open-sourcing agricultural tools deserve to be opened up for empirical investigation and theoretical problematization.

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