Open source agriculture: a root to leaf revolution?

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ABSTRACT

This thesis employs the concept of open source agriculture as a novel social movement which not only advocates a certain agenda but also creates technological products under a unique technology development model. To do so, it brings together social movement and technology theory in order to examine it. Specifically, on the social movement aspect, framing analysis and resource mobilisation theory are employed to identify the collective action frame and the material considerations of the movement respectively. Outcomes of this process are then translated on the technological analysis of this thesis, whereby the technological action frame of the movement will be synthesised using constructivist approaches for technology research (mainly the Social Construction of Technology). This allows for the tracing of values and interests being coded within the technological artefacts the communities produce as well as their development processes. Critical theory of technology is further applied to examine the broader societal impact on the development model.

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LIST OF ABBREVIATIONS

AP	L’atelier paysan
ANT	Actor Network Theory
CBPP	Commons-based Peer Production
CAD	Computer-aided Design
CP	Confédération Paysanne
FH	Farm Hack
FSF	Free Software Foundation
GPL	General Public License
ICT	Information and Communication Technologies
IFOAM	International Federation of Organic Agriculture Movements
IP	Intellectual Property
NYFC	National Young Farmers Coalition
OSI	Open Source Initiative
SARE	Sustainable Agriculture Research and Education Program
SMO	Social Movement Organisations
STS	Science, Technology and Society
SCOT	Social Construction of Technology
SST	Social Shaping of Technology
VC	La Via Campesina
VoIP	Voice over Internet Protocol

CHAPTER ONE

1. Introduction

> "Its technology is how a society copes with physical reality: how people get and keep and cook food, how they clothe themselves, what their power sources are (Animal? Human? Water? Wind? Electricity? Other?), what they build with and what they build, their medicine - and so on and on... Technology is the active human interface with the material world. But the word is consistently misused to mean only the enormously complex and specialised technologies of the past few decades, supported by massive exploitation both of natural and human resources. We have been so desensitized by a hundred and fifty years of ceaselessly expanding technical prowess that we think nothing less complex and showy than a computer or a jet bomber deserves to be called technology at all."
>
> Ursulla K. Le Guin

I have spent most of my life (so far) in and around a farm in one of the most remote and mountainous areas of Greece. It is one of the poorest regions of Greece as well. Being surrounded by farmers and people working in the primary and basic construction sector, I never truly appreciated the ingenuity and collaborative effort these people (as did my family) put in their day to day activities in order to simply achieve sustainability. It was not until I had spent several years away from my family home that it dawned on me how uncritically immersed urbanised societies were, myself included by that point, in the technology that they are handed. I had always been enamoured with information and communication technologies (sparked by my gaming PC) so I decided to experiment with open source software and tinker with hardware as a way to get my work done in an affordable way and to have some control over the instrument that was consuming so much of my time. Having met a group of likeminded individuals we established a research collective, the P2P Lab, through which we would explore and advocate collaborative practices and open source technologies.

My original idea for a PhD thesis was about information technology and specifically about the internet of things. Concurrently at the P2P Lab, we were also developing an EU wide project as well as a funding bid regarding agricultural communities and the technology they produce. The project would study how these communities operate and at the same time develop a platform to enable collaboration and knowledge exchange in a global scale. While that original bid was unsuccessful, my desire to explore the intersection of those two important themes in my life pushed me to change the topic of my thesis towards that direction. Openness, sharing resources, and other terms like these are extensively used today in an effort to add a "sexiness" factor to products or institutions that do not really deserve the name. This has led some to use the term open washing (borrowed from green washing) to call out this trend. Similarly participatory or user driven design, co-creation or co-construction and other terms have been proposed as ways to include the public or at least some diversity of stakeholders in the technology development process. However initiatives, mostly externally driven, are often organised top-down and do not involve civilians in meaningful ways, thus maintaining the dichotomy between expert and layman which ignores the social complexities of stakeholder engagement.

In order to avoid the complications of engaging in participation research (see Bogner, 2012), my aim with this thesis is to explore those initiatives that have been self-mobilised from within farmer communities, in a bottom-up fashion, and are engaging in technology development for the community itself. At the same time, the practical lessons learned from this research project are being applied in the Lab's efforts to provide the community where I grew up with the necessary tools to formulate an effective organisation similar to the ones which will be extensively explored later. After all our collective research goal, like my own with this thesis, is normative in nature.

With the thesis I explore technology designed and produced by farmers to accommodate their particular needs. Through this, I aim to trace the emergence of a social movement that facilitates and promotes this type of technology and then examine its characteristics. This is achieved by examining the case study of social movement organisations and their technological communities. These are Farm Hack in the US and L'atelier paysan in France. The focus is placed on how they frame their activities and how this translates in the alternative technological development model by utilising conceptual tools from the following theoretical approaches: Framing analysis and resource mobilisation theory from the social movement research field; the constructivist approach and critical theory of technology from the technology research field.

Through a combination of these concepts the thesis will illustrate how individuals refuse to embrace a technological system of mainstream agriculture that does not reflect their values, interests and preferences, and instead rely on alternative framings of technological culture to give meaning to their own vision of how agriculture should be. By doing so, the thesis will explore a novel collaborative mode of technology production which, it will be argued, is substantially different from the dominant market driven one.

The concept of the social movement is employed to describe this collective activity, albeit in a rather early stage. This is done in order to enable the tracing of the various ideological frames that contribute to the creation of a common set of principles and goals for those engaging in this activity as well as their efforts to gain support. That is why framing analysis has been selected as a key theoretical approach, while combined with resource mobilisation theory, the incentivising and resource management processes within the movement organisations will also be explored.

It will then be argued, through the incorporation of technology theories, that the framing and mobilisation processes in the movement influence how technology is conceived and produced within this movement. Specifically social constructivism will provide the necessary tools to examine the details of the production process while critical theory of technology will allow the thesis to examine this activity in the broader sociotechnical environment. Last, I will argue that it may signal a break from the capitalist mode of technology production and formulate a more democratised alternative.

1.1 Technology and conventional agriculture - Capitalism in agriculture

The shift from feudalism to capitalism and the start of the land enclosures along with colonialism have marked the transformation of agricultural production. Brenner (1976) in his seminal essay "Agrarian Class Structure and Economic Development in Pre-Industrial Europe" postulates that the end of feudalism and the rise of capitalism in Europe were mainly driven by changes in the agricultural class structure. Albritton, on the other hand, (1993) points to the importance of trade opportunities rising in the domestic and international level. At any rate, the capitalist system evolved alongside agricultural activity, greatly influencing how production took place while marking a gradual shift from subsistence to commodity production.

While peasants were transformed into labour workers to feed the industrial revolution, machinery and modernised farming techniques, which increased productivity and yields, were in turn introduced to feed. All economic activity became driven by capital accumulation, labour exploitation and escalating competition (Wood, 1998). This development sparked the accumulation of land and great centralisation of production in large farms where former peasants became waged labourers (Federici, 2004). Further, as even Marx (1999) pointed out, capitalist production robbed not only land from peasants but also the soil itself, meaning the fertility of the land due to overproduction thus initiating the need for modern farming methods.

This competitive environment substantially transformed agriculture and enabled the rise and dominance of "agribusiness" (Davis and Goldberg, 1957). Davis and Goldberg (1957) introduced this term to characterise the infiltration of the industrial sector in agriculture. Initially with mechanical inputs that favoured large scale production (Gifford, 1992) and later with chemical and biological ones (Lewontin, 1998), intensive industrial agriculture and proprietary technology gradually captured more and more traditional practices from farmers. This has led to the cannibalisation of farms by competitors which were more adept at what Cochrane (1993) called the "technology treadmill" and the massive expansion of the agribusiness sector, which is basically fuelling the treadmill. Large, complex and expensive motorised machinery that multiplied productivity were introduced by the industries. This initiated the treadmill and forced farms to keep upgrading into new inputs in order to be able to compete (Mazoyer and Roudart, 2014). The process of capturing quickly expanded into new methods of farming with the introduction of chemical fertilisers, pesticides and growth hormones but also proprietary, genetically modified seeds, essentially replacing free knowledge and techniques developed and tested by farmers themselves over centuries.

This development is consistent with the social transformations of the last decades that signify the emergence of a new type of capitalism; named "cognitive capitalism" in which "the object of accumulation consists mainly of knowledge" (Boutang, 2012: 57) that is now a basic source of value. This new form of capitalist accumulation takes place through the use of exclusionary intellectual property (IP) licenses and the creation of artificial scarcity. In other words, it encloses and privatises knowledge in order to exact rents, thus limiting its diffusion in society (Boutang, 2012). This is justified with the claim that IP rights create incentives for economic agents to pursue the research and development of new products and services (Arrow, 1962). IP in agriculture today is manifested in all stages and is dominating over farmer-developed options. Patents for plants, for instance, were first issued in 1961 after the establishment of the International Union for the Protection of New Varieties of Plants (UPOV). Traditional farmer varieties failed to meet the criteria for protection and over the years were appropriated and replaced by proprietary ones. The advances in bioengineering in the 1990s spread IP licences drastically (Lewontin, 1998), enforcing restrictions not only in specific plants but also in certain traits, genes and even methods that were manufactured in labs (Aoki, 2009).

The outcome of this enclosure process is the tremendous agriculture-related technological concentration in the hands of a few mega-corporations. According to a report (2013) by the ECT (Erosion, Technology and Concentration) group, the world's top three companies control 53% of the global commercial seed market and the top 10 control 76% (meaning the seeds that are sold which excludes seeds developed and exchanged by farmers); six companies account for 76% of the global agrochemical market; ten pesticide firms hold about 95% of the global market; ten firms control 41% of the global fertilizer market; three companies account for 46% of the animal pharmaceuticals market and seven firms control 72%; and finally four companies account for 97% of poultry genetics and another four account for 66% of swine genetics. As far as mechanical inputs are concerned, concentration is continually rising with four companies controlling 50.1% of the global market by 2009 and eight companies controlling more than 60% (Fuglie et al, 2011). Meanwhile by 2008 five companies held 90% of the global grain trade, three countries produced 70% of maize, and the thirty largest food retailers accounted for 33% of world grocery sales (McMichael, 2009).

The notion that conventional agriculture presents serious challenges to small scale farmers and that the technology model supporting it has effectively removed them from the creative process of developing artefacts that are supposed to accommodate their activity, largely ignoring their empirical input and desires, has been the point of departure for oppositional activity. Mumford (1964) argued that there are two parallel sets of technology being developed in modern society, one authoritarian and one democratic. The former is system-centred and powerful but also unstable. It is centralised, large-scale and with a high degree of specialisation that turns humans into resources. According to Mumford, while this system has been around for centuries, it has infiltrated modern society to such degree because it seemingly accepts the basic principle of democracy. In other words, its products are equally available to anyone who can afford them. However, one can only take what the system offers and nothing else. The latter is human-centred, based in craft and agricultural communities whose activity is, while limited, adaptable and durable. This type of technology, characterised by creativity and autonomy, is developed to address specific social needs through appropriate means.

Mumford’s distinction, simplistic and wide open to criticism as it may be, builds a framework upon which the thesis will explore the potentialities of an alternative technological strand. To do so I will be looking into initiatives that formulate a new social movement whose goal is to promote open source technology developed by its own users in agriculture against the perceived authoritarian version of the agricultural system. This allows for the examination of the political, economic, ethical and cultural stimuli behind their technological development as opposed to the economic-political agenda of the agribusiness sector.

1.2 Conceptualising open source agriculture as a new social movement

These initiatives, mainly consisting of small scale and organic farmers, adherent designers and engineers, and activists oppose the socioeconomic and technological aspects of conventional agricultural production but also its other, arguably more severe, consequences. For instance, its environmental impact due to the large scale methods employed and the reliance on fossil fuel resources has been widely explored in the past two decades (Tilman, 1999). Further, biodiversity has been greatly reduced; (Biao et al., 2003) energy requirements greatly elevated (La Rosa et al., 2008) and water depleted and contaminated (Brown, 2004). These projects are collaboratively designing and manufacturing their own tools and machines to address their needs. Utilising modern information and communication technologies (hereafter ICT) the designs for these pieces of technology are made widely available for anyone to adopt and adapt to their own needs.

This activity which I call open source agriculture is explored in the context of an emerging social movement and it is the main focus of this thesis. This treatment allows me to systematise and make sense of the breadth of factors that affect the development process as well as their output. Because if we are to call the aggregation of initiatives producing open source technology for agriculture an emerging social movement, then we can contextualise it within social movements that came before it. That is in order to locate commonalities and trace linkages as well as the values and ethics they embody in a structured way. Framing analysis applied in larger social movement theories (Benford, 1997) provides the necessary conceptual tools to do so. According to this approach, adherents of movements engage in framing in order to "assign meaning to and interpret relevant events and conditions in ways that are intended to mobilize potential adherents and constituents, to garner bystander support, and to demobilize antagonists" (Snow and Benford, 1988, p.198). Thus tracing the (master) frames of broader movements that guide the collective action of the open source agriculture movement will inform the exploration of how and to what end its adherents are framing their activities. Open source technology for agriculture as a movement that focuses on developing and promoting alternatives to the dominant agricultural paradigm can be associated with the frames of various relevant movements. Preliminary investigation indicated three broad movements whose master frames can be identified in the open source agriculture frame: The organic, open source and peasant movements. Their content and connection to the open source agriculture movement will be presented in chapter four.

Further, resource mobilisation theory will be utilised in order to look into the social movement organisations in the centre of both agricultural communities examined in this thesis as they seek to secure and distribute resources necessary for their operational activity as well as provide adherents with incentives that correspond to their specific interests and values in order to elicit participation (McCarthy and Zald, 1977). This allows the exploration of the creative capacity of the movement that goes beyond opposition and the organisational particularities that facilitate it, with a particular focus on the technology development processes.

1.3 Focus on the technological perspective – Formulation of a development model emanating from the open source movement

This new social movement is identified as technology-oriented with the main focus of this thesis being the mode of technology production that emerges from within its activity. A key assumption for this thesis, as is arguably the case with most contemporary technology studies, is that technology is socially determined. Various theories exploring technology have emerged over the past few decades, effectively overcoming technological determinism, i.e. the notion that technology evolves linearly and autonomously and influences society without being directed by it. Here a constructivist approach, informed by the critical theory of technology, is adopted. While the constructivist approach examines pieces of technology in an attempt to explain why and how they have emerged, the critical one adopts a socio-political and philosophical standpoint on how the technological domain evolves.

The constructivist strain of technology research emerged from within science studies that opposed positivism at a time when the environmental concerns and information technologies were rising. This led to their rejection of determinism and claims that technology is a social phenomenon leading to a large volume of case studies where the relevant social groups and the friction amongst them were carefully examined to determine how they defined the shape of certain technological artefacts. Similarly, conceptual tools from constructivist approaches will be borrowed here to track how interactions of community members as well as their values and interests (as they are formulated in the social movement inquiry) create alternative technologies.

For all of their undisputed contributions to the understanding of how technology is developed, however, the constructivist approaches have been criticized extensively with the main point of contention focusing on the lack of political or even normative relevance (see Woodhouse, 1991; Hamlett, 2003). Critical approaches on the other hand bring the views of the Frankfurt school into technology studies by incorporating an analysis of the entire system of capitalism and its subsequent structures.

When reviewing the progress of technology on a grander scale, the complexity of the issue makes discerning a pattern that clearly explains the evolution of technological development quite difficult. Instead, we should look back in history to establish what specific social circumstances lead to a specific technological outcome. For instance the fall of the guild system at the end of the 18th century and the rise and struggle to maintain control in capitalist production is what defines the conditions for technological development until today (Feenberg, 2002). While the change looks quantitative and technical at first look, a deep qualitative change, which was a necessary condition for industrialisation, also took place in work, design, management and conditions with the main feature being the deskilling of workers (Ibid.). If guilds had managed, instead, to evolve into worker-driven manufacturing facilities then the nature of technological development would have been different.

The transition to the capitalist economic system of production brought about a radical change in the way technology is developed by transferring control from the craftsman to the owners of productive resources and managers (Feenberg, 2010a). Technical values, experience gained and lessons learned from using technologic artefacts were no longer feeding back into the development of technology. While the technology expert and the user would interact closely before, in capitalist production their connection has been largely severed (Feenberg, 2010b). As a result, the consequences that escaped the scope of profit from newly developed technology became irrelevant. Marcuse criticised the technological rationality developed by techno-scientific management that proliferates in capitalism despite its apparent irrationalities (Marcuse, 1964). This rings especially true in the agricultural context, where as previously discussed, the industrialisation process has had an enormous impact. These irrationalities are the starting point for critique according to Marcuse (1964), which, if followed by the establishment of a new historical subject (a vague notion which is understood as a catalyst or agent) may progressively, despite limitations, lead to transformation.

Due to its characteristics, peer-produced open source technology, as it will be presented in the following chapters, could potentially form such a subject pushing for technology that breaks free from the capitalist framework. In the wider academic discussion about the democratisation and constructive assessment of technology, open source presents a possible bottom up alternative for citizen inclusion in the development process of technology. An alternative that goes beyond the arguably suspicious populist appropriation of the language of “participation” from the political and scientific elites (Thorpe, 2008; Levidow, 2007). Open source technology may be viewed as subject to reconstruction and democratic participation, enabling people “to participate effectively in a widening range of public activities” (Feenberg, 2002, p.3). It also seems to echo Gorz’s (1983) argument that decentralised productive infrastructures, focusing on the development of locally-controlled technologies, are vital for democratizing decision-making.

In this vain then, the thesis uses as a point of departure those independent initiatives that already engage individuals in the co-creation of technological artefacts. Their experience can, potentially, provide valuable insight in the theorising of democratisation of technology in general and “socially inclusive”, “participant driven”, “grassroots” development more specifically rather than attempting to explore this activity through conventional top-down means and institutions.

Up to this point the development process of open source technology has been researched marginally. Most available studies have focused on the characteristics and development models of open source software. This thesis will utilise the aforementioned theoretical approaches in an attempt to formulate a robust theoretical underpinning for technology within this project. It will be claimed that the collective framing within the movement provides the foundation for the technologic development process and artefacts produced. The goal is not only to understand the process through which this technology is produced, in terms of the interests or goals of those involved (via the constructivist approach), but also to look at the effect of the broader economic and cultural factors (with the help of the critical approach).

Further employing the constructivist approach to open source technology, and specifically hardware used for agriculture, can provide important insight on the evolutionary trajectory of socially constructed technology. For instance as we will see in chapter six, the concepts of stability and closure within the constructivist tradition, used to comprehend the development process of a specific piece of technology, are challenged here since they violate the basic values of technology as it is conceptualised.

1.4 Thesis structure

Chapter two will present the research methodology as well as the data gathering and analysis processes for the thesis.

Chapter three will review the relevant social movement theories with a focus on resource mobilisation and framing theories which will be utilised in this thesis. Of particular interest is the role of social movement organisations and selective incentives for the participation in social movements since material artefacts are developed as part of the movement activity examined here. The framing activities that social movements engage in are pertinent especially in the context of wider master frames.

The fourth chapter will examine the master frames that have been identified as the main contributors to the creation of the open source agriculture collective action frame.

Specifically the organic; peasant and open source frames will be synthesised. Each sub-case of the open source agriculture movement will be analysed under the framing lens. This will contribute to the understanding of what motivates the adherents of the movement to engage in the production of technological artefacts within this thesis's context. At the same time, both social movement organisations will be reviewed through the resource mobilisation viewpoint to examine the material factors affecting this process.

Chapter five will review the technology theory which will be applied in the thesis. Particular emphasis will be placed in the technological frames as tools of the social constructivism of technology school of thought and the application of the social movement analysis output in the technological analysis in this thesis. Emphasis is also placed on the critical theory of technology that will provide a structural consideration and a normative perspective in technological development emerging from the juxtaposition of the technological actors presented in this thesis and modern large-scale agribusiness.

Chapter six will again examine the two sub-cases, this time under the technology theory lens. First the various aspects of activity will be explored, like their organisational and economic models that are formulated to support technological development. Then the social construction and critical perspectives will be applied in order to examine the technological development process in the micro and macro level respectively.

Chapter seven will provide an overall synthesis for an alternative technological rationale emanating from this and other technological social movements as well as the emerging mode of production that is empowered by this rationale to expand globally.

Concluding remarks will be offered in the last chapter.

CHAPTER TWO

2. Research design and focus

This chapter will provide an outline of the methods utilised to both gather and process data as well as how that data are presented. In other words the strategy with which one may examine and discuss the topic they are concerned with in an academic manner.

As already mentioned, this thesis sets out to research open source technology development as an alternative technology built on an alternative set of values. To explore how this technological trajectory can manifest itself I focus on agriculture by borrowing a social movement theory approach and applying it on technology theories in order to identify the political identity and collective action plan that is formulated through the values, goals and interests of the open source agriculture movement. Meaning the aggregation of individuals, organisations and communities, mostly comprised of farmers, who contribute to the development of machines and tools for farming. The design and know-how of these tools are made freely available without restrictions preventing their reproduction. Such activity takes place in various productive fields, yet its application in this open source agriculture movement provides one of the most mature instances of open source technology besides software.

2.1 Research design

The case study approach, and specifically the embedded type, has been adopted to gather and analyse empirical data, in order to be able to examine individual cases separately but also as part of a larger case. Thus the overarching case, open source agriculture, is examined through two sub-units of analysis, which provide diverse data for the analysis of the main case (Yin, 2003). Engaging in purposive sampling and specifically criterion sampling (Palys and Atchison, 2008), the sub-cases chosen are non-profit social movement organisations and their respective communities. Those are L’atelier paysan Paysan, a cooperative in France that is developing farmer-driven technologies and practices, and Farm Hack, a community of farmers promoting open source tools and machinery designed and developed following the open source principles, in the USA. Out of the various actors in this movement, these have been selected due to the collaborative and self-mobilised nature of tool development within their rather large communities.

Meaning projects that have been initiated by those within farming communities with a goal to develop and disseminate technological solutions that would primarily benefit the community itself. Initiatives by external organisations like state agencies, research institutions and social enterprises were reviewed but rejected on that basis. That is not to suggest that such projects could not qualify as important for this type of research project. But merely to provide some focus for this thesis (and cater to the researcher's preferences).

Furthermore, the thesis focuses on the European and US regions, mostly due to resource limitations. That does not mean that there are no noteworthy projects in other regions. For instance the Honey bee network in India, a project which was in fact initiated by a researcher rather than self-mobilised, promotes technology for poor rural areas that would, potentially, fit in the context of the thesis. While similarities with the projects selected are significant, each is defined by a unique mixture of local economic, political and cultural characteristics shaping their actions, goals, values and interests. In this regard, beside practical reasons, those two sub-cases were selected in order to limit the scope of the thesis even further into the "western world" and allow for an in-depth as well as comparative examination of the selected sub-cases. No doubt further research that would include initiatives from non-western countries would provide much richer insight in the phenomenon studied, but it would exceed the limitations of this thesis.

Being able to adapt diverse research techniques is an important component when conducting case study research as well as multiple sources of data gathering (Yin, 2003). A mixture of interview and observation has been selected, as dialogical methods that spark reflection through conversation. Documentations as well as digital web tools, typically utilised by this type of communities, provided further data that are used for triangulation (Murthy, 2008).

I have managed to secure access through key individuals from both sub-cases which should be viewed mostly as key informants (Rieger, 2007) and not as gatekeepers, since despite their varying organisational structures this type of initiatives avoid rigid hierarchical structures and instead adopt a consensus-driven decision making system based on mutual validation and meritocracy. This bottom-up approach has previously been described as peer governance (Bauwens, 2005). Therefore, these first contacts function primarily as conduits to the rest of the members of each case as well as for further information regarding field work.

2.2 Data gathering

Semi-structured interviews were conducted with members from each sub-case. This type of interview was selected due to its flexibility that allows interviewees to discuss what is most important to them. The goal was to establish dialog with the interviewees in an attempt to reach a common understanding of the issues explored. Further participant observation (Yin, 2003) was employed, where interaction with members of each case took place on-site in order to immerse myself and attain a clearer picture of the internal structure and processes of the groups observed. Prominent members within these cases have been identified during the observations and targeted for interviews, while more were secured through snowballing which aimed for those with long standing participation in the organisations and/or particularly interesting perspectives in the context of this thesis.

The interviews were structured around specific core questions and probes that attempted to elicit important data regarding their goals, desires and ideologies as well as their coordination and development methods. These, in practice, were mostly indicative however and were used to place emphasis on the questions that were deemed most relevant during the design process of this research project. Some topics were of more interest than others to interviewees so they elaborated as they pleased, revealing more interesting questions which were not previously considered. Furthermore, some interviews took place on site so the surroundings coloured the flow of the discussion.

In total, 20 interviews were conducted and audio recorded, 10 for each sub-case. 6 of these were conducted using a video call tool due to large geographic dispersion of the interviewees and time limitations. A detailed list of the interviewees (no pseudonyms are used) can be found in the appendix as well as the interview guide. Due to the long duration (more than an hour long) of most of these interviews, only the parts that were deemed integral to the research purposes were transcribed by myself. Meaning those parts that are more informative and representative of the interviewee's perspective.

Field observations took place in various sights, including workshops, events and organisation bases of the sub-cases. There I managed to witness the groups' interactions and activities as well as interact with them myself. I travelled in France in various occasions during the spring and summer of 2016. There, I participated in two machine prototyping workshops, attended a three day gathering/festival and spent some time in the operational base of the organisation. The US sub-case field trip took place over a two-week period in various locations in the states of New York; Vermont; New Hampshire and Massachusetts in December, 2016. There, I visited farms, attended a prototyping workshop and a farmer tool summit sponsored by the organisation under examination. In both cases I had the opportunity to converse with numerous farmers and other individuals involved in the movement as well as observe (and sometimes assist with) the work and general interaction around tool development. On some occasions, I had the privilege to be invited into their homes and share food and stories. Even so, a large part of the activity in this type of initiatives is distributed with their community members widely dispersed in their respective regions (as well as internationally) with much taking place online. Hence managing to achieve physical interaction proved difficult considering the limited resources at my disposal.

Last, data was gathered from the online platforms, fora, discussion sections and documentation (audio-visual material, reports, articles, blog posts) available as well as email communications with individuals from each sub-case. Given the fact that openness is a principle permeating such initiatives, there are rich and diverse sources available for the mining of research data. Like the interviews, key documents and discussions have been selected that provide the most insight in each sub-case. In other words, those that provided details on the intricacies of the technology development model as well as insight on what motivates participants.

2.3 Data analysis

The data are analysed under two thematic lenses. First they are reviewed under the social movement theories which then inform their review under the technology theories, leading to a synthesis of the two. At the same time each sub-case is examined individually and then in tandem.

This sequential process will be elaborated upon in the following chapters after the presentation of the theoretical approaches and conceptual tools. However, every step follows an iterative approach which attempts to include the participants' input in the whole undertaking. Kloppenburg and others point out that the conceptual framing of alternative agriculture in academic research is primarily “based on the reflections of academics and policy specialists rather than on the views of sustainable producers” (2000: 178), which despite being valuable, may ignore the diverse empirically developed reflections of those involved in the movement. Similarly, within the wider discussion about the democratisation and assessment of technology development the language of “participation” and “engagement” has been widely appropriated by political elites as an attempt to avoid criticism, while academic research has often focused on the introduction of novel institutional arrangements (like citizen forums) to tackle the issue than critically challenging the dichotomy between expert and lay participation (Thorpe, 2008; Brown, 2009; Levidow, 2007).

The above indicates the limited empirically grounded research which adopts a bottom up and inclusive framing of participatory technology development. This thesis is an attempt to bring forth the perspectives of those engaged in the development of technological artefacts for the agricultural production sector while being, at the same time, the ones working with these artefacts bridging knowledge, values and skill. In order to articulate their alternative conceptualisations of technology, the chapters presenting my empirical work will heavily feature their voices rather than just my own. Additionally, analysis in the technology section (chapters five and six) will take place in two levels. The ground level which will be exploring the interactions within the community and a macro level which will evaluate the impact of socio-economic forces in both sub-cases based on insight provided by critical theories of technology.

Chapters three and five will establish the necessary framework, from a social movement and technology perspective, while chapters four and six will provide the analysis respectively. In this sense this current chapter does not offer a comprehensive description of how the data is analysed but rather a guide for how this research project is structured in the thesis.

CHAPTER THREE

3. Open source agriculture as a social movement

Open source technology in agriculture is a newly emerging phenomenon that is not easy to classify. As chapter four will show, while certain individuals within these communities do not classify themselves as the adherents of a specific social movement (this has also been noted by other researchers before) they do see themselves as ideologically kindred to larger global movements that inform their activities even if some participate simply because it makes practical and economic sense. It may be viewed then as a social movement itself emerging from the agglomeration of the various initiatives from around the world. Although, much like in the case of the free and open source movement, there are undoubtedly varying goals and backgrounds among these initiatives it can prove beneficial to examine it as one in order to determine whether there is collective action that stems from the realisation of common political goals. While looking into a failed case of open source hardware, Soderberg (2011) concludes that lack of a strong common political cause within the community developing the technology may have contributed to its failure. More importantly however, the social movement concept enables this thesis to analyse the varying struggles for meaning of the various actors as attempts to mobilise support, which combined with technology theories can provide a way to conceptualise technology development as a complex process defined by their collective values and interests.

Typically social movements oppose an established status quo via protest, for instance the movement against genetically modified food, and in some cases via promoting alternatives, like the organic movement (Hess, 2005). Similarly, O'Mahony and Bechky (2008), examining the open source software movement, claim that adopting a broader definition of the term social movement was required since instead of contesting proprietary software, like typical oppositional movements would, it actually produced an alternative. More specifically Hess (2005), viewing movements from a technological perspective, coins the term technology- and product-oriented movements to label those that create and promote specific technological artefacts and practices. Open source agriculture is conceptualised as such a movement within this thesis and the sub-cases form its social movement organisations.

Technology and product-oriented movements challenge scientific knowledge and certain technological systems while often promoting or even producing alternatives by establishing alliances with groups sharing similar interests like scientists and entrepreneurs (Hess et al., 2007). Examples of such movements can be found in a plethora of fields: the antismoking movement as oppositional to cancer and HIV therapy movements as promoting alternatives in the health sector; the nuclear power and genetically modified food as oppositional movements to certain technologies and the organic food movement as promoting alternative agricultural methods in the environmental sector; the media reform oppositional movement and the open source, alternative media in the information sector. This movement is similarly defined as such, in conjunction with its technological output.

Hess's work (2005) illustrates how such movements are connected to wider social movements and enter uneasy, yet beneficial, alliances with the private sector (to produce, supply and promote the alternative technologies). They adopt unorthodox organisational structures and navigate varying sources of support over their evolution to achieve their goals regarding alternative technologies, often at the expense of their most radical design elements and political rhetoric. He further finds how occasionally technologies developed as alternatives tend to be transformed into complementary ones to those they are supposed to replace, in order to be accepted by their target professionals and industries. Such observations are imperative in the examination of activity within the initiatives as they evolve. This chapter will attempt to assemble the elements necessary to review open source agriculture under a similar vein and answer the first scale of this thesis's research question, i.e. how the adherents of open source agriculture organise themselves and frame their technological activity. In order to achieve this, the relevant social movement theories will be explored, namely resource mobilisation theory and framing analysis, starting with a general introduction to the field.

Social movement theory emerged in the beginning of the 20th century. Early research was centred on the ideas of deprivation and grievances that pushed individuals to act spontaneously and often irrationally (see for the example the work of Gustave LeBon and Neil Smesler). However, the proliferation of various social movements with explicit goals, strategies and beliefs in the following decades required more concrete theoretical frameworks and conceptual tools to be examined. The racial, women's and environmental movements are only some indicative examples.

New theoretical approaches emerged that can be thematically divided into three streams. The first, influenced by organisation theory, examines predominantly social movement organisations at the core of social movements as hubs of strategic planning and coordination. The most prominent example of this stream is resource mobilisation theory (hereafter RM), first introduced by McCarthy and Zald (1977). According to this approach social movements are not mere manifestations of grievances but expressions of rational collective action made possible by the utilisation of available resources. To achieve this, social movements rely heavily upon organisations. These formal Social Movement Organisations (hereafter SMO) are examined extensively in RM in order to establish how they mobilise a variety of resources and engage various actors in order to maintain the social movement and extend its influence.

The second stream borrows from political studies to examine social movements. Within this stream, political opportunity (or alternatively coined as political process) theory focuses on the impact that institutions and political/structural factors might have on the success or failure of social movements (Tarrow, 1998). According to this approach, political opportunities and changes in the political environments might have a profound impact on social movements, as they might enable or constrain collective action for certain social groups (McAdam, 1998). Thus, the actions of social movements are viewed as reactions to changes in the political process.

The third stream views social movements through a cultural and social-constructivist lens. Sparked by new social movements whose groups are formed on a shared identity, like for instance the LGBT or the women's movements, research here focuses on processes of construction of meaning and ideologies. Within this stream, framing analysis examines how social movements enable collective action through the construction of frames that provide a common identity and goals for the adherents (Snow and Benford, 1988).

Social movement theories allow us to gauge the form of political structures within society, i.e the peoples' engagement in public issues (Tilly, 2004). Examining the phenomenon under study in this thesis through this line of reasoning allows for it to be reviewed as an agent for change in the technological system of agriculture. Framing and RM analysis are selected for this thesis as they provide useful conceptual tools to track the diverse set of values and interests represented in the sub-cases as well as examine the organisational forms of the SMOs under study and the selective incentives for individuals' participation. Political opportunity is deemed unable to provide the right tools for insight in this case, since the political climate within which this particular movement is emerging is, arguably, not shifting towards favourable conditions (an understatement according to many of those I conversed with). Elements of it however are implemented in the RM analysis, for instance in exploring the securing of resources through state outlets and working around regulatory hindrances. At any rate, both approaches will be presented in detail in the following sub-chapters.

3.1 Framing analysis

3.1.1 Basic premise of the framing analysis

A frame is a methodological concept popularised by Goffman (1974) and is used to describe the amalgam of ideas and perspectives that motivate individuals and groups. They provide meaning to individual experiences and contextualise human interactions in society. As a research tool framing analysis has been utilised in various academic fields like media studies, political science, economics, social psychology, organisation and policy studies.

Within social movement studies, framing seeks to explore the collective meaning making processes of social movement actors to mobilise action and interpret events and ideas (Benford, 1997). A frame is "an interpretive schemata that simplifies and condenses the 'world out there' by selectively punctuating and encoding objects, situations, events, experiences, and sequences of actions within one's present or past environment" (Snow and Benford 1992, p. 137). More specifically, the concept of collective action frames is used to describe "action-oriented sets of beliefs and meanings that inspire and legitimate the activities and campaigns of a social movement organization" (Benford and Snow 2000, p. 614). These collective action frames are deployed "to mobilize potential adherents and constituents, to garner bystander support, and to demobilize antagonists" (Snow and Benford 1988, p.198) towards the achievement of the movements' goals.

To achieve this, SMOs and social movement activists utilise collective action frames to engage in three main framing tasks, diagnostic framing; prognostic framing and motivational framing (Snow and Benford, 1988). Diagnostic framing entails the identification of social issues and, and in some cases, their cause. Prognostic framing is the process of providing potential solutions to the identified problems through certain strategies and goals. Motivational framing then provides a “rationale for action” (Snow and Benford, 1988, p.22) since consensus about the problems and solutions does not necessarily guarantee the spark for action. Benford (1993) identifies “vocabularies for motive” within movements which aim to mobilise individuals into action. For instance, in Benford’s (ibid.) work with the nuclear disarmament movement the vocabularies of severity, urgency, efficacy and propriety were utilised by movement actors to elicit collective action.

3.1.2 Frame processes

Collective action frames are generated via various processes that Benford and Snow (2000) thematically categorise as discursive, contested and strategic. Discursive are the ones that emerge through communication amongst movement members and can be further distinguished as frame articulation, which is the joining of experiences and ideas in new ways, and amplification, which involves the accentuation of certain ideas or events as more important than others.

Contested processes emerge through contestation and confrontation for the establishment of collective action frames. These, according to Benford and Snow are “counterframing by movement opponents, bystanders, and the media; frame disputes within movements; and the dialectic between frames and events” (ibid, 625). The first two involve the reframing of a movement’s activity due to external and internal opposition respectively. The dialectic between frames and events refers to the dialectic relationship between movement discourse and actions which may lead to the rearrangement of the collective action frame.

Last are the strategic processes which will be of particular interest in this thesis. These processes, which were originally termed as “frame alignment processes” by Snow et al. (1986), are utilitarian, deliberative and with specific goals, such as to spark engagement and mobilisation within the movement and acquire resources.

Frame alignment is divided in processes that have been termed as frame bridging, frame amplification, frame extension, and frame transformation. Frame bridging is the process of connecting “two or more ideologically congruent but structurally unconnected frames” (ibid. p. 467), usually between a movement and unmobilised groups and individuals, in order to address a certain issue. Frame amplification is the process of accentuating existing beliefs and values in order to gain supporters. Frame extension refers to the process of extending the focus of a movement's goals in order to include concerns of potential adherents. Last, frame transformation is the process of transforming old meanings and perceptions into new ones.

3.1.2 Master frames

Some collective action frames may be so successful with applying these processes and acquire such a broad scope that they achieve a status of master frames which influence the activity and orientation of other movements. While regular collective action frames are specific and limited to the issue they attempt to address, master frames are wider and flexible allowing for various movements to utilise them. Initially the term was coined to explain the cycles of protest that emerged even when the conditions were not favourable (Benford and Snow, 1992).

Over time, the scope of master frames has expanded to fit various research purposes. Moone and Hunt (1996) for instance, extended Benford and Snow's use of the term to look into the ideological bridging of various periods of activity in social movements. Carroll and Ratner (1996) have researched the capacity of master frames to connect varying social movements into a combined front by examining Canadian movements under the prevalent injustice master frames.

Swart (1995) redefines master frames as symbolic tools with cultural significance in certain time periods, which allow various movements to adapt them in order to elicit support. Examining the political movement of Sinn Fein in Ireland, and its appropriation of the League of Nations nationalist frame to promote its agenda, he concludes that similar to frame alignment, master frames may be moulded to tap into wider political and social historical contexts. This thesis will be expanding upon Swart's (ibid.) line of inquiry in order to explore how the open source agriculture movement is engaging in master frame alignment processes to reconfigure three master frames, namely the organic; open source; and peasant ones to formulate its collective action frame.

3.1.3 Critique of framing analysis

Criticique on this approach has been extensive. Benford (1997), as one of its key proponents offers an aggregation of potential pitfalls identified in the bibliography: it potentially views movements and their frames as static and not malleable and subject to constant change; it overlooks individual frames of participants; it overemphasises frames as existent when they are merely mental constructs; it often values conceptual analysis over rigorous empirical work.

3.1.4 Application of framing analysis in the thesis

Framing analysis in this thesis will enable the systematic tracing of the various ideals, beliefs and ideologies that contribute into the emergence of open source technology as a social movement and subsequently a development model for alternative technology. In other words, framing analysis allows the exploration of the link between ideologies and action, which in this case goes beyond opposition to create artefacts, possibly, imbued with these ideologies.

Frame alignment processes within each SMO, elevated in the master frame level, will be traced in order to identify the open source agriculture collective action frame. As a social construction this frame is malleable and ever evolving, formulated in a transnational level by different types of actors engaging in productive activity rather than merely promoting a certain agenda. Framing analysis, then, offers several conceptual tools that may be used to better understand how technology is produced in the context of the economic activity outside the dominant mode of technology production.

However, given the fact that this mode of technology production relies, at least partially, into market and state relations, it would be safe to assume that interests and values of these spheres also influence the technological outcome of the movement under study. Indeed, this type of specialised social movement activity is dependent on material resources and the socio-economic environment it is taking place. This is where resource mobilisation theory will be utilised, to provide further insight on what type of structure these organisations adopt in order to maintain their activity and what incentives are offered in their adherents to elicit support and resources.

3.2 Resource mobilisation theory

3.2.1 Basic premise of resource mobilisation theory

RM emerged partly as a response to previous scholarship claiming that social movement activity is irrational and practiced by fringe members of society. Instead, RM maintains that social movements need resources to exist and act rationally in order to obtain them. The social movement here is viewed as "mobilized or activated (effective) demand (preferences) for change in society" (McCarthy and Zald, 2001, p. 534) and SMOs are important elements of representation for this demand, as they mobilise the necessary resources for the demand to be met.

According to McCarthy and Zald (1977), who are key contributors to the theory, there are three basic assumptions for RM: instead of being supported by aggrieved populations who provide resources, movements draw upon a wider base of supporters both individuals and groups; movements can use several tactics to achieve their goals; and last, movements interact with and are influenced by political and institutional structures, primarily through SMOs.

A SMO is defined as a formal organisation which aligns its interests with those of a social movement (ibid.). Several SMOs might be affiliated with one movement, grouped in what is called a social movement industry, and it is possible for them to be competing for the resources available for the achievement of the movement's goals (McCarthy and Zald, 2003). These resources may include materials, money, labour, land, facilities, technical expertise or even legitimacy (Tilly, 1978; Mcarthy and Zald, 1977).

For resources to be attained, the SMO focuses its actions towards the individuals and groups in society that may assist in the achievement of the movement's goals. These may be categorised in various ways. For the purpose of this thesis, Mcarthy and Zald's (1977) categorisation will be outlined: Generally speaking, there may be opponents to the movement's goals and mere bystanders; more importantly, those that share the movement's convictions are called adherents, while those that actively contribute resources to the achievement of the movement's goals are its constituents. A further distinction for each of these categories is whether they may benefit from the achievement of the groups goals or not as, presumably, even an opponent could potentially be a beneficiary. Having said that, an adherent or even a constituent is not necessarily a beneficiary as they might contribute out of simple agreement to the movement's cause.

In broad terms, the SMO attempts to turn bystanders into adherents (beneficiary or otherwise) and adherents into constituents, but the goal of each movement is what defines the specific course of action. More specifically a SMO may provide selective incentives that will ensure continuous involvement from constituents. These incentives may be monetary or material, while Jenkins (1983) has pointed out the importance of individual entrepreneurs associated with SMOs. Thus, RM attempts to examine social movements and SMOs to identify what groups and individuals are engaged and how resources are mobilised to achieve the movement's goals.

3.2.2 Critique of resource mobilisation theory

Over the years RM has been critiqued. A major point of critique is RM's insistence on material resources to explain social movement participation, often ignoring grievances and ideological motivations (Buechler, 1993; Ferree, 1992). The analysis of mainly professional SMOs and individuals is another point of critique since it ignores informal organisations and social movement communities (Buechler, 1993; McAdam, 1982); Further, RM is accused of downplaying the importance of a collective identity for the success of a social movement (Melucci, 1996).

To counter the shortcomings identified in the critique of RM, specifically its one-sided focus on material resources to explain the successes and failures of social movements, as well as the critique levelled against framing analysis over its emphasis on frames as existing, this thesis utilises a synthesis of the two. In this sense, RM will examine the material motivation for participation in the movement, whereas framing analysis will look into the ideological and symbolic factors that come into play in the mobilisation process, thus formulating a comprehensive and balanced understanding of the movement under question here.

3.2.3 Application of resource mobilisation theory in the thesis

RM may provide useful tools for the analysis taking place in this thesis. Specifically its focus on SMOs and selective incentives, which combined with the insights from motivation framing in the master frame analysis, will enable the examination of the organisational structures featured in both sub-cases as well as the material motivation behind the involvement of individuals in the movement. Meaning, it will enable their examination as rational actors pursuing goals that could be perceived as attempting to escape the prevailing socio-economic context of market relations in conventional agriculture while at the same time struggling to secure the necessary resources to remain sustainable within it, or at least at its periphery.

L’atelier paysan and Farm Hack are only two of the SMOs involved in the open source agriculture movement. They have been selected due to their extraordinary organisational structures and the large communities supporting them. RM will enable me to analyse how they organise, mobilise the community adherents and constituents; attract more through selective incentives; secure funding and resources, and operate in order to achieve the movement’s goals. Further, it will allow the examination of the “business ecosystem” forming around the communities and their SMOs, primarily through the individual entrepreneurs allied with the movement.

3.3 Application of social movement theories in the case study

This chapter presented the social movement theories employed in the first half of analysis within this thesis. These provide the tools to organise and make sense of the rich data collected which will then be fed into the second half of analysis dealing with the technology aspect in chapters five and six. The following chapter will be an application of the theoretical approaches presented here in the two sub-cases.

First each sub-case will be reviewed under the RMT lens. AP and FH, as SMOs, are examined separately in order to pinpoint their unique characteristics as they are formulated within their respective environments even though they are geared towards similar goals. This will provide insights in the material factors influencing the movement’s evolution in the two sub-cases. Their organisational structure will be reviewed as well as their productive activity, i.e. their technology development processes. Further, their tactics to secure and optimally utilise resources will be examined. Special focus is placed in the selective incentives provided in either case as the movement’s productive capacity requires careful examination to understand how this alternative activity is made possible in practical terms.

Then, the three master frames identified as contributing in the open source agriculture collective action frame will be reviewed. Master frames here are viewed as historical thematic umbrellas to aggregate the immaterial underpinnings (values, ideals, interests, goals etc) of the movement. These have been identified via preliminary research in either sub-case which included tentative interviews and a review of documents and online material. They were then synthesised through a mixture of extensive literature review on the topic of framings in the identified social movements as well as key documents of their prominent transnational SMO's. The frames are broad enough to encompass all relevant elements identified in the subcases. No other broad frames were identified. Each master frame will be presented, followed by its adaptation and application in either sub-case. This will be done separately as well, since different aspects of each master frame are adopted and highlighted in the efforts of each SMO to elicit support for their cause. The data was reviewed multiple times to locate and assign those framings that correspond to each master frame. They were later structured in such a way as to provide a unifying narrative for either subcase.

That is not to say, however, that the data gathering and analysis were linear as the master frames were informed while the process progressed. For example, as will be presented in the following chapter, preliminary analysis did not indicate an appropriate technology framing in the movement. However, during my field work it became evident that it was indeed present with an open source element attached to it. Hence I updated the open source master frame to reflect this.

Last, a synthesis for the overall case of the movement will be presented. All common elements identified in either subcase are aggregated in order to formulate the collective action frame for the open source agriculture movement. In other words, it is the framework which offers a unified front encapsulating the diverse values and motivations as well as a common language for the whole movement. This will later provide the basis for the second part of analysis in this thesis which will adopt a theory of technology lens to apply the frame onto the development process emanating from within the movement.

CHAPTER FOUR

4. Open source agriculture: a case of two social movement organisations

This chapter will provide a thorough analysis of open source agriculture as a social movement. First, each sub-case, i.e l'atelier paysan and Farm Hack, will be introduced and examined under a RM perspective in order to explore how the availability of resources shape their organisational form, economic activity and operational mode. Then the master frames contributing to the open source agriculture collective action frame will be synthesised. These have been identified through preliminary investigation of key texts from both sub-cases as well as discussions with prominent figures. After each master frame is reviewed, its application in both sub-cases will be presented, leading to the final synthesis.

All data regarding l'atelier paysan in this chapter was gathered from interviews with the founders and core team of the organisation, discussions with constituents as well as from its extensive multimedia material (promotional leaflets, yearly activity and financial reports, photographs, videos, forum and blog posts) most of which can be accessed online in the spirit of open access. Similarly, data was gathered from interviews with key members of the Farm Hack organisation and community as well as from its online material (platform, coordination tools, blog posts).

4.1 Resource mobilisation in open source agriculture

4.1.1 The social movement organisation of L'atelier paysan

L'atelier paysan (hereafter AP) literally translates as the peasant workshop. It emerged in 2009 as a subgroup within an association for the development and promotion of organic agriculture called ADAbio in Rhone-Alpes (a region in the south east of France). It all began when the founders of this project Joseph, an experienced organic farmer and a member of ADAbio, and Fabrice, a very politically aware carpenter and then agronomist, realised that farmers could genuinely benefit from each other's tool-building experience and creativity. So they standardised, documented and disseminated three essential pieces of machinery that had been developed by Joseph along with other farmers and were utilised in raised bed farming (one of the basic methods for soil management in organic agriculture). This effort was well-received by the farmers in their network so more tool-building knowledge was accumulated over the next three years from farms in the area. Sixteen farmer-build tools were standardised in total. Their designs were then printed in a comprehensive guide-book complete with blueprints and pictures, for more farmers to be able to construct them in their own farm. Prints of the book were sold to support their activities while its digital version is available on the website for anyone to access (along with an invitation for users to translate it into other languages).

Meanwhile, in 2011 the first workshop took place. The tools made by AP are, almost, entirely made of metal. Ten farmers attended the workshop to learn how to work metal (basically cut, drill and weld) and attempt to assemble some of the aforementioned tools. The workshop was quite successful with the farmers producing eight tools by the end of a week. At this point these farmers along with Joseph and Fabrice established ADAbio auto-construction, which was basically the branch of ADAbio that was promoting the self-building of machinery by farmers. In order to facilitate the demand for more activity, first utilising various internship programs funded by the French state and later through regional state funds, they managed to hire people with specific sets of skills to assist in their endeavour, like for instance engineers and political economy graduates. After that, the first season of workshops began, were farmers learned metal-work and built the first three machines. Initially this activity was exclusive to their local region but later expanded in others.

While their workshops started attracting more farmers from all over France, the group began developing more tools along with farmers that were not limited to organic market gardening but included all types of small scale farming. For instance, they work with wine and fruit producers, cattle farmers and farmers utilising horse power. As their activity expanded significantly it became obvious that ADAbio could no longer facilitate this work so in 2014 AP was founded. As a legal entity AP is a cooperative whose stakeholders are the individual constituents (mainly farmers) and groups (other farming and solidarity organisations) that belong in the wider network of AP. The base of operations of AP is in the Rhone-Alpes region (south-east of France) while one of the first engineers to have worked in the project has established a branch in the region of Brittany (north-west).

4.1.1.1 Organisational structure

AP was initially conceived by a group of farmers led by Joseph and Fabrice. Their activity was institutionalised through ADAbio, the organic farming association they were all part of, forming ADAbio Autoconstruction. Within ADAbio they managed to secure initially funds for paid internships and later regional funding to employ initially an engineer and a development officer. This enabled them to expand their activity and the number of farmers involved. Over the years it became apparent that ADAbio could no longer facilitate this operation. As my key informant Julian, a political science graduate with a focus on social economy (which before joining AP had interned in a cooperative microfactory that creates and sells appropriate tools for farmers in Argentina) puts it "we were an association so each farmer trained by us needed to be part of it. We had a core team of farmers elected by the members of the association. This core team did a lot of everyday decision making and ultimately it was not the right way to invest their energy available for this project". So the decision was made to create the not-for-profit cooperative that was named L'atelier paysan and now the core group engages in strategic planning and general direction while the operational team can make everyday decisions without the explicit consent of the cooperative. The structure of the organisation could be illustrated as an inverted pyramid with the cooperative at the top; the core group in the middle; and the operational team in charge of implementing the action plans and day to day decision making at the bottom.

The constituents that were directly involved in the endeavour were invited to become share-holders in the cooperative in order to contribute to the decision-making process. They basically form the AP network, which includes various active farmers, farming associations, solidarity associations, groups that assist farmers and individuals that are active contributors to the mission of AP. According to French legislation the maximum number of shareholders for the current legal form is 100. Above that number the legal entity is required to switch its organisational mode. This is not deemed desirable due to the prescribed structure of such companies, hence potential shareholders are carefully selected. Groups are generally preferred over individuals since that way a single share may represent more people. The shareholders meet physically at least once per year in their generally assembly. Their annual meeting involves discussing what has been achieved the previous year; plans for the next year; voting for the admission of new shareholders; and various activities and promotional events.

Furthermore, the core group of AP convenes over the telephone, as the constituents are spread all over France, once per month to discuss current issues. This group is comprised of shareholders but often enough, other people with a special skillset or insight on various current issues are invited to participate. These people may ultimately end up joining the shareholder group if their contribution is considered valuable. For instance, a farmer with previous experience as a patent lawyer was invited in 2015 to provide counsel for a potential infringement case. He later became a shareholder as well. Similarly a farmer/web developer working on the AP website also became a shareholder.

The cooperative currently has several full-time employees as well as volunteers (paid) tasked with the various essential activities. While most do not have a background in agriculture, it was made obvious through the interviews conducted with them, that they all share the vision of the AP. Besides Joseph and Fabrice, who act as CEO's of the cooperative, there are currently a number of engineers, architects, a web developer and other individuals in charge of administration, development and dissemination. Several of these employees (as well as previous ones) have become shareholders in the cooperative over the years.

The size of the operational group of the cooperative is considered to be the ideal, given the available resources, to facilitate the amount of activities decided upon by the cooperative. Should the need for further expansion come up, the group is reluctant to increase the size and complexity of its activities which would in turn reduce their capacity for direct communication and cooperation with farmers. Instead they propose the creation of more groups similar to theirs which would form a network of cooperation and solidarity.

4.1.1.2 Economic model

AP has developed a unique model to secure monetary resources for its activity, specifically tailored to the French socio-economic context. In Julian's words: "we come from the world of associations so we know it is difficult to run a healthy business model with an association because it relies heavily on subsidies. This is not really massive right now, state funds I mean". They needed more autonomy and a way to produce some profit to help the whole project develop, hence their elaborate model to acquire resources.

The AP cooperative is non-profit in essence. Its shareholders receive no dividends and the shares are not re-invested. Whatever positive balance the cooperative has every year goes into an indivisible reserve which funds their activities. Acquiring a share will provide the shareholder with the capacity to influence the decision-making of the AP network but not much else. By redeeming it the shareholder will either receive the original value invested or less if losses have occurred. AP does not sell its services to individuals or other companies. Thus, in order to secure funds for its operations AP has developed a multifaceted support model.

Initially it relied mostly on the contributions of the founding farmers and some regional funds for rural development. Over time the workshops became established providing important financial resources for the organisation. Contributions by farmers participating in the workshops make up for a large percentage of the budget. These resources are allocated towards the development of new technology; the maintenance of AP's equipment; the dissemination of the work; and to support the participation of farmers that are unable to make a contribution. However, by tapping into a special mutualised state fund (in collaboration with a public-interest organisation which is eligible for income tax relief) for vocational training and skill development, AP manages to secure reimbursements for most or all of the contribution each farmer makes. Furthermore, they buy raw material and equipment in bulk and then resell them to farmers below market prices yet still making a very small profit. However they do not manufacture nor sell any of the machines that they produce, besides those produced in the workshops which are then acquired by the farmers that, in turn, pay for the materials.

Further, financial support comes from crowd-funding as well as various solidarity organisations. For instance, associations for solidarity financing groups from all over France offer their support to AP. Last, important financial support (about 40% of the budget) comes from national and regional funds for agriculture that have recognized AP's contribution to the development of agriculture in France. Though the group feels that it would be best to reduce the percentage of this type of support for reasons that will be further explored later in the thesis. All of the financial activity is made public in the AP website to ensure transparency.

4.1.1.3 Mode of operation

The operational activity of AP is two-fold: on one hand they engage in research and development of new technology and on the other they disseminate technological know-how. These may be considered the main social movement activities AP devotes resources to. Resources are, of course, allocated in other, more traditional SMO activities, like organising an annual gathering/festival for dissemination workshops and other activities as well as producing promotional material (like leaflets, posters, even books). Yet the focus is predominantly in the productive capacity of the SMO rather than relying solely in advocacy, absorbing the bulk of their available resources. Providing the farmers with practical solutions is deemed a more effective way to communicate their ideological convictions and achieve the movement's missions.

Knowledge transfer

The first of the two main goals of AP is enabling farmers to create their own machines and tools. The AP is based is in the region of Rhone-Alpes along with its branch in Brittany. However, they own three fully equipped trucks that function as mobile workstations which enable them to transfer their activity all over France. They conduct workshops that last three to five days in farms, warehouses or any other space that could facilitate them. The nature, location and time of the workshops are defined by the farmers themselves at the end of each year according to their specific needs and time availability. In general they take the form of either intensive courses for big machines; open days for people to adapt and repair their own tool or learn metalwork; introductory courses for smaller tools; co-work days in farms; building construction workshops; and Computer-Aided Design (CAD) classes for farmers to learn the basic functions that will aid them in their prototyping of new machines. The workshops are usually conducted by one of the engineers working for AP. There, the farmers are initially instructed on and familiarised with metalworking (basically drilling, cutting and welding). Then, they collectively engage in the manufacturing of one or more machines following the comprehensive instructions drawn up by AP. All participants are urged to engage in all stages of the manufacturing process to acquire the full skillset required to be able to recreate it and, more importantly, to experiment, modify, improve and maintain their own machinery.

The farmers attending might have some previous experience but often they do not. They usually tend to be engaging in similar agricultural activity so the machines built in each workshop target a certain need of the specific group. The farmers that provide the funds for the materials get to keep the machine(s) at the end of the workshop.

Some of the farm workshops are for prototyping purposes. In these, a certain piece of machinery is experimented upon and manufactured for the first time by the group of farmers that designed it along with the AP engineer that assisted them. The blueprints for the machine built each time are printed out along with lists of tasks and placed in a prominent position in the work space. These are used as points of reference by the farmers in the manufacturing process of the workshop. The level of detail allows the farmers to carry out the whole process themselves, with the engineer supervising and instructing when needed. Beyond observing and learning from each other, through these workshops, farmers can socialise and share ideas and tips with regards to their farming activity as these workshops are quite intensive and require them to spend several days together sharing meals and possibly lodging.

Technology development and dissemination

AP started as an attempt to gather, systematise and disseminate essential farm equipment created by farmers. This is still a primary goal for AP. For this reason, its people travel across the country, meeting with farmers and gathering information on farming equipment and later farm buildings as well. This information is codified and uploaded to the AP forum for anyone to access. Several groups and individual farmers have been inspired by AP and have created machines that were later uploaded in the forum. For instance the "Charimaraîch" is a machine built by a group of small-scale vegetable farmers called ALADEAR which was then featured in the AP forum. The forum post includes the design and pictures of the various versions of the machine. There are over 500 posts in the forum containing instructions and conversations regarding farm machines, methods and buildings.

Beyond that, AP enables the creation of new technology from farmers. Machines that are either non-existent on the marketplace, too expensive or not suitable for small-scale and organic farming. These machines need to be modular, easy to replicate using materials that can be upcycled or easily sourced. However, in order for AP to engage in a project the ethical principles of the community must be met.

A group of at least 5 farmers with a specific need or idea need to be gathered, since AP will not work with individuals. Then an engineer-facilitator is assigned to the project and the design process begins. After several meetings and feedback exchanges, a design is finalised and the prototyping process begins. The farmers need to be involved in every step and the prototypes are produced after consensus is reached amongst them. The prototyping process is documented and uploaded in the AP forum. The farmers then test the prototypes in the field and, having acquired the necessary skills in the workshop, they make modifications and adjustments. After the testing phase is completed the AP engineer produces a complete and comprehensive blueprint for the machine which is then uploaded in the list of machines of the AP website. Yet it is pointed out that these designs are not final and it is up to the users to further develop them according to their needs and knowledge. Indicative machines are the “Dahu”, a machine specifically developed for wine-makers with fields in steep slopes which is currently tested by the farmers, and the “Sandwich”, a tool for orchard cultivation created in collaboration with an organic agriculture research association called GRAB.

This process may also take place in order to improve or modify an already existing machine, like in the case of the “Neo-bucher” which is horse powered tool developed in the 1950s. The Hippotese association of farmers that work the land with horses approached AP in 2013 to improve the tool. Several versions of the tool have been released since then. The tool, having been tested and standardised by AP, is featured in the website machines. Further, AP may work with other groups, beyond farmers, that produce tools for farming provided they share the same principles. For instance the “Aggrozouk” a pedal powered tractor was developed by an independent group of makers called Farming Soul. AP was later invited to help improve the machine. All these processes will be further explored in chapter six which will focus on technology development.

4.1.1.4 Selective incentives for participation

The farmers participating in these activities may be considered constituents of AP after having adopted an active role. They potentially were adherents to the AP cause before or just bystanders that were exposed to the activity. At any rate, the incentives for joining the cause are multiple and fairly evident. After all, the point of the organisation was to help their constituents while attempting to politically engage them in their cause. As

Julian points out, the goal was, “to create an organisation that would be a hub of resources, of farmers exchanging knowledge and know-how with the support of a team of workers. This would make the process faster than remaining farm-based which would be limited”, which also “would be a good start for them to rethink their practices and have the right tools to change them”.

Thus regarding material incentives, these farmers gain valuable skills, in most cases without any significant cost due to the aforementioned vocational training fund. This enables them to support their agricultural activity more efficiently by making their own tools and machinery as well as maintain their already existing equipment. Furthermore, they gain access to materials and manufacturing equipment that they utilise, with the help of AP, to build machinery tailored to their needs with relatively little cost. Additionally, this enables them to tap into the productive capacities of their peers that also participate, enabling them to form partnerships. For instance, a group of goat farmers, along with AP, created a rather large seeding machine (the prototyping workshop of which I personally attended) that they would collaboratively use in their fields, instead of having to invest to acquire one each. As far as immaterial resources are concerned, the general knowledge exchange, the sense of community and working together appear to be strong incentives as was indicated to me by a farmer. He points out that while in the past the term paysan (person that lives in the land) was mostly used to describe farmers, in recent years it has been widely replaced by “exploitant argicole” (roughly translated as exploiter of the land), which according to him indicates the current status of commodification in agriculture. The practical application of AP’s alternative methods and processes is considered the most convincing argument one can make to promote the movement’s goals.

4.1.2 The social movement organisation of Farm Hack

Farm Hack (hereafter FH) emerged as a collaborative effort of farmer activists. It was first conceived as a gathering to brainstorm and produce ideas for various tool-related problems in a farm. This first FH event was a big success, leading to the hosting of several more events in the USA and later all over the world. It also lead to the establishment of a large and decentralised community comprised mostly of farmers. From within the FH community emerged a digital platform that functions as communication, coordination, dissemination and, to some degree, technology development tool. Primarily the platform functions as a database of tools that have been built, modified and shared by the community. The tools are released under a creative commons license for everyone to use and modify freely, provided they will release the designs under a similarly open licence.

FH was established in 2011 after the first event that was organised by members of the Greenhorns and the National Young Farmers Coalition (NYFC), non-profits that provide support for young and small-scale farmers in the US, in collaboration with engineers from the Massachusetts Institute of Technology (MIT). FH inspired by the open source culture, would bring together farmers, designers, engineers, academics and activists in events to engage in dialogue; skill development; tool design, building and demonstration. The results were then documented in the FH platform for other farmers to access them. Over time the platform was joined and enriched by farmers from all over the US but also other countries and to this date features more than 500 tools. The content can be accessed by everyone and is open to improve or modify to whomever joins the platform (along with the platform itself).

4.1.2.1 Organisational structure

FH had no legal entity of its own at the time of its conception nor any type of dedicated organisation. Instead, resources were provided by the non-profits, which primarily organised the FH events and built the platform. It relied almost entirely on volunteer work from the expanding FH community in order to build the platform and run the events. Activity in the early years of the community was heavily centralised and guided by the participating organisations, specifically the Greenhorns and the NYFC.

While the community grew however, FH acquired a non-profit status in 2013. Having a legal form, it managed to receive some funding through grants to make improvements on the platform and provide resources for the short term employment of two of its constituents, who worked on community outreach. After this point the community became more independent and decentralised and relies entirely on the support and time of its constituents as well as its partnerships with other organisations rather than attempt to secure its own resources to employ personnel. This has, inevitably, led to reduced momentum, given the fact that everyone is contributing in their free time. Yet the consensus in the community is that it should keep relying on the constituents' voluntary contribution rather than employ workers for its operations, remaining independent and faithful to their principles. This structure allows them to operate in a relatively low risk, low maintenance and distributed mode.

FH, in fact, lacks formal structure. As a non-profit it has a board of directors, however its role is mostly nominal. Instead, every member of the community is free to contribute to the decision making process. Practically, this means that the constituents most engaged in FH end up being the ones most involved in the organisational structure. A do-ocracy of sorts as RJ, one of the interviewees with a software development background and a key developer of the FH platform, puts it. Weekly coordination virtual meetings would take place as well which are open to whomever desired to participate. At the same time the platform has been incrementally improved over the years to provide an easier and more independent service to the users and reduce the effort required for its expansion and upkeep. Thus making, for instance, the tool documentation process better as well as providing a detailed template for users and affiliated organisations/groups to organise FH events autonomously.

4.1.2.2 Economic model

FH, as a non-profit organisation and a community, does not engage in any type of commercial activity. For its operations it relies mostly on the contributions of its constituents and initially on the resources of the participating organisations. After acquiring the non-profit status its collaborations with other groups allows it to utilise their resources as well. There have been instances where some small grants have been acquired in collaboration with other organisations. These funds were directed towards employing community constituents, who were already volunteering their work to FH, to work more intensely for short periods of time, namely on improving and maintaining the platform and community coordination. A topic under discussion within the community is whether acquiring funds to employ individuals for more systematic documentation of tools should be pursued.

Having said that, some of the most active farmer-inventors contributing tools in the platform have invested a considerable amount of their time and resources in prototyping and documenting. Another important topic within the community is how to enable a business ecosystem to thrive around the platform that may provide sustainability to individuals and groups dedicated to the FH principles. Individuals are free to engage in commercial activities. As long as the basic principle is maintained, that of openly sharing, users may add in the description of their contributed tools that they can also sell them or some sort of service to those that would prefer to purchase rather than invest the time and effort to create a tool themselves.

The FH platform features a commerce component where "businesses and organizations invite other users in to see what they have been working on, the events they have hosted or will host, the tools they've worked on, and the conversations they've been involved with". Their ultimate goal with this open shop initiative is to provide a simplified toolset for users or groups to sell their tools or parts or even certain services as well as spaces with fabrication or educational capacity. Commerce is considered important according to the FH ethos as "regionalized manufacturing makes for resilient economies and tools which are customized to a farmer's particular needs".

4.1.2.3 Mode of operation

FH's operations revolve around activity in the platform and the events, with documentation from those events resulting in the platform.

As mentioned above the Farm Hack events were, during the early years, mostly organised and facilitated by the organisations which invested their own resources on FH activities. Over time, as the community grew more independent and decentralised, a detailed guide for events was developed and featured in the platform to enable the constituents and affiliated organisations to host events as an attempt to distribute the resource requirements across the FH network. In order to uphold the standards, certain requirements should be met for a successful FH event and the guide offers various suggestions to meet them. In general, these events are problem-solving oriented with various specific goals. For instance they may involve conceptual meetings to brainstorm new tools; collaboratively design, build, or document tools; skill and know-how transfer; and, software hackathons. Documentation of results, regardless of the focus of each event, is always encouraged in order for the entire community to benefit from these events. Further, these events are opportunities to attract new adherents and constituents (as well as for existing ones to socialise).

The FH platform is the second point of operational activity. It has been developed by community constituents with software development skills and it is based on various other open source tools. The platform serves both as a coordination and collaboration tool for the community and as tool database for the ones that have been individually or collective produced. While there has been a steady influx of users and tools, the platform has not been very successful as a collaboration tool, with most of the coordination happening "behind the scenes" and the collaborative tool design taking place in physical spaces, like the events, rather than digital. Further, proper documentation of both processes and tools is an issue that the core group is trying to improve, as it is a resource heavy process. Updates in the platform are driven by community feedback as well as other content featured, like for instance the FH blog.

Some community constituents are also involved in the development of FarmOS a web-based tool built on Drupal (which is also open source software). FarmOS allows farmers to keep records, plan and manage their farms. Contrary to other similar proprietary platforms, farmers do not have to sign off their data if they desire to use the service. Yet, the idea here, much like with the FH platform, is to share the data in order for everyone to benefit from the common knowledge as well as share them with researchers and service providers and receive specialised help.

4.1.2.4 Selective incentives for participation

Similarly to the AP case, several incentives are available here for potential constituents. The FH platform features hundreds of tools that farmers can adapt to their needs and the events present opportunities for valuable knowledge exchange and collaboration. Unlike the AP case however, financial resources are much more limited in FH. Relying almost entirely on individual resource contribution FH has enabled commercial activity to be developed around the platform with the hope that constituents/entrepreneurs/tool developers would support the FH activity while simultaneously making a sustainable living within the community.

Lu and Tim, two of the farmer/engineers from FH, exemplify this. Combining engineering and agricultural knowledge they invest considerable resources in the development of new tools in collaboration with farmers of the FH community. In order to be able to maintain their activity they are experimenting with various methods to secure resources. These include crowdfunding campaigns, organising workshops similar to the AP ones, offering manufacturing services to other farmers, bidding for (the admittedly limited) support grants for agriculture, selling the tools themselves or partly assembled kits. This is an aspect of FH that is still under development and a best course of action has not been determined yet. The difficulties are evident for these individual entrepreneurs, and making their activity in the community sustainable is a constant struggle. However, they recognise that engaging in this activity within the community is preferable to doing so outside it. As Lu notes "it would be a hard business plan for me to take the development costs up to myself for every tool I build. But if there's an ocean of designs on FH and people come to me to build someone else's design then the one tool I develop and contribute the design for can be amortized over all the other tools I'm building". Further, the platform enables the capacity for feedback to further improve on their tools.

Another interviewee, farmer/inventor named Rob, having distanced himself from the community after feeling frustrated by the community's inability to provide enough support for the prototyping of new tools, attempts to continue his activity independently in his own business. He finds however that this too proves quite difficult to achieve without a community to draw support/clients from. He says he would consider engaging with the FH community again. The open shops feature is a step towards enabling entrepreneurial activity in line with the community's principles. Yet ultimately the community itself will determine how this aspect of FH is going to evolve, if at all.

4.1.3 Resource mobilisation in the movement

Typically SMOs tend to compete for the finite resources within a social movement which in turn influences the tactics adopted to achieve their goals (Soule and King, 2008). In this case however, given this movement's transnational scope, competition, at least between these two sub-cases, does not appear to be a factor. On the contrary there is collaboration, where possible, with members of either community calling the other "cousins". Cousins because they realise that there are considerable differences amongst them stemming from socio-political as well as cultural differences between France and the USA.

For instance, the fact that the French receive considerable resources from the state allows them to be significantly more active and organised than their American peers. Financial resources mean that AP is able to employ constituents to work full time in its various activities leading to some degree of professionalisation within the SMO. This professionalisation inadvertently creates a more centralised structure of operations. Consequently it enables AP to provide a lot of support to farmers and have a very productive and standardised output (i.e machines and tools), but could potentially hinder independent initiative within the community, as evidenced by the low degree of user tool submissions in the AP forum.

On the other hand, lack of resources for FH mean that the community depends heavily on independent initiative to achieve its goals, hence the desire to provide enough selective incentives, namely the capacity for commercial activity, to elicit participation. This is further enhanced by the lack of mistrust towards market relations in the US context and the potential impact these might have on FH's activity, which according to Fabrice is more prominent in France and specifically the AP community. As a result FH's structure is loose and decentralised in order to be maintained even in periods of high inactivity. Its output is more diverse that way, but less standardised and not as well documented as AP.

Despite their differences however, the target group of either SMO as well as their broad goals are similar, if not the same. Also both cases share the conviction that the best approach to achieve their long-term goals is by providing tangible results instead of advocating change like most social movements. Eliciting participation in FH comes from "cascading networks to find people who would be excited to join us" Dorn, a farmer inventor and leading figure in FH, points out. Severine, a founding member and farming community organiser, also mentions that the various movements FH taps into, are well networked and offer much dissemination to their work. Similarly in AP, the extensive network of farming associations allow the recruitment of farmers that are both partial to the agricultural model AP promotes but also conventional ones with the hopes of convincing them to convert.

Each sub-case has developed a unique model to achieve this, yet the narrative of both shares a very strong focus on the utility of tools developed within their activity as a powerful argument to garner the attention of constituents looking to elevate the quality of their work and tackle everyday problems through their engagement in the movement. Furthermore, resource exchange between the two happens on the level of design and know-how, with several instances of knowledge sharing for the development of identical or similar tools. This is especially important considering how "closed off are the information pathways in agriculture across borders" as Kristen, another farmer and active member of the FH community, says. For instance, the Aggrozouk that was mentioned earlier in the AP sub-case was initially inspired by the Culticycle that is being developed within FH. This aspect will be further explored later in the chapter dealing with the technology development model. The next section will examine the movement through the lens of framing analysis in order to identify the ideological and cultural factors in each sub-case that play into the formulation of a collective action frame for the movement.

4.2 Framing the open source agriculture movement

Preliminary analysis of data has indicated three master frames prevalent in the framing of the movement, namely the open source, organic and peasant frames. Master frames in the sense that they are not specific to one movement but influence and orient the activities of several, often similar, movements due to their flexibility and capacity for cultural resonance (Benford and Snow, 2000). Identifying them was a relatively straightforward task. Clear references were elicited in texts, early interviews (with people outright mentioning them), and media in either sub-case. Further, the type of farming activity the farmers engage in is also an indicator, meaning, most are small scale, independent and organic farmers. Other, more specialised collective action frames can also be identified, but their influence has been aggregated under these three master frames. A bibliographical synthesis of each master frame follows as well as a detailed description of how these frames are adapted in each sub-case. Then, an aggregation will take place to provide the collective action frame for the movement under examination.

4.2.1 The open source master frame

The open source frame encompasses the activity of various social movements that share the principle of "openness". This sub-chapter will explore its development.

The open source master frame traces its roots in the late 70s with the free software and its primary proponent, Richard Stallman. As a computer programmer at an MIT lab he worked alongside other programmers/hackers under a regime of sharing the code in order to collaboratively develop it (Stallman, 2002). However this environment of openness eroded over the years, with various enclosures creeping in to limit the access to the code. In 1982 he began developing his own collection of free applications, GNU (Gnu's Not Unix) which would emulate the functions of the Unix system. In 1984, Stallman quit his job and devoted his efforts to the establishment of the Free Software Foundation (FSF), a SMO dedicated to the promotion of free software through the use of the GNU General

Public License (GPL), a “copyleft” (an inversion of the term copyright) license which enables the creation and free distribution of code, as well as ensures that the code will remain free. Free as in free speech and not free beer as the free software advocates like to put it.

Three distinct but also intertwining social movements will be presented next. These are the free software movement and the open source software movement (often presented and researched as one under the acronym FOSS), the open hardware movement and the open source appropriate technology movement. All three share the broad principles of the open source master frame, which can be summarised as: 1) Collaborative and decentralised development of artefacts that may be software, tools, machines, food, medicine, even houses; 2) The release of these artefacts under licenses that allow free access and redistribution over the internet; 3) A distinct governance model inspired by the open source development model that relies on transparency, open and autonomous participation; flexible and meritocratic hierarchies.

4.2.1.1 The free and the open source software movement

As discussed above, the free software movement framed its activity through four freedoms which represent the ethos of its proponents:

“The freedom to run the program as you wish, for any purpose (freedom 0). The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this. The freedom to redistribute copies so you can help your neighbour (freedom 2). The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this (freedom 4).” (Free Software Foundation, 2017)

These freedoms were deemed essential for the building of community and consistently represent the values and ethics of the movement and are presented as “the right thing to do” (Barrett et al., 2013). Basically the freedom to co-create and share information beyond commercialisation. Elliot and Scacchi (2008) distinguish three transformative periods in the free software movement’s frame, calling this period the freedom frame.

In 1991 Linus Torvalds along with collaborating volunteers over the internet released a free version of the operating system UNIX, called Linux, which utilised the components of GNU. Linux was developed with the assistance of an online community and quickly it became as reliable as other marketable version of UNIX. The development model of Linux, which was based on a new version released weekly according to feedback by the user community, was quite radical and over the years its efficiency was widely recognized.

As interest in Linux increased and businesses distributing it emerged, several key software developers, with the support of Torvalds and activist developer Raymond (1998), adopted the term open source software instead of free. The justification for this transformation on the frame was twofold: first, the term free caused confusion as to what free really means, and second that it would be more pragmatic and friendly to businesses who would be willing to support the mainstreaming of free software (Raymond, 1997). A second SMO, called the Open Source Initiative (OSI) was established along with a set of principles outlining the transformed frame. The “business frame” as Elliot and Scacchi (2008) call it. Its principles relied mostly on pragmatism that focuses on the advantages of the open source development model, like for instance its reliability and low cost, rather than the ethics and freedom of the previous period. New licenses were established to facilitate these principles that embraced the marketing of open source software in the business world but at the same time ensured the openness. In other words, these licences provide more liberties, with regards to commercialisation, than the GPL (for instance they allow the combination of proprietary and free software). The success of the open source development model has brought about another transformation in the frame, which Elliot and Scacchi (2008) call the “occupational frame”. The emergence of a business ecosystem around open source software, which also incorporate the open source principles in their structures, has expanded the capacity for employment within software communities, amplifying with it the growth of the open source frame beyond its original limited communities of enthusiasts.

The differences between FSF and the OSI created tensions that still remain to this day. Yet the fact is that most pieces of open source software are also, in essence, free software and are treated as one and the same by many. After all, both promote open access to software for the betterment of the world and both oppose proprietary software. Even Stallman, the most vehement critic of the open source re-framing, admits that "we disagree with the open source camp on the basic goals and values, but their views and ours lead in many cases to the same practical behavior—such as developing free software" and “we in the free software movement don't think of the open source camp as an enemy; the enemy is proprietary (nonfree) software” (Stallman, 2013). In this vain, the open source software frame is viewed as an extension of the free software as it ultimately encompasses its goals and draws support from the same pool of adherents and constituents.

4.2.1.2 The open source hardware movement

The open source software movement can be considered a predecessor for the open source hardware movement which became prominent in the early 00s. This movement appropriates the open source frame but may trace its roots to the hacker community that emerged in the late 60s and is exemplified by the Homebrew Computer club (Söderberg, 2013). Initially active in the intersection between software and computer hardware this movement sought to apply the open source principles into hardware. Several initiatives appeared that aimed to do so the in late 90s. Perens (1997) launched the Open Hardware certification program for devices whose program interface would be open. Similar attempts to frame open hardware followed after but most disappeared due to inactivity. However, over the years various open source hardware projects appeared like the RepRap 3D printer and the Arduino microcontroller. These projects developed large communities around them and the open source hardware movement was revitalised. Initially, the open source software licenses were used to protect their openness but over time several organisations appeared along with dedicated open hardware licenses. The CERN (European Organization for Nuclear Research) for instance created its own open hardware license in 2011 “in the spirit of knowledge and sharing and dissemination” (CERN, 2017).

After much debate within the community and the various initiatives the Open Source Hardware Definition was formulated, which is based on the definition of the open source software. The definition frames the movement’s activity under a set of principles: “Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. The hardware’s source, the design from which it is made, is available in the preferred format for making modifications to it. Ideally, open source hardware uses readily-available components and materials, standard processes, open infrastructure, unrestricted content, and open-source design tools to maximize the ability of individuals to make and use hardware. Open source hardware gives people the freedom to control their technology while sharing knowledge and encouraging commerce through the open exchange of designs" (OSHA, 2011). It is fairly evident that these principles are more in line with the framing of the open source rather than the free software. The open source hardware association was formed as well, a SMO that would promote the movement's goals and standards, study the movement and disseminate its work, and provide guidance according to the movement's values and principles.

The open source hardware movement's frame has encompassed the maker and DIY communities discourse as well (Hatch, 2014), while a growing number of open hardware projects greatly boosted by the proliferation of digital fabrication tools (like 3D printers and CNC machines) and the various spaces that enable making like fablabs, hackerspaces, makerspaces, etc., have contributed into its wider dissemination (for more on these spaces see Smith et al., 2013; Kostakis et al., 2014). Similarly action in these communities is framed around empowering individuals and communities to experiment, create locally and share globally artefacts or services to address their needs (Nascimento and Pólvora, 2016).

4.2.1.3 The open source appropriate technology movement

The appropriate technology (also termed intermediate technology) movement's roots go back into the 60s and was later popularised by the influential work of economist Ernst Friedrich Schumacher "Small is beautiful: Economics as if People Mattered" (1973). Appropriate technology was initially conceived against the importing of western industrial level technology in developing countries which were not suitable for the local socioeconomic conditions and ended up being either idle infrastructure or even detrimental to local communities. This technology would be located somewhere in the middle of traditional, labour-intensive technology and capital-intensive, industrialised technology.

While there are various definitions in the literature, the movement framed its activity around the development of technology that can be summarised as of low cost; locally and collaboratively designed and produced using local materials; small in scale and complexity yet suitable for groups of people and mindful of environmental and social concerns (Willoughby, 1990; Hazeltine and Bull, 1999). For two decades, until the mid-80s, several SMOs, state and private, were established in both developed and developing countries to promote the movement's goals. Yet by the end of the decade activity was significantly reduced and most SMOs seized to exist. The reasons were multiple: First, the movement emerged in a period of disillusionment with the industrialisation programs of the 50s and 60s which resulted in a lot of support in the form of resources that over time were severely diminished as neoliberal policies and market-based development were established (Morrison, 1983); second, there was not enough opposition against those benefiting from the incumbent technological systems, like large construction and manufacturing companies, agribusiness, large private utilities (Pursell, 1993); and last the very definition of the appropriate technology was so broad that it created inconsistencies and technical difficulties in its applications as well as too much external engagement with little involvement of the people for whom this technology was supposed to be for (Zelenika and Pearce, 2011).

However, in recent years the appropriate technology movement frame has been transformed due to the proliferation of information and communication technologies and the emergence of the open source movement. The open sharing of designs using open source licences and the collaborative development are brought to the front in the open source appropriate movement. The framing of the movement is extended to include the efficiency of the open source software development model into appropriate tools and machinery; its acceleration of innovation due to easy and patent-free access to information; as well as access to technology that has been developed elsewhere and is accessible over the internet (Pearce and Mushtaq, 2009).

SMOs that develop appropriate technology have embraced the open source model and are sharing knowledge openly. Appropedia is a wiki website, created by an SMO of the same name, which aggregates more than 7000 thousand articles that provide collaborative solutions for sustainability, the reduction of poverty, farming, and appropriate technology in general.

The open source master frame in L'atelier paysan

AP appropriated the open source frame soon after becoming active. They have engaged with the open source movement and adopted a creative commons license (typically used for openly sharing music, photographs, films, website content etc.) to make the design files of the machines available. They have been quite vocal about the merits of collaborative designing and manufacturing machines and then sharing their effort with other farmers. Pointing out the collaborative nature of the tool development procedure rather than just focusing on the open availability the machine design files indicates a strong influence from the open source frame and the open source development processes it promotes. As the *Who we are* section of the AP platform states: “We would like to create an open source Encyclopedia, where people can freely contribute and make use of resources available. We believe that farming skills are common goods, which should be freely disseminated and adapted”.

Relevant references can also be found in their various brochures, stickers and other promotional material. The farmers I interacted with during my field work in the various AP events approved of the open source approach with a few noting that a strong reason for their attendance was the joy of sharing and producing something together. Furthermore, the topic one of the discussions during the cooperative’s general assembly (and open annual gathering of AP) was the use of open source software like open source design software for the tool blueprints. The AP operational team explained that while they would prefer open source software, the proprietary one (Solidworks) they currently use allows them to illustrate the design in a much more comprehensive way. No open source alternative can do that at the moment. Though it was decided to at least export the designs in open source formats rather than the proprietary one of Solidworks. Another discussion, about patents, had the largest attendance in the gathering. All attendees felt strongly against them with the consensus being that while patents were originally introduced to protect the livelihood of creators, nowadays it is an issue of profit making for big companies.

In the interviews that I conducted with the members of the cooperative the use of this language is also evident. Joseph, a prolific inventor farmer and arguably the soul of the whole initiative, says “my capacity (to build tools) comes from other people, family; friends; farmers I met from traveling around the world, it is only natural to give it back”. With regards to open source licences he adds “the machines we built all those years ago are a lot better today because people have adapted and modified them. That would not be possible with patents. It is just logic; natural”.

The feeling is mutual for Gregoire, one of the engineers in the group. He says “open source seems logical to me, to share without barriers” and adds “when the prototype is ready we need to protect the idea fast, so we make it available with the creative commons license and we specify that this is a prototype at the moment and we don't know if it is ok for every use". Meaning to ensure its openness from potential third parties which would appropriate and patent on it. Nicolas, the animateur (in change of promoting engagement with communities and facilitating communication) of the group, was previously working in the national organic agriculture research institute and there he realised the importance of open source in research. In his own words "who owns the results and how can we make them more visible".

Fabrice, the second founder of the initiative shares this view. He says "all my career has been about giving somebody else the information that I have" which is why he created a couple of publication about ecology. He continues "I didn't have any political conviction about open source hardware. But then I became specialised in organic agronomy, and I met hundreds of farmers. I saw that many were adapting and creating their tools like Joseph". After this creative friction and their initial attempts to assist farmers they initiated their "political project about autonomy and open source in agriculture". With regards to the movement in agriculture he believes that "the movement about open source seeds is very developed, but not tools". He adds "tools influence the lives of farmers. The agronomy - how they organise their day. So tools are important, as important as seeds". He thinks there is a connection to the appropriate technology movement but not a very strong one. "Our goal was to insert ourselves in bigger movements" including the open source and commons movements. This is how they were exposed to other open source tool initiatives like Farm Hack and Open Source Ecology (another initiative which has admittedly received wider media coverage). Although he quickly notes regarding the latter that "it is not the same experience because users are not included in the creative process. It's a top to bottom approach. It is a big concept, like a teaser for a movie but users are not involved". An opinion which is shared amongst some of the FH people I talked to as well (in fact, this was partly the reason why this particular project was not selected as a sub-case for this thesis, despite its very ambitious and relevant scope).

Julien, while describing the development process, says that keywords like "collaborative, participatory, user innovation, open source" often appear. At the same time, he says that these keywords are fashionable currently, so their use could help them secure state funding in the uncertain future of the newly elected right-wing government. Further, the tools that end up in the platform are the "appropriate" ones to satisfy "collective needs", and besides that they also openly publish the various photographs, videos, documents and notes on the forum in order to spark “inspiration”. All in accordance with the open source frame.

Though while he thinks it is good if people are inspired by their work he is a bit sceptical of many of the actors in the wider open source movement, echoing Fabrice’s sentiment. As Julian words it “we would like to tell them that there are other ways to promote open source and develop technology. Their promotion and their methodology for development is often demagogique (grandstanding). They are so desperate to find real applications for the, very good, idea of open source that they endorse any project without filtering. That is not a good methodology and is doing a disservice to the movement”. Meaning that a lot of these projects are not collectively developed and often do not correspond to real needs. He attributes this to entrepreneurship with the drive of the start-up culture, which is blooming within the open source movement, to create something new whether it is for the social good or not.

AP has appropriated the more radical “free” elements of the open source frame rather than simply treating it as an alternative development model. Focus is placed on the collaborative way of designing and producing tools that ultimately tackle the real needs of farmers. It is also placed on the critique of the patent system that is viewed as outdated, preventing farmers from accessing affordable and appropriate tools and enabling big companies to control how agricultural production is evolving.

The open source master frame in Farm Hack

FH has adopted the open source master frame in a significantly more prominent way. Several aspects of the frame are highlighted both in all of the interviews and the FH platform, forum and other material. For instance the FH culture section in the platform critiques the patent system as “most agricultural tools are built in a framework of proprietary knowledge generation - companies invest money in research and development, and license their design in a way that does not allow others to replicate it, or even know how it is made” and offers the open source way as the solution: “the Open Source community believes that everyone benefits from freely sharing knowledge and working together to create new tools to fit our needs”.

Similarly to AP they have adopted a creative commons license for all the tools uploaded in the platform as well as utilising solely open source software while also acknowledging the division between the terms open source and free software which, according to RJ, finds FH somewhere in the middle (the practical application of open source and the political implications of free). As stated in the licensing section of the FH platform "all Farm Hack documentation and written materials are open source, both hardware and software (some prefer the term 'free software' to 'open source software'). This means that you're free to use, modify, and redistribute them, as long as you open source your own contributions". It continues "why do we do things this way? By sharing our techniques and tools under open source licenses, we ensure that the development process is open, and that anyone can contribute. Open sourcing also ensures that nobody can take exclusive control of a project by using patents or copyrights to exclude others from using it".

As far as the development process of hardware itself is concerned FH has adapted the design principles outlined within the open hardware movement and expanded them to fit the agricultural production context. Hence the FH principles may be condensed into an open source design model revolving around the following: "Biology before steel and diesel" as in prioritising solutions that come from biological systems, "holistic approach" that includes personal gratification besides utility, "universality" through the use of standardized components or measurements and systems that simplify alterations and replication, "transparency" regarding the visibility of the tools' components, "modularity" of components, "adaptability" to enable tools to be used for more than one functions, "design for disassembly", "replicability" and "affordability". These indicate strong commonalities with the open source development model promoted by several of the aforementioned movements under the master frame.

Another set of FH principles, the community principles, feature several references to the open source frame such as a commitment to openly sharing knowledge and know-how: "farm Hack is a community to support user generated content and knowledge exchange… we create a culture of collaboration, striving to identify shared values and engage in open exchange"; lack of strict hierarchical forms of organisation with instead utilising the flexible open source structures: "as a horizontal volunteer-driven effort, we use agile and adaptive development approaches, leadership is shared within the core group. Leaders serve goals defined by the community… it is a primary objective that no one organization or individual dominates Farm Hack or is seen as 'running farm hack' - but that Farm Hack is a process of collected best management practices for open source R&D rather than a product”; utilising and promoting collaboratively produced tools: “farm Hack will only use and promote open-source software. Closed-source (proprietary) software can be referenced, but not promoted or used. This is to further the culture of collaboration, sustainability, and protection”.

The interviews with members of the FH community reflect these views. According to Dorn, a strong motivation for the project “was to build a platform for knowledge exchange and a community that embraces the open source history of agrarianism” and “of course introducing the idea of copyleft right from the beginning”. Daniel, a political science graduate and farmer who was briefly employed in FH, adds that FH is “a voice for the open source side of agriculture”. He adds that the open source philosophy inspires people to create and share but also “ties together all the organisations that have been involved in FH”. RJ shares this sentiment adding that open source processes, like distributed and low risk - maintenance organising, are applied in FH in order to maximise the potential of the community.

The community itself “has a strong framework and experience with the open source community functionalities” ranging from open source biofuel applications to software development according to Severine. In fact, as Dorn points out, the decision to build the platform on Drupal was made due to several members’ experience with the software. As for the tool developers contributing in the platform, their views also share the open source frame’s principles. Lu reflecting on the notion that humans have been openly sharing knowledge throughout history says that “the idea of withholding information for profit is new. It had a great run for a 250 years where everyone hoarded their secrets trying to maximise their personal benefit but probably that’s not going to be a permanent situation. All the open source movement is doing is to revive that previous state” so he makes the information for his tools freely available and reproducible with locally available standard metal sizes. Grant, another farmer inventor, also points out that open source has been common place in history and while he would consider marketing his tools he would never patent them. He believes that appropriate, reproducible, non-high technology is ideal for agriculture and that FH facilitates “open source, appropriate technology that can be skilled out in many places”.

In general, the interviewees agree that FH has managed to bring attention to the application of open source in agriculture. In Dorn’s words “the original idea was to have a diversity of talents supporting agriculture. Roboticists; open source software community and really excellent farmers. To this extend we have been successful". But it didn't end there. He adds "extending the idea of open source in agriculture from something really novel or odd into being not only accepted but expected. If you're not doing it you have a bit of explaining to do – there's a little bit of a social stigma, like you might be being greedy or short sighted. There has been a shift." Severine shares this view "as a cultural project FH is very successful in normalising open source as desirable and empowering people to view themselves as potential designers" adding "we were successful in making a cultural story about how a more open culture is an ancient tradition and proprietary, controlling uses of technology is ahistorical in agriculture".

However, she is critical of the way this story is framed: "the language and culture of software in the open source community has defined what the rules of open source are. It has limited the extent to which open source can penetrate the real world". Instead she argues for more focus on "the culture of a peasant – based movement, which is also open source. The passage of seeds and breeding technologies differs significantly from the way code migrates. Code and seeds are not the same thing". In a similar vein, Grant is a bit critical of the strong focus on the open source software and its philosophy which potentially reduces the experience in the platform. He feels the focus of open source should be placed in the tool output rather than the notion of "open source everything".

It is evident that the open source master frame has been more prominent in the FH case with elements from all open source movements present, touching upon the development methods of open source software, the design principles of open source hardware and the appropriateness of tools. While it appears that some of these framings might be in conflict, the overarching belief that knowledge should be freely accessible and technology should be appropriate and adaptable forms a unifying narrative.

4.2.2 The organic master frame

Before the advent of industrial agricultural methods in the early 20th century all agricultural systems could be considered, in one way or another, organic in nature. Scientific applications for the manufacturing of farming inputs proliferated around Liebig's "Law of the minimum" (van Der Ploeg et al, 1999). This is basically the notion that growth in plants in mainly determined by the scarcest element in the soil (like phosphorus and nitrogen). This sparked the establishment of the conventional agriculture science and industry with the synthetic creation of nutrients that dramatically increased the productivity in crops (Goodman and Redclift, 1991).

The organic agriculture movement became prominent in the 1920s with the work of Albert Howard in the UK and Rudolf Steiner in the German speaking countries. Steiner developed a set of lectures on biodynamic farming, a system of organic agriculture, in response to the deterioration of soil health and crops due to the use of off-farm inputs like fertilisers (Paul, 2013). He further established the "Agricultural Experimental Circle of Anthroposophical Farmers and Gardeners of the General Anthroposophical Society" to experiment with his methods which greatly contributed to the emergence of organic agriculture (ibid.). Steiner's work is akin to that of the Life Reform movement (Lebensreform) which appeared in the late 19th century. Its activity focused on the promotion of environmentalism vegetarianism and rural living (Vogt, 2007).

Howard was an agricultural adviser in India where he was exposed to various farming methods, mainly composting, which he then developed further and promoted in the UK. Howard was critical of agricultural research that aimed at profits rather that sustainability and practical farming (Hershey, 1991). Howard's work inspired many, among which was Lady Eve Balfour, an organic pioneer, who in 1943 published her seminal work "The living soil" based on her research in the Haghley Experiment (which was the very first comparative study between organic and conventional farming) (Balfour, 1976). Following the success of her book in 1946 she cofounded the Soil association in the UK, an SMO dedicated to the goals of the organic movement which is still very much active today (Conford and Holden, 2007). Another important figure for the movement, Jerome Irving Rodale from the USA was so inspired by Howard's work, even though he was not a farmer himself, that he bought a farm to experiment with organic farming. Rodale published extensively, through his own publishing house, on the benefits of organic and the dangers (often unsubstantiated) of conventional methods (Kelly, 1991). He also established an SMO, the "Rodale Institute", to promote the movement in the US. The term organic agriculture itself is attributed to Lord Northbourne who first framed the farm as on organism in his book "Look to the Land in 1940" and soon came to be utilised extensively to describe non-conventional farming (Paul, 2014).

During the 1950s, organic farming fuelled by its success in the UK and Germany, was also popularised in France as "agriculture biologique" by Claude Aubert's work and the subsequent establishment of the "Nature et Progrès" association in 1964 (Vogt, 2007). Over the next years the movement successfully expanded in a global scale and a multitude of local organic organisations emerged in the 70s. In 1972 the International Federation of Organic Agriculture Movements (IFOAM) was established, an SMO coordinating the various independent initiatives and promoting the principles of organic agriculture. While various organisations around the world had established standards to define organic agriculture, the IFOAM offered the first unified definitions and standards since the movement's success created an entire market for organic produce which became increasingly difficult to monitor (Schmid, 2007).

The efforts of individuals like the aforementioned but also of farmers all over the world to provide alternative farming conceptualisations (for instance approaches like agroecology; permaculture; sustainable – biodynamic - regenerative agriculture) to the conventional ones led to the proliferation of communities and organisations promoting and developing these conceptualisations further. All these initiatives are aggregated in a movement under the organic moniker. It is near impossible to attribute a robust set of beliefs in the organic movement over the years, as there are various tensions and contradictions amongst the various approaches which range from a mere set of ecologically friendly methods to proposing a complete overthrow of the incumbent food production system (Guthman, 2004). Yet the belief that agricultural activity within the profit driven industrialised production is responsible for a range of unwanted effects constitutes a unifying force within the movement (Conford, 2001; Guthman, 2004).

This overarching critique of industrialisation in agriculture and subsequent turn into organic agriculture can be broken down into four movements and ideological framings that formulate the organic frame: 1) the agricultural production through alternative means, 2) the food and health movements, 3) environmentalism 4) and the counterculture movement that became prominent in the 60s (Guthman, 2004).

The first point, and admittedly the most prevalent and long-lasting one, includes most of the European individuals and organisations that have been discussed up to this point. They initially engage in diagnostic framing where intensive, conventional agricultural production and dependence in industrial science and technology which is detached from the farmers is identified as the cause for great soil degradation and loss of biodiversity. Consequently, they engage in prognostic and motivational framing by developing and disseminating their various alternative systems and technologies which, despite the many variations, were all presented as beneficial to the soil's fertility and akin to the natural ecosystems.

The second point can be traced back to the various vegetarian and other movements critiquing processed foods on their potentially hazardous effect in health both in Europe and the US (Peters, 1979). The movements challenged the motives of the actors within the industrialised food system and demanded greater oversight and transparency (ibid.). The connection with organic agriculture became most prominent by Rodale who was a firm believer of the superiority of organically grown food and its health benefits. Through his extensive publications Rodale framed organic farming as a solution to the food safety and health issues (Kelly, 1991). Further, critique towards genetically modified foods was also aligned with the promotion of organic alternatives within the motivational framing of the organic movement.

Environmentalism offered an important framing component as well. Rachel Carson and her critique of pesticide usage in her seminal work *Silent Spring* in 1962 provided a milestone for the implementation of this critique in the organic movement (Lockeretz, 2007). While originally environmentalism was primarily concerned with preservation, gradually the focus expanded also in the exploits of conventional agriculture which was then infused with the diagnostic component of the organic frame (Gottleib, 1993). Further, the issue of sustainable development also imbued the organic movement's frame with regards to resource management but also technology use which, taking a cue from the appropriate technology movement, was presented as subservient to the agribusiness sector (Guthman, 2004). After all, Schumacher was, besides a key instigator of appropriate technology, the president of the soil association in 1970. Thus they called for more decentralised and farmer controlled centres for distribution of technology.

Another way environmentalism has influenced the organic framing is through the concept of bioregionalism which takes into account agronomic limitations and seasonality. This, in combination with small distribution networks, would enable more environmentally viable organic agriculture (Kloppenberg et al, 1996).

The last formative movements for the organic master frame was the counterculture and back-to-the-land ones. Counterculture emerged in the 60s with the desire of its constituents to differentiate themselves from the conventional way of living and values.

Food being part of the various sub-cultures attempting to do so (Belasco, 1989). In this attempt the organic movement was co-opted as an alternative to the dominant food culture of processed food that was so highly valued in the industrialised society thus imbuing it with leftist social and political values (Kuepper, 2010). In the counterculture tradition, organic food is alternatively produced and delivered without middlemen to be cooked with minimal processing in the "counter cuisine" (Pollan, 2006). Hence through the counterculture a new back-to-the-land movement appeared with communes to create small farms that adopted organic methods (Belasco, 1989). Food coops and direct sales links to consumers were established with social decentralisation as a result of this newly established production system (ibid). While most of these initiatives did not live long, their impact on the organic movement is lasting.

In 2005 the IFOAM published a set of principles revolving around health, ecology, fairness and care which frame organic agriculture. The principles were formulated through participatory processes by the members of the federation and was finalised in its general assembly (Luttikholt, 2007). A brochure was produced and translated in several languages to disseminate the principles. It can be claimed that the principles encapsulate the essence of the movement's history and influences as they were previously discussed here and may be viewed as motivational framing. After all they have been labelled as the "ethical principles to inspire action" (IFOAM, 2005).

Within the brochure organic agriculture is framed with regards to health as capable "to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings", to ecology as able to "attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity", to fairness as "characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings" and "should conduct human relationships in a manner that ensures fairness at all levels and to all parties – farmers, workers, processors, distributors, traders and consumers. Organic agriculture should provide everyone involved with a good quality of life, and contribute to food sovereignty and reduction of poverty", and finally to care as "a living and dynamic system that responds to internal and external demands and conditions". Yet with regards to technology it should "prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering" while decisions on the matter should "reflect the values and needs of all who might be affected, through transparent and participatory processes" (ibid.).

Widespread market demand for organic food after the 80s lead to the adoption of organic methods and distribution systems globally (Aschemann et al, 2007). Originally sold in specialised vendors, soon major retail chains offered organic options boosting their popularity further. Organic regulations were established regionally to provide uniform rules for producers, notably in the EU, US and Japan. These however led to increased costs to a developing industry, with the acquisition of an organic certification soon becoming a costly affair. Several European countries offered subsidies to support their national organic production as a result, though that is not the case with the US where organic development is mostly market driven (Lohr and Salomonsson, 2000; Uematsu and Mishra, 2012). Further, market activity (as is the case with most industries) has led to a concentration in production and consequently distribution. A result of both a dramatic growth of pioneering organic firms and the involvement of large conventional companies like McDonalds and Heinz (Aschemann et al, 2007). This meant that organic no longer meant local and fresh food necessarily. It was to tackle these rising concerns about the globalisation effect in organic farming that the IFOAM established the aforementioned principles.

Yet despite these efforts and the strict enforcement of regulations, there is evidence of what is called conventionalisation of organic agriculture, meaning the gradual conversion of organic farms into the form of conventional ones since while their practices comply with regulations, they don't seem to be aligned with the principles of organic agriculture (Darnhofer et al, 2010). This conventionalisation takes place in various ways according to Buck et al (1997): through extensive marketing and the end of local food by distribution channels in a global scale; the abandonment of sustainable practices and adoption of intensive mono-cropping methods; substitutionism, the process of accumulating other food processing activities like packaging; appropriationism, meaning the process of externalising the various organic inputs traditionally developed in the farm like organic compost. This ultimately leads into a bifurcation between farmers that are faithful to the organic principles and organic producers that engage in agricultural activity in the scale of conventional practices. This thesis explores communities whose organic farmers may be squarely placed in the former category.

The organic master frame in L'atelier paysan

The appropriation of the organic frame from AP is obvious. After all, as stated in the platform, it is "born out of an activist network of organic farmers in the Rhone Alpes region". Further the platform states as a goal the promotion of organic practices through their tools: "the development of tools and self-built machinery adapted to small-scale farming is a technological, economic and cultural instrument which has been little explored within agricultural development in France, although it can provide a significant impact on the growth of organic farming and contribute to improving organic farming practices… For us, organic and small-scale agriculture go hand in hand. We cannot promote a model of organic farming which does not have a wider social vision behind it. Similarly, we believe that the principles of small-scale farming lead naturally to a chemical free approach". It is further evident in their description of the workshops: "our training courses promote tools which are adapted to organic vegetable production, including for example cultivation and weeding tools for permanent bed systems".

References to organic agriculture (the corresponding term for organic in French is biologique) can also be found in all of the AP material while the guide-book featuring the original pieces of technology of the collective is explicitly dedicated to the support of organic practices. Further, their annual gatherings feature on-farm exhibitions and debates around practices and methods in order to enable knowledge sharing about best practices among organic farmers but also promote their merits in consumers and conventional farmers.

The interviews also illustrate the elements of the organic frame within AP. Indeed, the whole project began when Joseph adopted permanent raised bed technics more than 20 years ago. He says "there were no machines in the market for this kind of system so we built them". Fabrice considers AP as part of the organic movement and in broader scale the ecology movement. He wants to engage in the debate for healthy eating and food systems as he believes that the conversation "should include tools for producing food as well as the open source agenda". Julien shares that belief and claims that his primary reason for his engagement in the project is "to tackle the challenge of how to feed humanity" while he prefers the term agroecology over all other because it is more clearly defined and it reflects the practices they promote which are a step beyond organic, citing the use of green manure (a type of plant that nurtures the soil) as an example.

He continues “if conventional farmers want to use our tools then that is very good but we will not adapt to their practices. These are practices of the past, not relevant at all for the future. We cannot afford them on an environmental or humane level”. Instead, he says, their goal is to get them to convert into organic practices. Jonas, another member of the team, agrees “any farmer can join but our activity is quite specific and most of it is for small farms and organic agriculture”. Nicolas, whose background is in organic agriculture is interested in collaborating with the various networks for organic agricultural development. Expanding on Julien’s proposed practices he says “we have to choose a different agricultural model and we are trying to create it… we try to show farmers that our model is more accurate, relevant and diverse considering how agriculture and alternative agriculture work”. He welcomes conventional farmers since he believes that if they want to use their tools then that means that at least they are considering changing their practices. He says he wants to “make people think about how they farm through their machines… make them realise that there are other ways to do things”. As an example he says “in conventional agriculture you don’t have to deal with weeds, there are pesticides for that. If you want to be more organic you have to do it with machines”. Similarly, Etienne, one of AP’s engineers who has become a peasant farmer himself, says that the very act of organic farming is political, meaning respecting the land rather than exploiting it, and he believes that most farmers share this view. He also considers peasant farming special because most of these farmers engage in activities that cover the whole life of a product so it is very difficult job and they deserve support in what they do.

Further, everyone seems to agree that the tools themselves carry the principles of the organic frame. According to Fabrice they assist farmers in the making of simple and appropriate tools “but with a high level of agronomy”. For example, during their annual gathering a participant presented a small but elaborate tool for the green manure plant mentioned by Julien. This tool was inspired by AP’s Aggrozouk and is meant to support the specific type of agricultural practices promoted by AP. Joseph also prefers cheap, simple tools which are important for resilience. Because, while complex technologies are efficient he thinks that “one day they might not be accessible. It is a possible scenario that one day we might not even have access to electricity. We need to diversify”. He considers modern agriculture not sustainable and resilient because of its dependence on external inputs. This reflects the more radical environmental concerns within the organic frame.

The organic frame is adopted in a straight-forward way by AP with a focus on the environmental benefits of these practices. While the term organic itself is utilised extensively, the group makes use of more precise language (like agroecology) to indicate approaches they promote which are deemed the most efficient and environmentally appropriate.

The organic master frame in Farm Hack

The appropriation of the organic frame in FH is not as prominent, yet its elements are easily identified. According to the FH culture material "Farm Hack aims to nurture the development, documentation, and manufacture of farm tools for resilient agriculture… By documenting, sharing and improving farm tools, we can improve the productivity and viability of sustainable farming". Resilient and sustainable practices are cited for a "healthy land" and "successful farms and local economies". The term organic agriculture is not employed despite the fact that according to Dorn the majority of farmers participating are organic producers though not exclusively.

So a reason for not using the term organic is because FH is not limited to organic farmers but according to Dorn is "a community where the tools are a reflection of our understanding of the environment". He continues "we chose resilient which has an environmental aspect… it was more accessible to more people". Acquiring an organic certification is an expensive and complex process to navigate and some farmers do not have it despite engaging in agriculture that could be considered organic. In fact, Grant suggests that organic standards are not enough. For instance, he says that the accepted rate of soil depletion considered sustainable is shockingly low. His critique goes further: "in the US everything is about commercialisation and marketing and a lot of it gets green washed. There is a lot of co-opting and half-truths in that story- organic agriculture is sort of managed by the USDA (the federal agency for agriculture) and industrial organic has become pervasive. You can buy organic milk coming from a CAFO (concentrated animal feeding operation) that somehow manages to meet organic standards"

Daniel agrees that the USDA organic is usually problematic: "on the consumer level when people say organic they mean ecological but on the production level it does not necessarily mean so". He continues "I am not against organic certification by any means but I do think it's only telling a part of the story so I see the need for more precise definitions of sustainable agriculture". So they deliberatively use more precise language about what practices they promote which may include “strictly carbon farmers or permaculturalists”. This he say comes from “a desire to create an alternative system, a way to interact with the environment that is against the way industrial agriculture does”. Grant argues that for this reason “regenerative has emerged as agricultural methodology which might be better for earth but does not necessarily meet organic standards or actually surpasses them… we are trying to regenerate the soil and land base not just be ‘sustainable’ and depleting at a marginal rate”.

Like AP, the tools themselves here also carry the organic frame, as Severine says “FH is making clear the organic community’s shared understanding of technology” since “there is this perception that if one is against farm inputs like pesticides and GM then they are against technology and progress. Our point was to be more discerning – we are evaluating technology based on its cultural and ecological impact”. “Ultimately it is not about the tool, it is about the agronomy” she concludes. Dorn adds “it is about accessibility, ownership and scale with a discussion towards moving to biological systems rather than steel underlining it”. Kristen offers her viewpoint which echoes these approaches: “I was a young farmer, farming in a way that was working with nature rather than opposing on it. Pretty soon you realise how unsuitable modern technology is to the small sustainable farm. We want to work with natural systems in a way that is appropriate for the scale we are operating… After discovering the project, the principles of FH spoke to me really strongly in terms of appropriate technology for small farms shared in a democratic way. It really resonated with the deeper values I have about agriculture”.

Lu and his farmer brother Chris also believe that in order to create a sustainable food network there will also need to be a local network that makes machines and solves problems for these farmers. That is because according to Lu “farming is a unique application of tools to environmental conditions, meaning that every farm has different conditions like soil type, altitude, rain fall etc. That means that every farm has very unique technology problems that they need to fix”. In a similar vein Grant, who is experimenting on farm-scale perennial crops and devising his one permaculture system, is building the appropriate tools for the particularities of his approach. He says he is leveraging this technology in order to create an agricultural ecosystem which humans can be maintaining without the need of technology in the long-term. An approach similar to that of Joseph’s which assumes a future worst-case scenario.

It becomes clear that several elements of the organic master frame have been adopted by FH, like the goals for environmental protection as well as sustainable and locally adapted practices, in order to articulate and tie together the various visions for alternative agriculture within the community. At the same time institutionalised organic agriculture and mainstream organic narratives are criticised for their lack of substantial impact, focusing on scale and efficiency, and difficulty to navigate regulation-wise which limit adoption.

4.2.3 The peasant master frame

While the organic movement evolved and expanded extensively over the years, ranging from promoting simple alternative farming methods to the conventional ones to suggesting the complete overhaul of the incumbent food system, the peasant movement, as it will be explored in this sub-chapter, pursued more politically focused goals framing it's activity against the effects of Neoliberal policies and globalisation.

The term peasant (among the equivalent terms are yeoman, campesino in Spanish and paysan in French) itself has been framed in numerous ways over the course of history with further variations amongst geographical areas, yet often it carried a derogatory meaning. The term might be used to signify social groups in the pre-industrial industrial era that were legally bound, socially and economically inferior and considered subservient and "simple", while even today peasants in several areas in the planet lead deeply disadvantaged and precarious lives (Edelman, 2013). It may also be used as a scientific term to describe communities with certain characteristics. For instance, peasants could be distinguished from farmers since the latter view their activity as an entrepreneurial project to be expanded whereas the former aim merely to sustain themselves (Wolf, 1966). Even here the definitions seem quite diverse and often interchangeable. A third way the term may be used is in an activist context, which is the connotation explored in this thesis. Having appropriated and empowered the term peasant, social movements (especially the global ones) give it a wider meaning in order to attract the maximum amount of constituents and adherents (Edelman, 2013). La Via Campesina (hereafter VC), arguably the largest transnational peasant movement which encompasses organisations from across the globe, defines peasants as people of the land (Desmarais, 2007). Those that depend on and care for it, including those with little or no private land.

While contemporary peasant and agrarian movements rose into prominence in the late 80s they trace their roots further back, in the diverse and revolutionary attempts of peasants across the planet in a struggle to secure basic human rights and rural reform. Like for instance the village population during the Mexican revolution in the 1920s which identified themselves as campesinos and demanded rural reform (Boyer, 2003), or similarly the Bolivian revolution after 1952. In Europe the peasant uprisings and agrarian parties were much grander in scale and activity. While their ideologies were quite different and often competing, there was common ground on the shared pursuit for the removal of landed groups and general land reform (Borras et al., 2008). In 1920, the Green International was formed, a coalition of various central European agrarian parties for the promotion of peasant rights (Bell, 1977). Various bloody conflicts over the next few years led to the subsequent establishment of the Red Peasant International by the Communist International in order to attract rural populations (ibid.). The threat of the communists sparked several efforts to mobilise rival peasant groups internationally, thus leading to the dynamic expansion of the Green International until its demise after 1929 (Borras et al., 2008).

Another antecedent for the modern peasant movements is the Associated Country Women of the World which emerged in the late 1920s when women from 29 countries convened to London to establish an International Council of Women (specifically rural women). The association has advocated women's rights and over the years initiated various programs supporting rural women in less developed countries (though its conventions' format is still in the English language reflecting its western roots and limiting the participation of non-English speaking women to those of middle or upper classes that often do not engage in agricultural activity) (Edelman, 2003). The International Federation of Agricultural Producers is yet another organisation that preceded the emergence of the peasant movements. It was formed after the Second World War by farmers from 30 countries in order to collaborate with the Food and Agriculture Organisation from the UN and mediate the interests of the various farmer group interests in the agriculture sector (Borras et al., 2008).

Jumping forward into the 1980s one may witness the rise of the several contemporary movements following a major food crisis in a global scale. The reasons for this crisis were multiple: the massive increase in prices of fossil fuel (and fuel-based inputs) as well as other inputs like fertilisers during the late 70s; the consequent rise in interest rates in combination with policies aiming to reduce inflation; the collapse of the Bretton Woods system which allowed the liberalisation and explosion of the globalised food trade; and as a result the fast decline of crop and livestock prices (McMichael, 1998). The domination of agri-businesses in all key agricultural sectors through chemical, mechanical and later biological inputs and the processing, storing and exporting of basic food products enabled them to control a large part of the food market and influence agricultural policies in a global scale (Edelman, 2003; Kneen, 2002; Lewontin, 1998). These neoliberal reforms and the attempts to transfer the industrialised model of production which would replace traditional systems in poorer countries (especially in the Latin America) has had a highly adverse effect in local peasant populations (Desmarais, 2007).

It is within this socio-economic climate that peasant movements emerged in multiple regions across the globe. In the Latin America specifically, several peasant movements and networks of cooperation between the countries in the region (as well as globally) were established. In the context of this thesis two movements/organisations and the way they frame their activities will be explored. The movement of VC due to its scale and field of influence and the Confédération Paysanne (hereafter CP). A French peasant SMO which is a leading actor in the peasant movement, both in France and globally, and a founding member of VC.

The CP emerged in 1987 out of leftist farmer groups that were unhappy with the French farmer's union (Fédération Nationale des Syndicats d'Exploitants Agricoles) and opposed the government's reform to modernise the agricultural sector which they claimed was marginalising small farmers. The CP engaged in diagnostic framing to present industrialised farming and globalisation as problematic and at the same time offered, through prognostic framing, "peasant farming" (agriculture paysanne) as an alternative model of producing farm goods (either for commercial use or not) for the benefit of society (Morena, 2015). Peasant farming is framed as the opposite of entrepreneurial farming whose goal is profit maximization and does not offer a specific set of practices to follow. Meaning it is not limited to certain farm size and could be organic or otherwise, yet it should respect the environment; food health and worker rights according to Bove (2001), one of the movement's leading figures. While originally the focus was set on criticising industrial farming for its obsession with productivism (deemed destructive for peasants), over time a more positive connotation was given to peasant agriculture that called for non-competitive; adaptive and autonomous activity (Morena, 2014).

The CP manifesto similarly provides three principles attached to peasant farming "it has a social dimension centred on employment, solidarity among peasants, among regions, among the world's peasants; it must be economically efficient by creating added value, in accordance to the means of production employed and volumes produced; it must be mindful of consumers while at the same time preserving the natural resources that it uses" (as cited in Morena, 2014, p.3). This lack of specificity allows them to attach different meanings to match the various groups they are attempting to approach. According to the CP itself "peasant farming is neither a technique nor a model to follow or create, but an overall enterprise that involves all of a peasant's life and transcends the simple act of production" (as cited in Morena, 2015, p.66).

In 1993, CP was one of the founding members of VC (translated as the peasant's way) along with several other peasant movements from Europe, Asia, Africa, Latin and North America. While cooperation existed before amongst the various movements, VC was formed to offer global peasant coordination. It grew out of the previously discussed conditions in the last decades first by movements from third world countries, where rural populations arguably experienced the worst side-effects of neoliberal and industrialisation/modernisation policies, and later from Europe and North America. The movement emerged as a globalised peasant effort against the universal enemy, globalisation. In other words, identifying the various supranational organisations like free trade agreements, the International Monetary Fund, the WTO and the World Bank as motivated by multinational corporations and international capital these peasant movements aggregated to face a common enemy and to speak in a unified and strong voice in global debates (Martínez-Torres and Rosset, 2010; Desmarais, 2007). In this spirit, membership in VC is solely given to grassroots organisation and not NGOs that up to that point often spoke on their behalf (Borras et al, 2008). Further it refuses external interference in its decision-making process and will not accept financial aid from questionable sources. Over the years it has campaigned for various issues like agrarian reform; access to seeds; ending violence against women as well as gender parity; and peasant rights.

VC utilises a human rights frame to present their demands in various struggles, like land and resource enclosures; seeds; international trade and investments, in a common language that encapsulates the varying ideological, political and cultural flavours in the movement (Claeys, 2014). These demands are distilled in the right to food sovereignty frame which was established in 1996 and over the years has been enriched, to address new issues like global warming and land grabbing, and presented as the focal point of peasant struggle (ibid.).

The forum of Nyeleni in 2007 summarises six principles in food sovereignty: 1) It focuses on food for people through "the right to sufficient, healthy and culturally appropriate food for all individuals, peoples and communities" and "rejects the proposition that food is just another commodity or component for international agri-business"; 2) It values food providers and "rejects those policies, actions and programmes that undervalue them, threaten their livelihoods and eliminate them"; 3) It localizes food systems by bringing "food providers and consumers closer together" and by resisting "governance structures, agreements and practices that depend on and promote unsustainable and inequitable international trade and give power to remote and unaccountable corporations"; 4) It puts control locally by placing "control over territory, land, grazing, water, seeds, livestock and fish populations on local food providers" and by rejecting "the privatisation of natural resources through laws, commercial contracts and intellectual property rights regimes"; 5) It builds knowledge and skills of "localised food production and harvesting systems, developing appropriate research systems to support this and passing on this wisdom to future generations" and rejects technologies that undermine them (like bioengineering); and 6) it works with nature by using "the contributions of nature in diverse, low external input agroecological production and by harvesting methods that maximise the contribution of ecosystems and improve resilience and adaptation" and rejecting "energy intensive monocultures and livestock factories, destructive fishing practices and other industrialised production methods, which damage the environment and contribute to global warming" (Nyeleni Food Sovereignty Forum, 2007, p. 1).

It is further evident through this document that frame extension is applied to bring forth the arguments of the organic master frame as a way to tackle environmental concerns. This is even more obvious in reports from VC the subsequent years that advocated ecologically resilient and autonomous practices applied by small, family and community-run farms (La Via Campesina, 2010; 2013). The 2010 report *Sustainable peasant and* *family farm agriculture can feed the world* states that there are multiple examples of peasant and family sustainable practices which might be called "agroecology, organic farming, natural farming, low external input sustainable agriculture, or others. In La Via Campesina we do not want to say that one name is better than another, but rather we want to specify the key principles that we defend" and "sustainable peasant agriculture comes from a combination of the recovery and revalorization of traditional peasant farming methods, and the innovation of new ecological practices (La Via Campesina, 2010, p. 2). While in the 2013 report *From Maputo to Jakarta: 5 years of agroecology in La Via Campesina*, it is clarified that organic practices are imbued with the peasant ethos as "peasant based sustainable production is not just about being "organic" (La Via Campesina, 2013, p. 9) since "industry is also appropriating so-called "organic food", so we need to differentiate between "industrial organic" and "peasant" or "family-farm organic" (ibid, p. 16). It is also interesting to point out that food sovereignty is mentioned, albeit briefly, in the IFOAM brochure discussed in the organic frame section so it is clear that there is some overlap between the two master frames.

The peasant master frame in L'atelier paysan

Given the fact that it is even in the title, the peasant frame is arguably the most prominent one in AP while the organisation is also part of the VC and CP networks. The frame's critique of the agribusiness is adopted for the diagnostic framing of the group as elicited from the platform: "In France, technological practices in agriculture are mainly driven by the agro-industry, and correspond to its particular needs. This complex process is likely to continue, until farmers using these technological practices which are not tailored to their real needs, reassert ownership of the system-wide design of their farms". The solutions offered aim to enhance farmer autonomy and efficiency through the dissemination of farmer created tools: "we identify and document inventions and adaptations of tools, created by farmers who have not waited for ready-made solutions from experts or the industry, but have invented or tweaked their own machinery". But also the collaborative development of new solutions: "we provide advice and guidance for small-scale farmers on agricultural tools tailored to their needs, and accompany them through their trials and tribulations in their farming journey, individually or collectively, whatever their area of production", and the training of farmers to achieve the capacity to manufacture themselves: "we provide training courses for farmers to learn to make their own tools. In the course of 3 to 5 days, agricultural tools are created in the workshop which are either non-existent on the marketplace, too costly or not adapted to small-scale organic farming. As well as building a tool, farmers gain in autonomy as they learn metal work. A farmer who has built rather than bought his/her tool is better placed to repair or adapt it in future".

Adapting and expanding the narrative of food sovereignty, AP encapsulates their activity in what they call technological sovereignty for peasants. According to their advocacy documentation: "by promoting peasant autonomy through the reappropriation of knowledge and know-how around the farm production tool, Atelier Paysan promotes technological sovereignty of the countryside. We argue that it is the responsibility of the farmers to question their tools of work, machines and buildings, their financial, agronomic and ergonomic impact". This critique lies in the heart of the initiative and is reflected upon the tools they create: "we are careful with the tools that we agree to develop, and ensure that they respect the ethical principles of Atelier Paysan. We want to develop agricultural machinery which supports small scale organic farming, and which can be appropriated and modified by farmers" (translated from the French language by myself).

The interviews with the AP members reaffirm this goal. Fabrice while critiquing the agribusiness sector says "I consider half of the industry tools inefficient. Their purpose is to support a financial system and often farmers buy tools they don't need because someone told them to… Unlike seeds and where their products are sold, there is no political critique about machinery in agriculture, yet historically the farmer is the machinery engineer and is sharing with other farmers… Now industry has taken over everything". Julien is also concerned about the concentration of equipment and seed markets in the hands of just a few big companies which are driven by their business models rather than the needs of the farmers. He expands his criticism to the supposed user innovation culture within the industry: "even if it is contaminating big companies their goal is to make profit. This is not our goal, we don't pay our shareholders. We are not accountable for that - the only thing we are accountable for is our social goals".

Instead Julien says their goal is to promote technology that is affordable and easy to recreate, use, and repair. Nicolas expands on that thought: "we promote, and help farmers build, tools that are simple in conception and reproducible in the farm, with few materials and equipment. That is how we promote low investments, autonomy. That is how we make farmers independent from banks, agroindustry and make sure that they own their tools". Regarding how he tries to convince people to join their cause he says "Each time I try to explain what we do and the frame that we built to do so – to show how the background is relevant… it was born in farms, a collective story, how we work on autonomy and resilience for farms". Jonas views this as a highly political project. He says "self-construction means something politically. That you are not part of the commercial system and that's how you get more autonomy". He considers the type of technology they promote as important for farmers "because they have needs and with it they can cover them themselves". They have been quite successful in creating a positive view on self-construction according to Joseph, who cites a law recently passed in the French parliament that recognises it as the best way for farmers to be efficient. He says this development was heavily influenced by AP's activity.

As far as the workshops are concerned and the resonance they have had with the farmers in France, Nicolas thinks that it is due to the fact that farming is becoming extremely polarised. There are huge farms and very small ones, while average sized farms are disappearing. Fabrice believes the reason is the competitive nature of modern farming and that the success of AP is partly explained by its appeal to new farmers who have no heritage in farming and are eager to learn. He says "it is a nice metaphor of them constructing themselves as farmers". Gregoire, whose job is to assist the farmers in the creation of the tools and conduct the workshops, aims to remove barriers of competence and confidence "it is important for me to demystify the work of metal and machines themselves. A farmer that can work metal will be able to transform tools into something new. It is important for a farmer to have the confidence, if they have an agronomic idea and some knowledge of mechanical systems, to pursuit it". In the long term he hopes that farmers will not require his expertise and AP will merely be providing logistics support while the "transfer of competence will be from farmer to farmer".

The peasant master frame is providing substantial context for AP with strong references to farmer autonomy and sustainability. While the goals of contemporary peasant movements are fully embraced by AP, the food sovereignty framing has been extended to include technological sovereignty as the group deems it is often omitted in the debate within larger transnational peasant SMOs.

The peasant master frame in Farm Hack

The peasant master frame is less prominent in FH than in AP even though according to Severine “FH is only possible because of the existing peasant network”. However she claims that the peasant language is not widely used in the US. This partly explains the heavy focus on open source language software within FH despite the many similarities between the two approaches with regards to collaborative endeavours and open knowledge dissemination. Grant believes that peasant mobilisation in the US is small, underfunded and often defeatist. Regarding state support he says “it can be clunky as far as small scale agriculture is concerned because they’re basically bought and paid for by large agribusiness interests”. Daniel continues this critique: “it’s a political analysis of where power lies in the system. In saying that power is held by giant manufacturers who can afford investing in research and development and lobby in the government”. Similarly, Kristen says that while engaging in small sustainable agriculture “it became clear that farm technology is focused on industrial scale agriculture and there is a gap between what small farmers need and that is available on the market”. So she and other farmers create their own creative solutions to their needs, yet she says “it shouldn’t just be up to farmers to solve their problems. Food is fundamental to our society and farming is a high-risk and challenging profession. I think the resources of our society should serve the purpose of growing food better and more effectively… and that is the case, but at one scale of agriculture only” (referring to industrial scale agriculture). Severine’s views are even more radical. There are converging monopolies around basically four large companies with established innovation hubs, university accelerator programs and government grants she says and concludes that “the militarisation of agronomy is the next phase in totalitarianism”. In the same vein, RJ says that the idealistic goal for his early engagement was to “end tyranny”.

While these peasant frame-driven views are evidently held by people within the community they are not voiced and featured prominently in the FH framing. According to Grant a reason for that is that US farmers suffer from “tall poppy syndrome” with regards to their opinions and are afraid of being outspoken. Tim, who during our interview almost used a Marxist quote but did not quite complete it, says he doesn’t use this type of language because people tend to think that it does not have practical applications. On not finishing the quote he says “I guess I stopped myself because if you use that language here, the immediate response is ‘so how are you going to make any money’ and then you need to backtrack and say ‘look, I’m not making any money anyway

– I will never make any money because the market system does not allow it'". With FH they are trying to "break out of the system and make something that should have been made before us and not ruining the planet at the same time". And the language used instead is based on rational arguments and examples that work with people Tim says, as illustrated by the FH platform.

It is mainly centred on the critique of the incompatibility of conventional agriculture equipment with alternative agriculture and the support of small scale farmers. According to the video introducing FH in the platform: "For the last 50 years mainstream agricultural technology has progressed along a trajectory of 'bigger is better' with top-down chemical, capital and energy intensive machines. The kind of equipment we need is affordable, adaptable and easy to fix… We want the right tools for the job and the job is sustainable agriculture". The initiative is defined within the historical context of agrarian activity but with a focus on new farmers and new approaches developed in collaboration with allied social groups. According to the platform, FH is "a community for those who embrace the long-standing farm traditions of tinkering, inventing, fabricating, tweaking, and improving things that break. We are farmers of all ages, but the project has special relevance to young and beginning farmers as a place to learn from their peers' and their elders' successes, mistakes and new ideas. We also seek to bring our non-farmer allies on board: engineers, architects, designers, and the like. Together, with an open-source ethic, we can retool our farms for a sustainable future". This, combined with the collaborative and sharing methods of open source may enhance the wellbeing of farmers: "we believe that greater knowledge sharing will lead to better tools, skills and systems to build successful, resilient farms. Open-source seeds, breeds and technology are the fastest way to accelerate innovation and adaptation, and ensure an equitable, diverse agricultural landscape".

Dorn feels there is a sense of continuity that comes from embracing the history of agrarianism which was in fact open source: "It's not something we invented, we are continuing. We are part of something that has a much larger lineage… learning from the past but at the same time looking at the future", or "peasants of the future" as Severine calls it. According to Dorn it goes back to the yeoman farmer ideals, the granges and agrarian politics which is "not class politics and it's not libertarianism" he says "it has the elements of independence and mutual aid, a non-commercial and a non-competitive market approach". On this continuity Kristen compares the US to Europe and says that the small farms never went away in Europe, while “in the US it feels like we’re re-inventing a lot of things”. Dorn says they are imagining a yeomen’s agriculture that is “diverse, direct to the market, with equipment that can be owned by the farmer or the community” yet like Kristen he thinks that to achieve this they need to invent the tools for it. But at the same time it is a big challenge with the greatest potential “to shift the mentality in order to have more empowerment at the farmer level” as Dorn says referring to convincing farmers to learn to build tools themselves or in the community rather than seek to buy them.

In general there is a lot of overlap between the FH community and other collaborating organisations like those of the greenhorns and the NYFC according to Dorn. So their politics spill over, like access to land, funds for education and healthcare and all things relevant to farmers being more successful and “having a more level playing field”. The peasant frame is adopted in a wider, less obvious way in FH in order to appeal to as many constituents as possible. Hence it mainly focuses on the historical context of peasant agriculture and the capacity of the model in the modern world to address farmers’ needs which functions as the driving factor for the wide range of views within the community.

4.2.4 Formulating the open source agriculture frame

Within this thesis the various framing processes each of the sub-case engage in have been distilled into three master frames which embody the common elements in the various social movements that produce them. The sub-cases tap into these grander narratives and engage in frame alignment in order to articulate their elaborate goals and various activities in a concise manner. While the individual sub-case frames are not identical, there are commonalities which may be systematised in order to articulate the new collective action frame shared by communities and individuals engaging in open source agriculture. A visual representation follows (figure 1), which illustrates the basic elements emerging from the data collected by either sub-case. Combined they offer the central narrative of the frame.

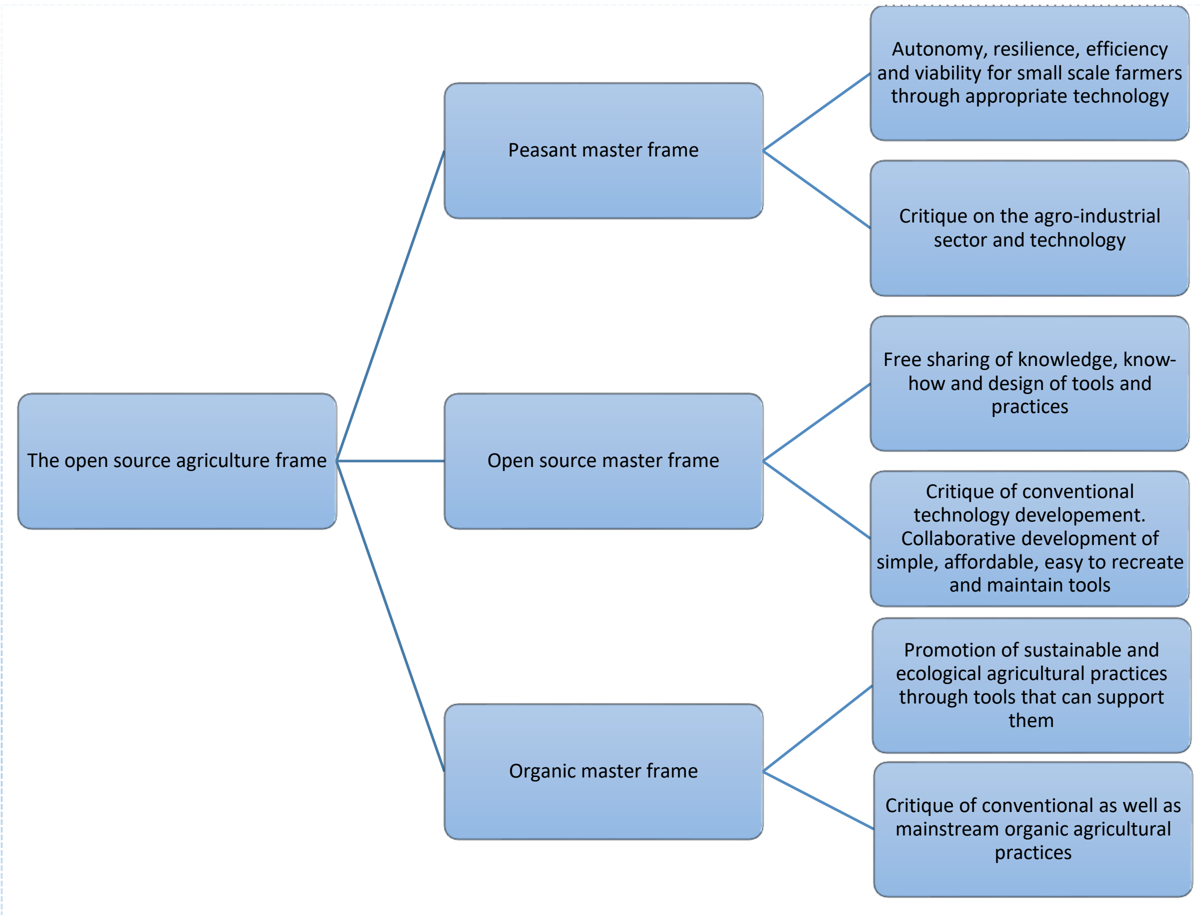

Figure 1: the elements of the open source agriculture frame.

In order to systematically represent the data, the three framing tasks (namely diagnostic, prognostic and motivational) presented in the previous chapter will be employed. Diagnostic framing involves the identification of a problematic situation and the attribution of blame. In this case the three master frames are bridged to offer a multidimensional critique of the modern, conventional agriculture and the technology supporting it. The agribusiness sector is deemed responsible for the elimination of small and middle scale farms and traditional farming methods through the implementation of technology and practices that detach farmers from the land and cause great resource depletion and environmental destruction. The technology that is supposed to assist the farmers into tackling their problems is instead developed without their input and serves the interests of large companies. Thus, farmers are either devoid of appropriate tools or unable to purchase the ones available in the market, due to patents that instead of protecting creators' rights are now perceived as a tool for profit maximisation.

Governments and knowledge institutions, like universities and research centres, are often viewed as complicit in this hostile system.

The prognostic framing is also a synthesis of solutions promoted by the each of the three master frames. Due to the nature of the open source agriculture movement, i.e. it being a technology and product-oriented movement rather than exclusively oppositional, the solutions offered are not in the form of demonstration and direct opposition but rather as alternative approaches to tackling their problems. Technology developed by farmers for farmers with the assistance of designers, engineers and software developers. This type of technology is portrayed as truly suitable for enabling small scale farmers to engage in alternative agriculture. At the same time collaboration, the sharing of resources, knowledge, and know-how amongst farmers is also promoted as a way of increasing viability and efficiency.

The motivational framing features the vocabularies of motive which are socially constructed to justify the movement's activity and spark further mobilisation. Three motivational frames have been observed, corresponding to each master frame. These are openness, sustainability and autonomy. Openness framing amplifies the merits of the open source model and collaborative processes as opposed to proprietary approaches that appear ahistorical and incompatible with agriculture. The open source model is presented as a natural continuation of ancient agricultural practices which were collaborative rather than antagonistic, while modern ICT technologies allow for such collaboration in a scale never before possible.

The sustainability framing pertains to the severity of the environmental and health concerns over conventional agriculture which for some is leading to certain collapse. Instead it promotes systems that are good for the environment and provide healthier food. Or in the worst case scenarios, "lifeboat" systems and tools which may be effective even under the most adverse conditions. These systems, while diverse in methods and approaches, are all viewed as radically different both in scale and philosophy from conventional ones since they refuse to treat the aforementioned concerns as externalities and they affirm the conviction to work with nature rather than impose on it.

Last, autonomy is presented as concerned with securing independence and resilience for farmers who are potentially contingent on a system that is beyond their control and does not cater to their needs and interests. Worse still, large companies are viewed as powerful enough to influence public institutions in order to assume control and manipulate the entire sector according to their own interests. The perceived solution is to break free from this system and operate as independently as possible. This may be achieved through minimising external inputs, self-creating machines and tools, diversifying the activities and skillsets of farmers, and establishing collaboration and support networks.

In conclusion the open source agriculture movement offers a critique of the incumbent system and a vision of technology that is attuned to socially and environmentally conscious agriculture which, according to its adherents, is posed to eventually replace it. The critique is distilled down to the essence of technology. In Fabrice's words people in the agricultural production usually "are not interested in tools. I mean they are not thinking about the political implications of tools. But technology is political, it is not neutral. They see it as not political. Just technology, just progress. In this way nobody questions the technology. Talking about what we do opens another door as it is lack of visibility that allows this to happen. One piece of technology paves the way for one political goal, and another piece leads to another goal". The vision then, is an amalgam of the elements from each master frame appropriated by the movement constituents which may be encapsulated as open source sustainable technology geared towards autonomy and resilience. The next chapters will further explore this technological aspect of the movement in order to identify how the ideological proclivities and beliefs of the constituents, as well as the availability of resources and socio-political opportunities inform the nature and development process of the technological artefacts.

CHAPTER FIVE

5. Open source agriculture as a technology model

Open source agriculture was previously examined through a social movement framework in order to systematically analyse what mobilises the communities and individuals involved in these initiatives and how they perceive and interpret it through three wide ideational frameworks. Primarily their creative activity revolves around the design and fabrication of technological artefacts that enable them to pursue their goals. A different set of theoretical approaches, focusing on the study of technology, will be utilised now to further explore this activity. This chapter will attempt to present the mixture of these approaches and how they will be incorporating the results from the analysis so far.

We live in a technological society, meaning that technology permeates every facet of the social structure which is, albeit fairly recently, reflected in human sciences. There is a plethora of research approaches and philosophies of technology attempting to make sense of its intertwining with society, hence this thesis is inevitably selective with the approaches utilised to tackle the phenomenon under examination. Some context will be offered in this chapter, however, as even the very definition of technology is wide and often contested. What we understand as technology determines what the focus for research should be as well as its basic assumptions and limitations. The chapter will begin with providing the premise and definitions that will form the basis for further analysis in the thesis.

5.1 What is technology?

The term technology has been utilised for surprisingly little time dating back to, possibly, the 17^{th} century and was only widely used in the late 20^{th} (Nye, 2006). Until then, the term technics was employed to describe collectively the “tools, machines, systems and processes used in the practical arts and engineering” (ibid.,12). Etymologically the word is derived from the ancient Greek techne. Greek philosophers, like Plato and Aristotle, distinguish nature (physis), which perpetually re-creates itself, from poiesis, which is the human activity of creating an artefact (Feenberg, 2005). Techne describes the knowledge and principles relevant to a certain type of poiesis, like for instance carpentry or ironwork. Nowadays the term is significantly more complex with the various academic disciplines and approaches providing definitions for “technology”, “technique”, “science”, “technoscience”, “society and technology” etc. according to their specific foci of analysis.

Early 20th century philosophers of technology, like Heidegger and Ellul, have built on the Greeks’ conception of technology, seeking to strip away the contextual layers and pinpoint the fundamental essence of technology (Dusek, 2006). This essence was often viewed as rather harmful for the human society since it was perceived as beyond human control and detrimental for community and spiritual values (Brey, 2010). This view was also shared by the advocates of critical theory like Marcuse, which considered modern industrial technology as having imprisoned humans in a destructive consumption cycle. However, Marcuse adds, that the goal should be to conceive a technology that is embedded with social and environmental values. This updates the notion of techne from its ancient Greek meaning, imbuing it with the capacity to reorganise modern society.

Scholars from the science, technology and society (STS) tradition, which is concerned with the empirical study of technology, adopt a more practical and precise approach to defining it. According to MacKenzie and Wajcman (1985) technology may be perceived in three levels: technology as artefacts, like mobile phones and computers; processes or activities, like designing the mobile phone; and knowledge around technology. This last level corresponds closest to the ancient Greek definition and entails the information and know-how regarding the manufacturing, use and maintenance of a certain piece of technology.

It should be noted that technology is often misunderstood as applied science. Technology is developed to produce artefacts while science aims to produce models and theories that provide insight for phenomena. Furthermore, the term technoscience is often used nowadays, illustrating how theories and practices - technology and science have become too similar (Misa, 2009). While the boundaries between the two are becoming ever more blurry, technological artefacts often precede scientific exploration or even make it possible (Nye, 2006). Throughout human history tools were developed before a scientific explanation existed for what they do and how, though cutting edge technology nowadays usually involves both. Within this thesis, the boundaries are clearer as the individuals and groups upon which it is structured view technology as artefacts and processes which may be created and re-created by the users themselves. While the scientific community and experts are often sought after, their role is assistive, and the focus is placed in the tacit knowledge and experience of the users, i.e. the farmers whose day to day activities and needs spark the creative process for a new technological artefact.

Contemporary technology theorists, like Feenberg and Ihde, influenced by the empirical focus in the study of technology in the 80s have abandoned their predecessors' pursuit of that single essence following the argument that technology is too complex and broad to be distilled in a single subject (Dusek, 2006). Feenberg (2003) specifically, as a student of Marcuse and proponent of the critical theory school of thought, notes that there is a gap between macro level philosophical analyses of technology and empirical research which needs to be bridged. The thesis is informed by this insight and while it is built on these broad theories, it will attempt to comprehensively explore the notion of alternative technology through the multifaceted study of the two communities and their technology development models. Next the theories that will be utilised to do so are presented.

5.2 The study of technology

Technology as a theme is researched within various fields, if not most. Since it would be impossible and irrelevant to review all approaches in the context of this thesis, an overview will be presented in order to situate this work within the fragmented terrain. The broadest distinction of narratives underlying the study of technology is arguably between technological determinism and constructivism. A second layer placed upon this distinction may be between the aforementioned macro level, philosophical (and often, at least perceived as, deterministic) critiques of modern technology as a whole and empirical (predominantly constructivist) studies in the micro and meso level which explore individual artefacts or systems of technology. The following sub-chapters will attempt to elaborate on this distinction and formulate the setting within which technology is dealt with in the thesis.

5.3 Technological determinism

The study of technology has been, from its conception until the recent past, dominated by determinism (Dafoe, 2015). Technological determinism is built on the belief that technology is independent of societal influence and its progress is fixed. Instead, societies adapt to technological progress in order to facilitate the requirements of each new piece of technology. In this sense, development of new technology does not take place within society and thus does not consider societal factors. This stance has excluded technology from humanistic studies since its explanation lies in technical rationality rather than a social interpretation.

While the definition above describes the extreme and simplified version of technological determinism, there is still significant debate as to what truly constitutes determinism. It is also referred to as “hard” by scholars. In another form of determinism, identified as “soft”, technology is perceived as a driving force for social change but influenced by social, economic, political, and cultural factors (Smith and Marx, 1994). 20th century technology philosophers like Jacques Ellul, Lewis Mumford and Martin Heiddeger are viewed by many as soft determinists and, at the same time, pessimistic against technology which they deemed was out of human control. This can possibly be attributed to the fact that since the beginning of the century heavy industrialisation caused severe social and environmental degradation, while technology has been widely used for warfare with catastrophic consequences (Brey, 2010). Ellul (1964) posits that technology has become an autonomous system which advances itself through social structures and values that place efficiency and logic above everything else, to the detriment of spiritual and moral values. Lewis Mumford (1966) similarly speaks about the mega-machine that “assembles” human beings to do its bidding. Their anti-technological views led them to ascertain that the solution to the problem of modern technology was to be rid of it altogether. While some (Fores, 1981) treat these views as soft determinism, other believe them to be critiques on the socioeconomic system that creates this technology rather than the technology itself (Wyatt, 2008).

In this context, Bimber (1994) proposes a different categorisation. He identifies three flavours of perceived determinism: normative, nomological and unintended consequences. Normative is the type of determinism where technology’s continued development has been uncoupled from ethical and political considerations. Nomological determinism is the view that technology’s underlying logic can drive societal change in a predictable way, much like the law. And last, “unintended consequences” refers to those consequences technological development might have on society that cannot be predicted or controlled despite the various social actors’ attempts. Out of the three, Bimber considers only nomological determinism as true determinism since it is the only one that accepts the intrinsic capacity of technology to produce change.

Wyatt expands on this classification of determinism based on the perception of certain social groups and individuals. These are descriptive, methodological, normative and justificatory (Wyatt, 2008). Descriptive is the form utilised by technology theorists as a form of identifying and avoiding it in their work. Methodological determinism is employed by other theorists to examine the role of technology within society by placing in it the centre of their investigation. Normative determinism follows Bimber's definition of technology that has become so big that it is no longer under societal control. Last, justificatory determinism is the one deployed by societal actors and can be found everywhere around us; from policy documents to corporate decision making. It is the type of deterministic rhetoric that is associated with the common views regarding technology and is often employed to justify controversial decision-making under the pretext of unavoidable technological progress.

Technological determinism, in its justificatory variety, is obviously the most problematic and while it has been widely vilified by historians of technology, technology philosophers and STS scholars as simplistic and devoid of political agency, it is still widely shared among societal actors, both civilians and those with political power, and thus merits attention. That is because it still informs the popular opinion and decision-making processes regarding technology (Wyatt, 2008). Determinism persists because technology is so pervasive in human societies that it is easy to mistake it as the driving force and it is thus often used as a defining characteristic for certain periods of times in history (Heilbroner, 1994). Its simplicity then, is probably the reason why it still persists despite the best efforts of technology scholars. It corresponds with most peoples' experience with technology, i.e. adapting to new pieces of technology whose design process and manufacturing remains largely a mystery (Wyatt, 2008). It just makes sense. This is important in the context of this thesis because, unlike those who welcome determinism as an excuse to uncritically consume new technology, the members of the communities under research are aware of how technology affects their lives. They reject this predicament and strive to produce technology that is aligned with their values.

That is especially noteworthy because agriculture is a sector where technological determinism has dominated the narratives of development. According to Hamilton (2014), determinist discourses have allowed agribusiness to push the capitalist, industrial logic of agriculture that was seemingly technologically determined and consumer driven. In other words, technological determinism was the façade used to justify the inevitable introduction of large scale mechanisation as an external input to heavy agriculture in the name of technological progress that cannot be stopped. Yet this technological shift was far from apolitical or independent. It carried the logic of the free market and the interests of large vertically integrated corporations which ultimately made the deterministic view of inevitable technological progress towards that particular direction a self-fulfilling prophecy (ibid.). It follows then, that the political impact of the groups examined in this thesis should be especially significant considering that they do not adopt a technophobic stance against technology and as a consequence reject it all together. Instead they aim to build an alternative narrative to the deterministic; one which enables critical appraisal and more democratic decision making regarding new technology.

5.4 Social shaping of technology

On the opposite side of determinism is social constructivism of technology which is built on the premise that technology is socially constructed and is influenced by a plethora of economic, political, cultural factors as well as the interactions of the various groups involved in its development. That is not to say that technology does not have a profound effect in society, but rather that it is not autonomous or neutral (MacKenzie and Wajcman, 1985).

The field's origins go back to the sociology of knowledge tradition which regards knowledge in general and science facts more specifically (even within natural sciences and mathematics) as socially constructed. While this notion has been criticised extensively by realists, its application in technology is much less controversial, as there are no metaphysical elements to contest. Technological artefacts are constructed after all. Constructivism in technology was widely popularised in the early 80s, following the proliferation of empirical studies regarding technology that can be aggregated under the "social construction of technology" (or SCOT) title or the "social shaping of technology" (or SST), but also "actor network theory" (or ANT). These examine technology not with a capital T but rather as individual technologies or technological systems (Bijker et al, 1987).

This view of technology is similar to that of several contemporary philosophers that do not view technology as a monolithic or as inherently detrimental for society. Under the moniker of critical theory of technology are theories that look into the economic, political, social and cultural values that motivate the production of technology in order to make normative assessments on the function of technology in society (Brey, 2007). This thesis espouses the constructivist approach and utilises a mix of various approaches to examine the two sub-cases, in combination with the findings of the previous chapters, under a technological lens.

5.4.1 Social constructivism of technology

The constructivist approaches to technology suggest that technology does not follow its own momentum nor has its internal rationale. Instead it is primarily defined by societal elements. Particular social interests (which is the focus for SST), as well as the relevant social groups (as supported by the SCOT approach) and non-human technical actors (in the case of ANT) involved in the creation of a technological artefact are the starting point of analysis. SST does not offer a specific framework for analysing technology and functions as an umbrella term for several approaches whose common thread is the inscribing of social factors in technological artefacts.

The SCOT and ANT approaches, on the other hand, provide certain tools to examine technology respectively. Both approaches rely heavily on the principle of symmetry. Symmetry implies that failed cases of technology are of equal (if not more) capacity for insight regarding technological and social issues and should be examined symmetrically. Its application to technologies studies is exemplified by the dispelling of the myth of objective technical superiority for the advancement of certain technologies over others (Bijker, 1997). This means that at any given time there is always more than one technical solution for a specific problem and the prevailing one is not necessarily the most efficient but it depends on the social environment that enabled its dominance. Essentially all actors, human or not, involved in the process of technological development are to be treated as having the same level of power to influence it. SCOT preserves the duality of society and technology and posits that technology is the one determined by society. ANT, on the other hand, avoids this dichotomy entirely by applying the principle of symmetry in the social and technical. Instead, it views technological development as a process of expanding networks with technological artefacts enjoying the same significance within them as individuals and groups.

The whole process is termed translation (Latour, 1991). Actors, which may be human, artefacts or even more abstract concepts like politics and science (Callon, 1991), enrol allies and negotiate their positions in the network shaping technological development in the process. Essentially translation begins with convincing allies that a certain problem may be tackled by a certain technology used in a certain way. Interests, goals, strategies, opinions are communicated amongst actors transforming what might have been the original idea, for instance a technological artefact or process, to tackle the original problem. In other words, the results of the translations are inscribed in the technology itself. Ultimately, the network seeks stability through irreversible processes and immutable objects which would be too costly to change. After the network has become fully rigid then the technology reaches the black box status where no further change is deemed possible and the social background of the development process becomes obscure, thus contributing to the myth of determinism.

The SCOT approach employs several tools similar to those of ANT but is less conceptually and methodologically hazy. While the framework has mostly been utilised as an approach within historical analyses of emerging technologies, it may also be used as a tool for the sociological study of technology (Bijker, 1997). Similarly in this thesis, technology will be primarily explored as a snapshot of its evolving development. The SCOT concepts will be informing the thesis more heavily. Pinch and Bijker (1987), who popularised this approach, introduced the notion of relevant social groups as the basic social units involved in the development of technologies. They may be institutions, organisations or simply groups of individuals (organised or not) which share a similar interpretations of a technological artefact. These social groups identify certain problems and corresponding solutions during the development of new technology. Different social groups ascribe different problems as relevant in the process thus affecting the form of the technological artefact. While an individual may be part of more than one relevant group, each one has a unique interpretation of the artefact.

Since the various groups view the technological development of a technology differently, there is interpretive flexibility in the way an artefact evolves, which means that there is not just one artefact but as many as the relevant interpretations. Interpretive flexibility is another SCOT concept to track how problem solving regarding a technology differs amongst relevant groups (Pinch and Bijker, 1987). The interpretive flexibility of an artefact demonstrates the various meanings imbued to it by the groups which means that an artefact is not merely technically developed but affected by social conditions. Bijker exemplifies this in his seminal study of the bicycle's history where various versions existed concurrently satisfying the needs of different social groups, instead of it evolving linearly as is usually assumed (Bijker, 1997). Over time and interactions between social groups the multiple versions of the bicycle diminished leading to gradual stabilisation and closure in the version everyone is familiar with today.

Stabilisation and closure are two more useful concepts of SCOT. Stability is achieved when the relevant social groups negotiate and align their interests in a certain iteration of the technological artefact. As the meanings attributed to the artefact begin to homogenise, it gradually stabilises. After several renegotiations a dominant design will be accepted by all groups and closure will be reached. A black box state where no further changes may take place. The artefact becomes obdurate and its essence fixed, with all previous controversy around its form disappearing. It follows then, that the final product is not necessarily the most efficient or successful version of the artefact but rather the outcome of all the aforementioned social interactions leading into consensus.

Both the ANT and SCOT frameworks adopt a radical approach in the constructivist account of technology, which might be considered social determinism (Bijker, 2010). Hughes' technological systems offers a more mild approach, bridging the two extreme versions of determinism. Systems are defined as amalgams of political, economic, social and political components beside the technical ones. The basic tenet here is that technological systems gain momentum as they grow and become more mature (Hughes, 1987). This is due to various factors which constrain the social shaping of technology like established infrastructure and standards; sunk costs and fixed assets; people employed and routines; embedded interests. While their origins are indeed social, it can be claimed that these limitations are not designated by certain groups and can therefore be perceived deterministic in nature. Linking to both SCOT and ANT, certain social groups, like engineers maintaining certain technological skills and practices, as well as the actor networks in which they are embedded, add to the system's inertia as it becomes mature. In other words, while technology is always socially determined in its conception, over time technological determinism sets in. Such are the automobile and electric power systems which still hold considerable momentum in our contemporary circumstances, though systems do decline and eventually get replaced like the gas lighting and the canal transportation ones that preceded the aforementioned.

Bijker, building on the systems approach, proposes another unit of analysis, calling it a sociotechnical ensemble to place emphasis on the generalised symmetry of the ANT between the technical and social, which he uses to explore the obduracy and hardness of technologies depending on the level of inclusion for individuals and groups (Bijker, 1995). Those with a high level of inclusion have a broad range of flexibility and options within the ensemble they are embedded in, but it is almost impossible for them to operate outside of it. Those with a low level inclusion, on the other hand, experience a “take or leave it” dilemma. Should they choose to take it they have very limited capacity to influence the ensemble but if they choose to leave it then it is possible for them to thrive outside it.

Viewing modern agricultural technology as either a technological system or a sociotechnical ensemble, a clear parallel can be drawn with the technology examined in this thesis. Agribusiness companies as actors dominate the system and shape it according to their interests. Farmers engaging in large scale agricultural production enjoy a high level of inclusion and are able to navigate it and prosper. Yet they would not be able to support their activity outside of it due to their heavy dependence on external inputs and highly mechanised methods. Smaller actors, on the other hand, like the ones featured here, are practically not included. It is almost impossible to appropriate this technology for alternative uses. Yet it is relatively easy for them to exist outside of it. The next sub-chapter will explore technological frames, which are a key tool in the attempt to methodologically examine the complex interactions taking place within the technology development processes of the open source agriculture movement and contextualise its attempt to change the technological culture around agriculture.

5.4.2 Technological frames

Admitting that social groups cannot simply conceptualise and create technological artefacts without any restrictions, Bijker (1995) introduces the concept of technological frames. Frames as conceived in the SCOT are not purely cognitive structures, but contain material and social elements as well, and are used by analysts to structure data under consideration and track interactions within social groups (ibid.). They do not describe characteristics of individuals or institutions, but are the glue that binds the actors together. They offer the problem as well as possible solutions but at the same time limit the freedom of the actors within them.

A technological frame emerges when work around an artefact begins. It organises the interactions amongst individuals in social groups, formulates their thinking and practices but also limits their capacity to design radically new technologies (Bijker, 1995). There are as many frames as social groups around an artefact and individuals might be placed in more than one frame. The concept itself is broad enough in order to focus on different elements depending on the case it is applied in and for it to be applicable not only to the technically savvy (like engineers) but also all to other individuals within social groups (Bijker, 1987). It is comprised of all the components that lead into the attribution of meaning in artefacts. Those might include (but not be limited to) the following: "goals, key problems, problem-solving strategies (heuristics), requirements to be met by problem solutions, current theories, tacit knowledge, testing procedures, and design methods and criteria" (Bijker, 1997, p.123), but also (and perhaps more importantly) other, previously established obdurate artefacts, cultural values, user practices and perceived substitution elements in order to take into account the diverse groups involved in the process.

There are three possible configurations for technological frames within a sociotechnical ensemble: "when no clearly dominant technological frame is guiding the interactions, when one technological frame is dominant, and when more technological frames are at the same time important for understanding the interactions related to the sociotechnical ensemble that is being studied" (Bijker, 1993, p.128).

In the first configuration, usually in effect during the early stages of technological development, there are no established frames as there is no dominant social group and perhaps several radical artefacts. Success is dependent on the formulation of a strong frame with the enrolment of several allies that will direct resources along a certain trajectory. The next configuration is dominated by one group and frame that is strong enough to articulate both the problem and the solutions to address it, thus limiting the range of technological solutions within the ensemble. The final configuration is populated by several competing technological frames, with varying problematisations and solutions. External factors are paramount for the technological choices made in this configuration and the interests of all groups will be accounted for in the technological output.

Following the earlier parallel, the agricultural sociotechnical ensemble is dominated by the large-scale, highly mechanised and chemical input intensive technological frame as in the second configuration. The frame allows those with high inclusion to define which problems are to be tackled and with what solutions. Those with a low level of inclusion are kept outside the development process and adoption through excessive costs and strict intellectual property rules that prohibit them from appropriating and adapting the technology. Thus, the only viable option is to cooperate and establish a competing frame that will account for their interests and goals as they were articulated in the previous chapter.

Iacono and Kling (2001) have previously merged frame concepts from the social movement and STS in order to explore computerisation movements, i.e. movements that promote the use of information and communication technologies in society and organisations more specifically. They build on Orlikowski and Gash's technological frames (1994) who in turn adapted Bijker's concept and applied it to organisational frames. Orlikowski and Gash aim to track organisational changes with regards to information technology due to the varying frames of different social groups. They termed congruence as the alignment of elements amongst different frames, whose lack leads to organisational difficulties. While they look into how the design and form of technology is influenced by frames, they perceive them as strictly individual cognitive structures shared by those in relevant social groups within organisations as opposed to the SCOT framework which examines frames in the societal level.

Iacono and Kling studied technological frames that, much like collective action frames in social movement research, were employed to mobilise adherents, demobilise possible antagonists, elicit resources and support in order to achieve certain technological developments. They focus primarily on goals, prognostic and diagnostic processes, theories, user practice and existing artefacts. Their conceptualisation of technological action frames provide a reasoning for the adoption of a technology which encompass shared understandings, expectations and beliefs on how the technology works. It also includes master frames rising over competing frames and stabilising the discourse around a certain technology through a specific set of meanings.

This thesis follows a similar line of reasoning where the aggregated frame of the open source agriculture frame will be translated into the technological action frame for the movement which itself shapes the technological output of the two sub-cases. The next sub-chapter will explore the theory enabling the consideration of political and normative aspects of technology but also ameliorates the shortcomings of these approaches. An overview of these shortcomings follows.

Even though the social constructivism approaches have the capacity to contribute to the political critique of technology they are often constrained into the examination of specific technologies instead of ever expanding into the broader political bias which may influence the entire network of actors or social groups involved in the development process. While the very notion that technology is socially driven may be viewed as political, they tend to offer descriptive accounts of how technology emerges rather than offering any criticism or normative evaluation about its place in society (Winner, 1991). Over the years, extensive criticisms has been laid on them with regards to lack of consideration for wider structures that influence technological development as well as the impact of the technology itself in society after tracking its development process (Russell, 1986; Klein and Kleinman, 2002). More specifically the principle of generalised symmetry has been criticised both for equating the importance of human and non-human actors but also for the assumption that all actors, large and small, enjoy the same amount of power (McLean and Hassard, 2004; Lynch, 2006). Similarly, the concept of social groups takes into account problems and solutions, and needs and interests but ignores any wider cultural, economic or political reasons for social choices over technological development. It is also criticised for the assumption that all relevant groups are present in the process and of equal power (Klein and Kleinman, 2002). For instance, some groups might be prevented from participating or affected without participating, while others might be misrepresented and others still might not be uniform groups but clustered, diverse subgroups.

5.5 Critical theory of technology

As mentioned above a critical theory of technology investigates the economic, political, social and cultural values that motivate the production of technology in order to make normative assessments on the function of technology in society. Contrary to most constructivist research, which focuses on the nuances of their empirical work and is wary to expand beyond it, this approach does not shy away from broad generalisations about technology practices and cultural values from carefully selected indicative cases. Through these cases they "show the ordering, disciplining, rationalizing and modernizing processes that are associated with technology" (Misa, 2008, p.372). An epistemological and methodological conflict appears at this point (ibid.). It is possible, however, to bridge the two approaches in order to formulate a comprehensive theory on technological change based on empirical evidence (Feenberg, 2003). This multi-level view is the foundation which informs the empirical aspect of this thesis and will provide a connection to the wider socio-political context influencing both sub-cases. The social movement framework is used to provide a reconciling methodological element between the perspectives of individuals and groups acting autonomously and the birds-eye point of view for the structural whole which transcends the limits of the empirical case study.

The notion of power is central in critical theories of technology which examine how technology is utilised to influence its distribution in society. Technology allows actors or social groups to exercise power with the use of technological artefacts and systems by either providing them with new powers or by allowing them to exercise existing power more effectively than others. People can be coerced, seduced, forced, manipulated or simply expected to respect a specific authority through certain delegated technological artefacts according to Brey (2007). However, there are instances of resistance amongst social groups at the receiving end of asymmetrical power relations. Pfaffenberger (1992) recognises three tactics of resistance: countersignification, where the suffering social groups adopt different framings of meaning for the technology affecting them; counterappropriation, where they attempt to appropriate an artefact that was not created for them regardless of their unfitness for it; and counterdelegation, where they strive to subvert the dominating characteristics of the technology. This might be achieved by modifying the technology or through the use of countering technologies.

Critical theories serve the normative goal of seeking better ways for power to be resisted and distributed more symmetrically in society through technology which is the primary focus for this thesis also. A more democratic, just and free version of technology is understood as constituting a foundation for better distribution of power in society (Brey, 2007). The democratisation of technology, meaning the wider participation of the public in its development and use, is a topic that several technology theorists have attempted to tackle (see for instance Winner, 1987; Feenberg, 2002)

The most prominent example of a critical theory of technology is offered by Andrew Feenberg who provides a thorough overview of technological change and the politics that drive it in modern capitalist society. Feenberg's critique of technology developed within the capitalist production system is focused on its concern with securing profit and power. As Herbert Marcuse's student he draws his inspiration from the Frankfurt school but, like Marcuse to some degree, rejects their grim outlook against technology as an instrument of domination. Instead he envisions change that stems from activity at the micro- and meso - levels by the marginalised who acquire the consciousness, and subsequently the technologies, to do so despite having to contend with much more powerful opponents like global corporations (Feenberg, 2002).

5.5.1 Indeterminism, technological hegemony and technical codes

Regarding research on technological systems, Feenberg proposes indeterminism, instead of unilinear determinism, whereby technological development follows technological branches that may reach a high level on more than one track. Such development is not a determining factor for society but is rather overdetermined by social and technical factors alike. To illustrate the flexibility of systems over social pressure he provides the example of child labour and work hours in the 19th century (Feenberg, 2002). Machines, at that time, were designed to account for a small person's frame and a factory was organised to function in a back-breaking rhythm. It was a fact of life, technology demanded it. Initially, requests for regulation with (partial) elimination of the former and reduction of the latter were met with fervent resistance based on the imperatives of technology. A multitude of alarming 'technical' counter-arguments were offered around the reduction of efficiency (narrowly defined within that specific paradigm) and competitiveness, increase of inflation and ultimately economic collapse. However, once regulations were placed, not only this was not the case but efficiency increased and the system gradually adapted to and internalised the new social conditions into its guidelines and practices. Looking back child labour is considered a non-issue, the reconfiguration of the system seems inevitable and the social struggles that took place are largely forgotten.

On the other hand, when one looks at the future it is quite difficult to conceptualise technologies to tackle societal issues which exceed the restrictions of current technological configurations. As Feenberg puts it "not only is it difficult to anticipate future technical arrangements, it is all too easy to think up utopias that cannot be realized under the existing ones" (Feenberg, 2002, p.98). That is because technological design is limited by economic, political and cultural factors often employed by powerful social groups to dominate over the rest. The prevailing capitalist technological rationality is imprinted into the technical base of society through a form of social hegemony that reinforces a hierarchal structure by selecting certain technological configurations over others. The assembly line, for instance, exemplifies how control through enforced repetitive and low-skill tasks around machinery is employed to increase productivity and profits for the management rather than improve the well-being of the workers (Braverman, 1974).

All this is made possible by incorporating the aforementioned social factors in the technical design, language and practices through a process Feenberg calls instrumentalisation (Feenberg, 2008). Instrumentalisation take place in two levels. Primary instrumentalisation breaks down technological artefacts into their most basic elements, decontextualizing them from the social environment. There, one can observe the most rudimentary of social influences, and distinguish which physical and technical principles are most important. However, during the secondary instrumentalisation these elements are re-contextualised in the social world and values, meanings and goals are coded within and influence the ultimate design of new artefacts.

These "technical codes define the object in strictly technical terms in accordance with the social meaning it has acquired" (Feenberg, 2002, p.88) and much like technical culture itself they remain largely unseen and self-evident. Only through careful investigation can one uncover the controversies that have taken place during their formulation. Hence, new iterations of mainstream technologies, like a car or a tractor, must conform to certain codes in order to be accepted in society at any given time. Yet the establishment of these codes over others was the result of conflicting ideologies and interests with the most powerful social forces defining the technical rationale shaping these technologies.

Technical codes dictate the design and manufacturing of technologies; the processes to be followed; standards and guidelines to adhere to in order to achieve maximum efficiency (broadly defined by private economic interests and ignorant of all other side effects which are largely socialised). In this sense, technical codes define many aspects of social life, but rather than treating them as containing some sort of deterministic capacity or functional rationality we may trace historically certain social interests attributed to and calcified in them. Similarly, the technical codes defining modern agricultural technologies are largely concerned with maximising yields, usually in large-scale applications and ensuring, of course, continuous profits and control for their manufacturers. But they are not expected to consider environmental arguments or the demands for the autonomy and well-being of small scale farmers so they safely ignore them.

5.5.2 Democratic rationalisation

This version of critical theory is meant to expose the underlying technological rationality in society and provide support to those initiatives that seek to be mobilised around radical new technologies. In other words, to uncover the formal bias which, although it appears neutral or devoid of values with a mere focus on efficiency, structures systems in such a way so as to serve the interests of certain social groups. To this end, Feenberg (2002) promotes what he calls democratic rationalisation which re-examines basic assumptions and values that are currently viewed as self-evident, both in the technical code and the relevant social structures and institutions. According to this notion a democratised technology is not only achieved through the participatory design of new technological artefacts, but also through the alternative re-appropriation of existing technology as well as social movement resistance and protests which push for shifts in the technological paradigm.

Micropolitics then, in the form of protest, participatory design, innovative dialogue and creative appropriation bring issues about technology to the foreground and open up its definition as something more than mere tools for profit and power. Feenberg (2002) offers the example of environmental controversies that mobilised ecological networks whose protests have managed to bring attention to those affected. This movement ultimately did influence the technical codes embedded in certain industries to, at the very least, recognise environmental concerns and liability to those responsible. He further provides examples of technology transfer (especially of agricultural technology) initiatives in third world countries which proved unsuccessful for the most part unless they involved local communities in the design process. Last, he provides the case of the French Minitel as an example of individuals re-appropriating technologies. While originally introduced as an information distribution component accompanying home telephones, users quickly began using it for anonymous chatting thus transforming it into a communication device. In other words, he stresses the capacity of micropolitics in which individuals engage in collective action, inspired by suppressed values like race and gender equality, ecology and meaningful work, to challenge the impact of the dominant technological rationality (Feenberg, 1999).

Similarly, as I will be extensively exploring in the next chapter, in the case of open source agriculture those technological externalities like environmental conservation or even regeneration, sustainable development, and quality of work for smaller farms - which are largely ignored over concerns for wield efficiency and profit maximization - become points of contestation for those who realise alternative potentialities through technologically mediated activities. In other words, individuals sharing the same values aggregate locally, but also on a global scale through information and communication technology, to materialise their technical needs and, at the same time, promote an alternative technological rationalisation.

Yet Feenberg questions the emancipatory potential of the movements he has explored, as they could be perceived as simply facilitating society's further enrolment to the existing technological logic. Initiatives from below often succeed in influencing the incumbent technical rationality without radically altering or destroying it as their political demands are negotiated (or even co-opted) and translated into "technically rational terms" (Feenberg, 1999, p.90). Whether the initiatives explored in this thesis and other similar ones will be able to be lead the way for radical change in the underlying technological rationality remains to be seen. At least, however, they boast a mixture of the elements discussed by Feenberg, along with a unique understanding of the technological factors' impact in their activity and interests. After all, there is a long history of agricultural technical systems structured on different codes than the contemporary ones. Furthermore, farmers are arguably the ones most proficient in their field based on extensive experience with natural systems and tacit knowledge developed and disseminated in farmer to farmer networks over generations.

5.6 Application of technology theories in the case study

The work in the previous chapters is an effort to trace the organisational structure and resource allocation but also values, motives and interests that appear in these sub-cases but cannot be interpreted by the capitalist framework (despite attempting to survive and thrive within capitalism). Consequently it is difficult to explain the technological development process the communities under examination engage in, considering how mainstream technology is arguably linked to market interests and organisations. The following chapter will filter these findings under a mix of theoretical approaches for technology, bridging macro and micro analysis, which attempts to facilitate the examination of a novel and complex technology development stream.

Thus it will illuminate the various aspects of activity around technology development within the two sub-cases in combination with the results of the first half of the research. The organisational and economic models, the community interactions around knowledge and know-how transfer, the design and manufacturing of tools will be explored within the context of the frame formulated through the social movement lens. Additionally, the national social context of both the US and French sub-case will be featured in the analysis as they influence their respective communities in interesting ways. Ultimately, the goal is to examine the prospect of a technology that could potentially present a radical break from the technological progress trajectory formulated in the incumbent societal configuration.

More specifically, the technological action frame will first be synthesised based on the previous analysis. Within this thesis the technological action frame, as a conceptual tool borrowed from the SCOT literature, is updated to describe the amalgamation of the values and overall ethos motivating the adherents of the movement. In that sense it mirrors the characteristics of the collective action frame previously explored. In other words, after reviewing the data yet again it assigns these characteristics to relevant technical features identified in the technological development processes and the artefacts themselves.

The technological action frame is the point of reference for further analysis in the chapter, which takes place in two stages. To examine the micro level of technological activity, the concepts of social groups and interpretive flexibility are borrowed by the social construction literature. These are utilised according to their prescribed purpose in order to shed light to the sub-cases but also challenge some of their basic assumptions based on observed incompatibility within the two subcases. The frame provides possible explanations for these inconsistencies. The macro level is examined in the last stage of the chapter. Influenced here by critical theory of technology the case is situated within a broader context to explore socioeconomic considerations influencing either sub-case. The concept of codes is used to uncover those values embedded in the various structures around agricultural technology and production that clash with those of the open source movement. It is also used to illustrate how the adherents of the movement are attempting to reassert their own values with new, competing, codes. Specific focus is placed on the role of the state since the data point towards that direction. This allows for the opportunity to highlight the state's, often ignored role within critical theory of technology, in the development of alternative conceptualisations of technology.

CHAPTER SIX

6. Open source agriculture: a case of technology alternatives

It is now time to examine the sub-cases as hubs of technological development whose particularities are deemed important for the dialogue over alternative conceptualisations of technology. AP and FH will thus be treated as technological communities beside SMOs in an attempt to illuminate the various aspects of their activity with a focus on the technology itself. To do so, this chapter will filter the data through the theoretical framework formulated in the previous one.

To begin with, the technology development model of both sub-cases will be examined with the assistance of the conceptual tools presented in the previous chapter. The movement's collective action frame formulated in chapter four will be translated into the technological action frame which provides the guide for the shaping of technological artefacts in each sub-case. This chapter will expand on the resource mobilisation inquiry of chapter four, albeit with a focus on the technology itself, which will help establish what effect socio-economic opportunities and limitations have on it. In addition, the political and cultural environment in each country will also be considered in the analysis in order to account for their differing effect in each sub-case. These elements will provide the complementary building blocks for that translation. Last, I will attempt to incorporate the effect of the wider socio-economic context on the organisational form and development model in each sub-case with a particular focus on the role of the state.

6.1 Technology development and organisation model

This sub-chapter will sketch out the processes taking place for the aggregation, development, improvement and dissemination of technological artefacts in the two organisations. Based on the interviews, field observations and extensive online material each sub-case will be presented individually in order to explore the intricacies of their respective approaches. The presentation for either sub-case will be structured according to the quantity and variety of data gathered.

6.1.1 L'atelier paysan

As an organisation AP employs a robust structure to both aggregate farmer developed technologies and collaboratively produce new ones marrying the rich peasant (tacit) knowledge with novel approaches of design and manufacturing. Furthermore, AP engages in awareness and critical thought building around technology which permeates all their activities. The term technologies does not simply imply farming machinery but also specialised processes as well as building infrastructure to accommodate these processes.

I will be providing an overview of the AP model which has been pieced together through a series of interviews with individuals working for the organisation; multimedia material which is mostly available openly through the AP website and forum but also graciously provided by the organisation; and my attendance in the annual gathering of AP which featured several workshops as well as two tools (specifically about a decorticating and scouring brush tool for cereals and a large seed drill prototyping workshops), all of which provided rich observational data and insightful conversations with the people attending. These on-site visits will form the narrative basis for this overview as they illustrate the most important aspect of AP's activity, the collaborative design and fabrication of new tools. This will allow for the exploration of the intricacies behind the AP development model through appropriate narrative cues.

Cereal brush

The first tool, the brush is a machine that cleans and removes the husk off cereals but also contributes to the reduction of mycotoxin (produced by fungi) levels which is concentrated in dust. Its inception took place in the beginning of 2016 after ARDEAR, a peasant farmer association from the Rhône-Alpes area, approached AP. As Alexander, the association's representative in the workshop, explained to me a group of bread farmers were interested in acquiring a tool like that. Yet market options were too expensive and incompatible with their smaller volume of production. Hence, AP was brought in to help them develop their own tool which would be suitable for their needs (which in this case is better quality of flour).

The first meeting with AP provided the basic parameters on what was needed by the tool. According to Nicolas the ideal set of participants for the development of a new tool includes farmers, AP itself and a relevant organisation skilled both "technically and agronomically on the question we want to answer". The organisation not only will facilitate the process more methodically but will also coordinate and urge the farmers to more actively participate in the development process.

Then, research was done for materials and methods of processing cereals through contemporary machinery while inspiration was drawn by similar tools created decades ago in order to conceptualise the basic design (since simplicity is paramount). The fact that potential patents for these tools have expired long ago adds to this choice despite the fact that regarding infringement "in agriculture everybody does it" according to Nicolas.

That is because it is very difficult to prove something is new and unique when it comes to farming tools. Furthermore the legislation is grey in this regard. For instance they recently devised a process to create the component for a star-shaped weeding tool cut by disposed material, which was inspired by a market tool typically made through injection in a mould. In this case the patent was really obvious due to the shape Nicolas says. The creator of this component warned AP that they would take legal action since they considered this a patent infringement. However several interviewees have told me that, following the advice of a farmer in the AP coop who used to be lawyer dealing with this type of cases, they do not believe they would lose in court since they are not actually selling or profiting in any way with the tool or its designs. In fact, they considered proceeding with the case in a very public manner in order to bring attention to the lack of a clear legislative framework for the self-construction of tools but also challenge the legal (and technical) codes behind what constitutes a public good with regards to technological artefacts. As Fabrice puts it, their solution is easily reproduced with DIY (do it yourself) means and it is agronomically efficient – "there is no reason not to appropriate it". However they ultimately deemed that it was not the right timing as they are "still too small". So instead, they altered the shape of the component to resemble the design of a similar one whose patent had expired.

Old designs then, as well as several email exchanges with the farmers provided enough technical specifications for an early 3D draft of the brush tool. A second meeting took place in the AP central office, three months later (March 2016) to further refine the design. Six of the several farmers in the group were present (as not everyone is always available due to time and location limitations) as well as a collaborator of AP who manufactures small scale artisanal mills. The technical elements were discussed in detail as well as all the concerns and desired features. Out of the various possible solutions for technical problems, the ones focusing on ease of implementation, adjustment and balancing were selected. Furthermore, the various empirically attained tips and tricks of everyone in attendance were implemented in the design. The wheat is to be funnelled in a cylindrical tube where a spinning rotor equipped with two steel brushes and two fins will process the wheat (Figure 2). An outer case allows for the collection of the dust and its disposal via a conventional vacuum cleaner.

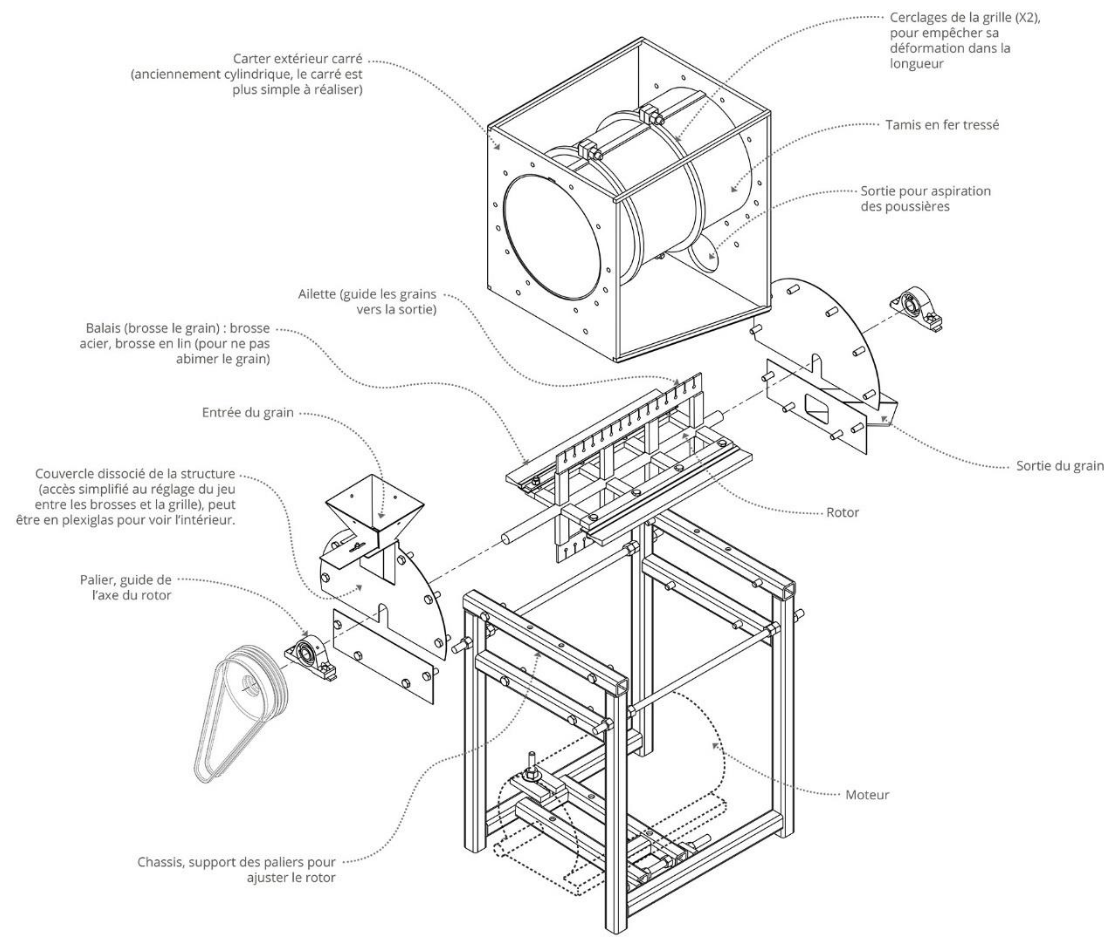

Figure 2: a visual representation of the tool's main components.

It should be noted here that this is a particularly complex piece of machinery utilising electric power which, according to Joseph, probably reaches the limit of sophistication the group can aim for. He believes that the tools they develop should be simpler and easier to reproduce, yet he acknowledges that their role is to assist and possibly guide the farmers rather than indicate to them how they should be doing things. “We have worked with farmers to build big machines because this is what they wanted” he says while specifically about this tool he adds he has “seen a lot of people happy for it, so why not”. Yet he finds them unsatisfactory due to their difficulty to adapt and use. This opinion is echoed by Fabrice who while he admits that he is not against high technology (pointing to his smart phone) he opposes “technology that makes people just operators”. He explains: “there are a lot of tools today were you just have to drive, not think. More and more farmers are not walking the earth, touching the soil… there is no more savoir faire (a capacity for appropriate action), autonomy or human interactions”.

This could reflect the older generation’s lack of familiarity with modern electronics technology but also their desire to create low tech tools which would be reproducible with the most easily accessible material and the simplest possible processes. This, for Joseph, would create an invaluable library of technology suitable for a collapse of the current system which he finds quite possible to transpire given the absolute dependence on external inputs that might not be there in the future. As for high tech machinery in the farm he wonders “what happens in two or three years when the machine breaks?”. Fixing it would require knowledge that farmers do not have. He adds “people can use high tech machines but they need to be conscious of their dangers… we need to preserve farmers’ independence, autonomy, resilience”.

The relatively younger people on the community though, which features several new farmers whose background is in the IT industry, recognise the dynamic of contemporary open source hardware technology. This is exemplified by the decision to now facilitate Arduino microcontroller workshops for farmers to be able to utilise them in their activities (like for instance using them in combination with sensors to measure greenhouse temperature and moisture levels). The rationale for this change, according to the call for participation, is that in order for the farmer to be the agent of technological development in the farm and for them to be able to recognise “the constraints and benefits inherent to each technology”, they need to attain the necessary skills to use and innovate with them as long as they are easily appropriable. By having a basic knowledge of the technologies they would be equipped to make informed decisions as to whether these technologies are suitable or not for their practices. This reflects the view of the group regarding technology and its impact on user autonomy. As Nicolas says “when we speak about technology we don’t speak about autonomy and that’s a problem... right now farmers are not skilled in coding” and that limits their control over how electronics can influence their activities.

Let us now return to the tool. A date was set in the following month for the prototyping workshop. The details over fees were to be handled by ARDEAR. These include attendance and consumable (like electrodes, drill bits, cutting discs) costs. As previously discussed, most French farmers are eligible to tap into specialised funds for vocational training which cover for most of these expenses. During the workshop three prototypes were to be constructed, each of which were to be later acquired by farmers provided they cover for the materials. The total cost is calculated at around 1000 euros out of which 400 is the typical cost for a generic motor.

This workshop takes place in a fabrication space rented by an agriculture school as a lot of farmers were expected to participate meaning that smaller workspaces would not be suitable. Everyone arrives early in the morning and gather in a classroom above the workroom where Etienne provides the specifics of the workshop but also discusses the AP approach to tools. The space below is already equipped with metal working tools, yet Etienne arrived with the AP van carrying all the necessary equipment and materials. In the course of two days 13 farmers attended the workshop. All of them either experienced or novice bread peasants (paysan boulanger), most members of collective farms, whose activity ranged from simply making and selling flour to artisanal bread and pasta. According to Etienne, in practical terms, peasant usually connotes farmers involved in all aspects of a products cycle. For instance in this case, these farmers grow, harvest, store, process organic wheat and ultimately sell bread either in the farmer’s market or in their farms. Etienne finds the term beautiful and something to be proud of. In fact, after doing internships in farms himself he now aims to become a fully fledged cheese peasant (paysan fromager).

In general there are typically three points in the workshop process. First, studying the blueprints which are created with much detail and in a step by step fashion, second cutting, drilling, welding components, and third assembling. The farmers change into the appropriate work attire and help set up the equipment. They then gather around for an introduction while handbooks with detailed instructions for metalwork as well as prints of the schematics are distributed. The design schematics and a list of tasks are set on the board which includes a table for everyone to note down as they rotate to the various steps and tasks (see figure 3). According to Etienne, as the facilitator of the workshop he needs to maintain a good balance between the experimentation - fabrication and educational aspects.

Figure 3: the participants study the printed out designs.

Next, there is a demonstration of how to properly use the machinery and a general safety overview before the works begin. The farmers split into smaller groups and take up specific tasks while familiarising with the equipment (figure 4). Some of the older farmers are more experienced so they provide assistance to the rest. In fact some worked as engineers for a few years before deciding to become farmers. Etienne moves around providing guidance and soon the work intensifies with the board being the focal point.

Lunch breaks are an opportunity for socialising and community building so everyone is expected to bring some food to share. Most bring home grown vegetables, cheeses and other products they produce and sell, allowing them to exchange tips and ideas. I was asked in advance to bring something “English”. Not being British myself, I brought some award winning pork pies (wrapped in the flag) and some samosas (from my favourite Indian restaurant). They were well received I thought.

After the break the intense work resumes which involves a lot of trial and error. Certain milestones of the fabrication process draw the attention of everyone. For instance when the assembly is about to begin, Etienne gathers everyone around to participate. Everything is discussed thoroughly in order for all to be able to comprehend the process fully. Whenever a significant problem appears, everyone assembles again in order to brainstorm and collectively offer possible solutions. After about 12 hours of work the first day of the workshop comes to an end having constructed the bulkier components of the three prototypes.

Figure 4: activity for varying tasks takes place simultaneously and interchangeably.

Since most of the farmers are based far away, they all spend the night together in the dormitory of the facility. This presents another opportunity for socialisation and knowledge exchange. Younger farmers have the opportunity to learn from the more experienced ones. Being peasant farmers is hard work and requires a lot of resilience. It is like having ten jobs in one according to Etienne. So they are used to collaborating and depending upon each other. He thinks the reason why the development process of the tool was easy is because the farmers were able to coordinate very well.

The second day of the workshop begins early with everyone resuming with the prototyping process, focusing on the finer elements of the tools. The main components of the tools are starting to receive their final form as the assembly process is about to begin (figure 5).

Figure 5: the frame of the tool completed.

By late afternoon the tools are taking shape and as the workshop reaches its end everyone makes an extra effort to complete their work. When another problem appears, everyone gathered around once more (figure 6). A module does not seem to fit well and with not much time left to tackle the issue they resolve to finalise the process in the next meeting. Having reached the final stage everyone is understandably somewhat disappointed.

Figure 6: a problem with assembly requires input from everyone.

Last, everyone works to clean up the workspace, gather the tools and go through required the paperwork and financial arrangements. A date for a second meeting is set. Three of the participating farmers will be taking the tools. Only at a fraction of the price of market options which would not suit their needs anyway, given the fact that they operate in smaller scale than what these alternatives are designed for. The rest of the farmers claim that the reason they participate is to acquire valuable fabrication skills which will enable them to make and improve the tool at a later time but also maintain and repair their current equipment. Most also confirm that they joined in the spirit of collaboration and sharing knowledge – this is how small scale farmers always operated anyway.

The fabrication process was later finalised and a second working group was set up in the Grand Ouest branch of AP which built on this experience. A new prototype was manufactured, which validated the assembly and adjustment choices. However, the brushing of the tool was considered too aggressive by the farmers of the second working group. The current version of the schematics for the tool can currently be found in the "under development" section of the platform. A tested and validated version will be published in the main tool list once feedback from the prototypes is collected and the current form of the tool approved by all farmers. However this list does not offer final versions of tools created. Instead, farmers are constantly encouraged to adapt them to suit their needs and share their modifications with the community.

Seed drill

Activity for this artefact began in the autumn of 2015 after a presentation of the AP approach for tools in a farmer expo. Several farmers were interested in developing a large seeding tool suitable for no till farming (which is a method of growing plants without disturbing the soil and the microorganisms living within it and increasing water retention). A meeting with Etienne to discuss the possible tool took place in Francois's farm, one of the four farmers who were eager to proceed. They are cheese farmers and the tool would help them seed (primarily with sorghum, though it can be used for legumes and is also currently tested for cereals) their fields for their goats to graze on.

A second meeting was arranged in another farm a few months later to decide on specifications. Several email exchanges with technical points and initial designs took place in the meantime. The tool, there, has its final form validated. The basic elements include a row of discs, a row of teeth, a row with lead and grader chains, two triangle hitches (front and back) for extra versatility when mounted in a vehicle. And last a proprietary, electrical seed distribution, ventilation and dosage detection system modified to be mounted upon the tool. Developing such a component from scratch is deemed too complex and costly by AP. Furthermore, according to Gregoire, certifications for that type of technical systems are difficult to attain adding that "every tool must be suitable for fabrication with cutting, drilling and welding. But some, more complex parts cannot be made like this".

Each of the tools AP develops comes with a folder of self-certifications for specifications and other issues like safety standards and insurance. Thus, for instance they are allowed to use basic hydraulics with their current certifications, but cannot develop electrical systems or PTO (a method of receiving power from a different source, typically from a tractor in agriculture). These limitations in certifications are congruent with those prohibiting farmers from repairing their equipment, as illustrated by recent "right to repair" initiatives (of which Farm Hack is also part of) which highlight the lack of autonomy and the potential impact in farmer livelihoods. This is exemplified by the company John Deere which prevented users from tinkering with the software embedded into their modern tractors, allowing only their dealers and their certified technicians to make repairs[1]. The long waiting period for these technicians to be available would potentially be catastrophic for farmers should a malfunction appear during periods of high activity. In both instances the arguments defending this practice are ensuring the optimal performance of the systems and safety concerns[2]. Yet one could argue, following Feenberg's assertions, that these technical and legal codes are the result of the embedded monopolistic interests of manufacturers seeking profit maximisation through the exclusion of others in the technology development and repair processes.

Going back to the tool, after further debates regarding the design for fabrication is finalised and produced by Etienne. A date is set for the prototyping workshop in April 2016 (prototyping workshops usually take place in spring or summer and dissemination workshops take place in winter corresponding to the workload of farmers). Three days in La Roque-d'Anthéron, a rural area in in south France, with the works taking place in a

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[1] http://blog.farmhack.org/tag/ifixit/

[2] See the letter against a, now passed in certain states in the US, proposed legislation that will allow users to repair digital electronics. This is met with fervent opposition by not only agricultural machinery companies but also large electronics manufacturers like apple and Microsoft as it may set a precedent: http://bit.ly/2BvOqHw

large storage shed. I attended this workshop, and Francois was gracious enough to host me in his family farm along two AP members, Etienne who would facilitate the workshop and Julian who joined for support and as my guide of sorts.

Etienne arrived with the AP van carrying certain prefabricated components of the machine beside the tools necessary for the workshop. These were pieces of metal that could only be shaped with industrial grade machinery (figure 7). As Etienne told me, several of the tools they develop have such components, hence the designs come with detailed instructions for steelmakers to follow. A farmer, who was previously an engineer, also pointed out that some of the prefabricated parts would probably cost more and be less precise if self-fabricated instead of ordered. These specific ones were made by a metalwork professional who works closely with AP. I later had the opportunity to meet him in the AP annual gathering where he was presenting a small seeder tool of his own conception inspired by another tool created by some of AP's collaborators.

Figure 7: some metal components are too solid to be practically bent in the required shape using basic equipment.

This workshop is atypical as the farmers were few and already quite adept with fabrication processes. While they all took turns familiarising with all steps of the process, a lot of improvising and experimentation was taking place as the various bits of the puzzle fit or not. As the day progressed more farmers joined in (figure 8). They were younger, relatively inexperienced farmers there to develop skills which would help them establish sustainable farms themselves.

Figure 8: aspiring young farmers acquiring necessary skills.

After two days of intensive work the tool is complete (figure 9). Its total cost is calculated at about 5000 euros while market equivalents are priced upwards to 20000 (and not optimised for the same use either). The four original farmers are to pay for the materials and keep the machine which they will use collectively. This tool is also currently in the under development section while it is being tested in various applications by the farmers. According to Etienne a part broke during its use but having acquired the necessary skills Francois was capable to repair it himself.

Figure 9: the, significantly large, tool is complete.

Annual Gathering

The cooperative’s general assembly coincides with a big open gathering each year which is a celebration of their philosophy and progress. In 2016 it took place in a large collective farm over the course of three days with many workshops, discussions, exhibitions and other events. At the same time a music - wine festival was co-organised by Fabrice offering entertainment to those attending the gathering. This was their most ambitious gathering to date, according to Joseph, with significant resources of the cooperative directed towards planning, infrastructure, and promotional material.

The gathering starts with the general assembly of the AP cooperative. A series of presentations regarding the previous year’s activities take place. Then new members are introduced and voted in and the objectives for the next year are voted upon as well. There is little debate amongst the members and they seem to put great faith in the operational team lead by Fabrice and Joseph. Only one member is purposely absent from the proceedings. I'm told that he finds it too business-like and calls for even more participatory processes led by farmers themselves (however later on, when he led a discussion about time management in farms, I tried to discuss his views with him but he was hesitant to express any objections saying that the coop is doing a great job).

Several other discussions took place during the three days of the gathering ranging from the possible expansion to the use of open source software, seeds and patent use in agricultural machinery to body awareness exercises to help with the physical impact of farm work. The most engaging of these discussions are the ones sparked by independent groups presenting their own tools which they developed to tackle the unique requirements of their activity. Each group highlights the specific values and interests that drove the development process.

At the same time workshops are organised around the estate, facilitated not only by AP but also their collaborators broadening the scope into agronomical applications (like a wooden seed cleaning tool), raw material processing (like a self-built oven), introductions to microcontroller technology, energy production tools (wooden wind turbines) and other farm related topics. In fact, knowledge transfer takes place in all activities through experiential means. For instance even the art workshop, where an artist collaborator of AP is demonstrating how sculptures can be created with repurposed scraped metal, is providing attendees with valuable metalworking skills. Other AP workshops similarly provide skills, while competitions on the fastest or most elaborate build take please (prizes are sculptures from the aforementioned art workshop).

The highlight of that year's gathering, however, were the building construction development projects and workshops that AP has been expanding to. Jonas, as the group's first resident architect spent long hours visiting about 60 farms to study how farmers structure them in order to suit their specific type of activity best and making blueprints which are made freely available along with similar efforts by farmers themselves. Samples of these blueprints were put on display in the main venue of the gathering in order to emphasise another element of farmer ingenuity that is often overlooked (figure 10).

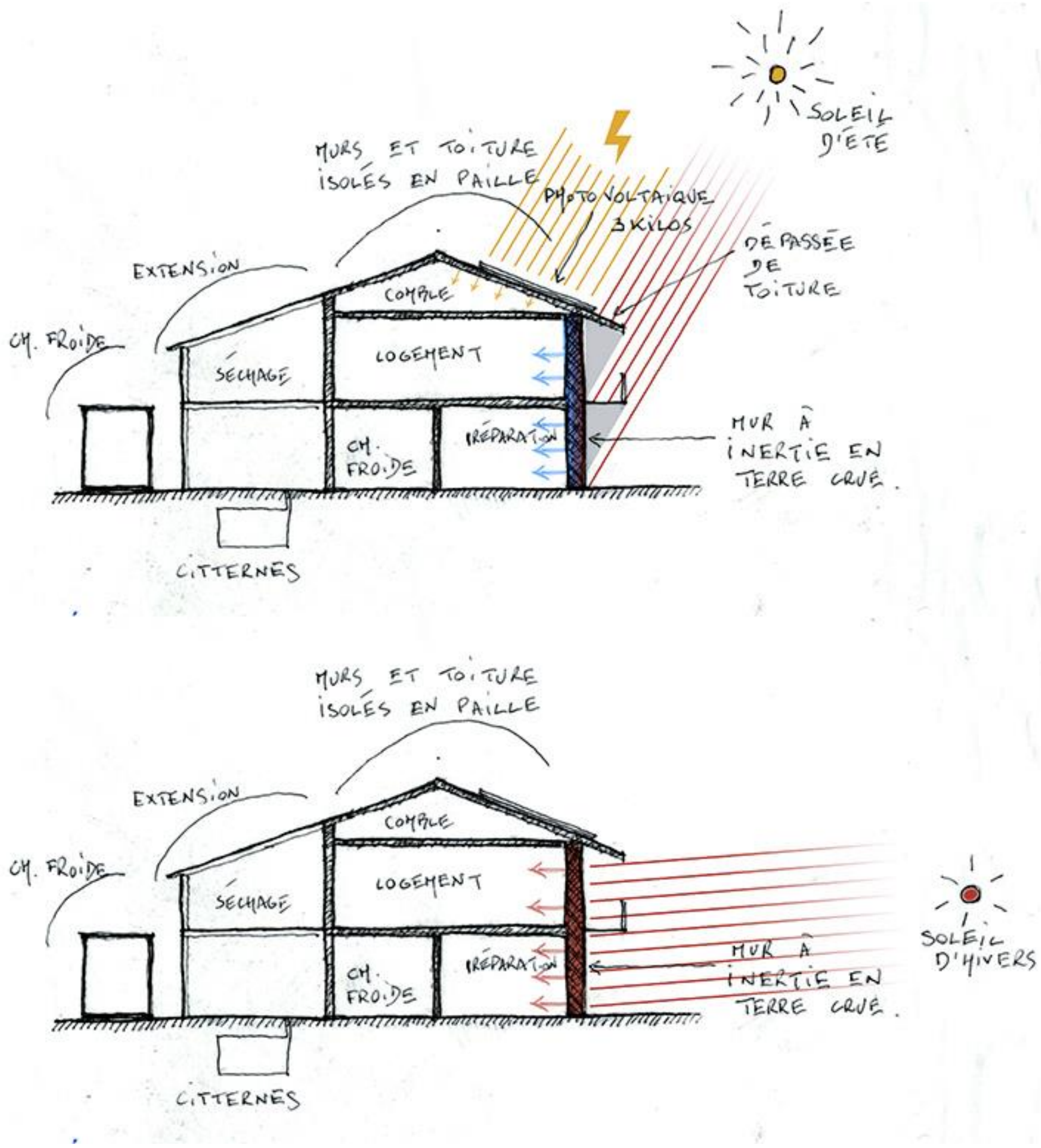

Figure 10: a building designed to best utilise the sun in summer and winter.

Workshops are being planned, as well, for farmers to conceptualise new buildings with an architect’s assistance or to develop their woodworking skills, typically whilst constructing a building on site. Jonas explains: “for mobile or modular constructions we rent a space to make it and then put it together like a puzzle in the farm… if the construction is fixed in a precise topography we do it in the farm”. Regarding the importance of this expansion in activity the relevant announcement proclaims that “when considering the question of adapting farm tools, the agricultural building is not separable from the equipment. That is why, after having invested ourselves on the question of adapted machinery, AP wishes to accompany the peasant dynamics with critical reflection and self-construction of their buildings. Because as much as farm machinery, the building is responsible for the proper functioning of the farm" (translated from the French language by myself). Through critical reflection they encourage farmers to question their buildings, to think about the multiple functions they must fulfil, and consider their evolution over a long time from the moment of their installation.

It is easy to notice how buildings are developed with the same design principles as the machinery. Modularity, for instance, is a key aspect of open source technology and the same is strived for here as well. An interesting example is the bati20. A highly modular, multipurpose, construction which can be modified to be used as a storage, living or commercial space. As its name implies the original design's size is $20m^2$ but due to its modularity it can be increased to whatever size the farmers need while its ease of assembly enables mobility as well. Another example is the mobile chicken coop which is an agronomic system tailored to organic peasant farming. As the coop is moved around the chicken clean up the soil. But as Jonas points out it also eliminates the need to thoroughly sanitise the coop every time new chicken are to be introduced (which is the case for static coops). This one can simply be moved to different position. The goal is always to provide assistance in the technical and construction aspects, as farm buildings are quite specialised and farmers know better what they need.

What differentiates small scale, self-constructed farm buildings from other constructions, according to Jonas, is that they are not as dependant, at least creatively, on building regulations and technical specifications. This provides farmers with relative freedom to construct buildings that are simple but very specific to their needs with locally sourced and often repurposed materials. He does, however, admit that they too need to get permissions and in some cases it is quite difficult. For instance the bati20 is specifically set on $20m^2$ because up to this size no permits are required. Deciding to build a larger construct adds a layer of complexity which, while AP offers some advice for, is up to each farmer to deal with. Once again, the technical codes embedded in these regulations come at odds with alternative conceptualisations of technology or as Jonas puts it with the "farming soul" as they enforce an approach that is too professional - generic and without consideration of the local conditions. This is even evident in infrastructure development funding schemes some of which are subsidised in the EU level through its

Common Agricultural Policy. The specifications for these are designed according to advanced and large scale agricultural activities, typically taking place in western European countries, which demand significant financial resources and are incompatible with alternative systems of agriculture (especially in smaller, less technologically savvy countries in southern and eastern Europe). The infrastructure AP creates, on the other hand, is adaptable to the space, landscape and above all the type of activity taking place in each farm. Much like everything the group is involved with, the design files and all pertinent information regarding these buildings are fully documented and available for everyone to access.

As part of the gathering workshops a mobile pigsty was constructed over the course of the three days which is based on the original design of a farmer's construction (figure 11). A detailed overview, along with drawings and photographs, for the farmer's design can be found in the AP forum, the documentation for which was curated by Jonas himself. A large percentage of the blog posts are initiated by the AP operational group in fact. Lack of tech literacy amongst farmers is not a primary reason according to Fabrice, as many have basic computer skills and some even have a background in IT. Other members attribute this phenomenon to the hectic work schedule of farmers, while Fabrice believes that another important reason is the fact AP provides a lot of assistance in all stages, which makes farmers less pro-active. At any rate, Julien admits that they don't have a concrete plan to tackle this issue, though the engineers do promote the use of the forum during the workshops.

The iteration developed by Jonas is an improved version designed in a standardised manner in order for it to be easily reproduced. It is ideal for farmers with pasture areas to move the sty (along with the pigs) in various locations depending on the type of farming employed. This system allows for the pigs to live comfortably while roaming freely but also for the soil to be prepared and enriched by their activity throughout the seasons. The design approach and ergonomics of this construction are aligned with those of all the other artefacts discussed before. During the event the project was constructed from scratch enabling participants not only to acquire metalwork skills but also woodwork under the guidance of Jonas.

Figure 11: an iteration of the pigsty collaboratively constructed in the gathering.

The gathering ends with the arduous disassembly of the event's infrastructure, for which several participants volunteered to assist, and a comedic auction of several sculptures created during the event. In a discussion with Joseph at dinner after all the work is done, he reveals that he was happy with the result even though the event consumed a lot of resources, time and energy. After all, they knew in advance that whatever proceeds they gathered, it would not be enough to break even. However, it was a testament and a celebration of the progress AP has achieved over the years and he was convinced that it reached a lot of people.

6.1.2 Farm Hack

As illustrated in chapter four, FH's goals and vision are similar and in some aspects identical to those of AP but their organisation and development model are in many ways quite different. The highly decentralised and to a large degree online activity of FH means that engaging in on site research is limited. In order to provide an analysis of the multifaceted technological activity I will be relying mostly on interviews with some of the most active members of the community (both in person in farms and via video call), rich multimedia sources from the platform, and my attendance of two events. A "slow tools" summit sponsored by FH and a build workshop for a machine developed by community members. This sub-chapter will be structured narratively in the opposite way of the previous one. Meaning that instead of using specific events to talk about the overall activity of the community, I will be presenting the general model and providing details from my field work in appropriate points.

Contrary to AP, its role as a technology development organisation is more as a facilitator and communication hub for dispersed activity and less an active participant in the creation of new technological artefacts. As briefly discussed in the section presenting FH as a social movement organisation, its operational activity can be separated into two main categories. The FH events which are organised throughout the world, but primarily in the US, and the FH platform which facilitates the cataloguing of agricultural technology and the online collaboration - coordination of farmers in the pursuit of developing new technologies.

Farm Hack events

FH events are the points for physical aggregation of the FH community. They provide an opportunity to share prototype designs, ideas or stories, create solutions to local farmer problems by drawing on knowhow available in the community. They also serve to recruit new community members, train them in the FH processes, and endorse future tool development and documentation. Last they enable organizational and individual collaborations to form as well as strengthen relationships between organizational partners and FH.

These events are free for anyone to host as long as the community's principles are upheld. The foundations for the initiative itself were quickly established in the early events whilst they were organised by the organisations supporting it. According to Dorn, the first ever event took place in November and the website began being built soon after in January.

The methodology of these events evolved naturally over time. "The most successful events were the ones that were the least formal" says Dorn, while Kristen points out that they were mostly crucial for bringing people together. She continues "farmers have already been doing this, we're not inventing a new strategy for farm inventions or even the sharing of ideas related to farm technology. It's really just enhancing the ability to share that information". On their evolution Severine notes that "at first they were more focused on ‘show and tell’. Then some brainstorming, design charrettes. Then we did some that were more focused on a specific tool”. The concept of charrettes refers to intense collaborative meetings of designers in order to tackle a specific design problem. While the term is usually employed in architecture applications, here it signifies the brainstorming session which takes place after a list of agricultural issues is identified. Typically this process would make some people really excited according to Dorn and built momentum to continue working on certain ideas. So they started to incorporate build elements. As the community matured “we realised there is a huge range of skills so we made skills demos as well” he adds.

Over time the events formulated a strong network of collaborators and gained significant traction. However the organisational structure was under debate amongst those most actively involved in the initiative. The greenhorns and the NYFC (the main organisations supporting FH), spearheaded by Severine “wanted to direct FH in a particular direction that many of the other people involved were not interested in, so FH ended up creating its own non-profit and became independent” according to Daniel who says it concerned how FH was to be organised: “it was about central organisation and control by a small group of people versus community oriented development, development guided by the community itself”. Dorn points out at that this transpired when “at some point it became clear that this can scale up and one option was to build an organisation with support staff and regional chapters to facilitate this”.

Severine reaffirms this assertion. She believes that FH lacked a “good governance structure” with the coordinative capacity to support the network. “What FH needs is few dedicated people to build institutional support” she says in order for the momentum to be maintained. They would also need to form partnerships with other organisations in order to secure the necessary resources to support their activity. This particular vision, which seems quite similar to the model of AP, certainly set good foundations. According to Daniel the way the greenhorns and the NYFC organised the events was “a great launching place and have legitimated FH in a huge way”. Dorn confirms that “a lot of those intensive events relied on the backing of these organisations”.

However scaling with this approach was not desired by many. Dorn echoes this sentiment: “we have plenty of competence to build a well-funded, centralised non-profit but we didn’t do that, it was a conscious choice… how do you go global with that, it becomes a massive organisation". On the same note, Kristen finds that organising like AP can bring impressive results noting how they gather significant funds but still manage to stay autonomous. "In the US you really need to invest hard in fund raising which definitely changes the nature and spirit of the work" she says however, continuing "I really would love to have that level of functionality but I don't think we're the same thing and so that wouldn't necessarily work for us".

They were also cautious of other forms of raising income like bringing on sponsors or selling kits like public lab. Public lab is another US based community creating open source hardware. They mostly focus on enabling citizens to tackle in environmental concerns through inexpensive and self-made tools. There is a lot of overlap and communication between the two communities with some of the most active FH members, originally being public lab members. Public lab, was "selling quasi-scientific equipment that didn't quite work as the real thing" Dorn points out. Don, who has worked with both communities on sensor applications but now is mostly active with FH, agrees with that assessment finding that effective advocacy was placed over instrument accuracy and utility in the face of very pressing issues. However "this muddied what they were trying to accomplish as an open source community" Dorn says. The message was "we're coming in this as a participant to build something that will work better but only if you participate. But that got lost because of the commerce approach which they used to raise funds for staff etc". FH does not engage in that activity and they don't receive grants that would require that type of investments. Instead Dorn says "we had enough volunteer enthusiasm that our efforts – investing in each other and our skills seemed a lot more fun and easier to do… the whole thing was user generated, there was no budget. That was part of the point of it". He elaborates on their preferred alternative for scaling and moving their ideas to a wider audience: "we focus instead on building an idea and a platform which other organisations with their own infrastructure can adapt and improve".

Hence the FH non-profit was established to carry this mission which also simplified the organisational and financial issues as both the greenhorns and the NYFC had fiscal sponsors according to Kristen (though there is still communication and support). The new organisation allowed for decentralised operation on minimal resources without diluting the core values of the initiative. This however has had an impact on the output. As Daniel puts it: "out of that conflict emerged FH at the state you see it now, free of central authority but also not developing as quickly as it might in other situations".

Kristen expands on that further: "We are essentially a peer to peer network - that is how we decided to function. It does make progress slow but that is intentional because we are volunteers". She continues: "…things sometimes slip through the cracks. It is hard because a lot of us are farmers, especially during the farming season the organisation work tapers off and if we had a lot of momentum at that time then maybe we'll lose it". Due to that, there is an ongoing discussion on whether someone who possibly isn't a farmer should be hired to do this work but for the moment the answer is no. As both she and Daniel have been paid for brief periods of time for certain tasks, they find it a challenge to navigate being the only paid individual in a community of volunteers. As Daniel puts it "the structure of FH does not let itself have a paid employee". Dorn, expanding on this idea, thinks that after reaching a maximum amount of volunteers at the early phases of the whole initiative, they received some grants to hire a couple of volunteers. That resulted in reduced volunteer activity as the paid members were expected to show the most initiative. Volunteer participation started to pick up again after paid development ended. This draws an interesting parallel with AP and the reason with the forum is not particularly active due to, according to Fabrice, the amount of curating by the AP operational group.

Going back to the events, this change in organisational structure has had an impact on the way they were to be conducted. Kristen explains that they had to get better in partnering with other organisations and playing with their strengths to achieve common goals rather than struggle individually. To do so they had to develop a philosophy for the events. "The idea is that FH is a banner that people can wave which was always the core to FH events – collaboration between FH and an institution like a non-profit or even a business" Daniel explains. That idea has been expanded upon with events now organised without being curated by FH directly. The slow tools summit, which is supported by the "Stone Barns Center for Food and Agriculture" non-profit, is endorsed by FH in order to solidify such a collaboration.

Dorn who attended the event along with Rob aims to link the output of slow tools with FH. The summit itself features farmers and small tool businesses who present their new tools and discuss ideas for new ones. While many of the participants are not even aware of the open source development process and licenses, their practices are reflective of the philosophy. Most of the time farmers make their tools to support their farming practices, as the market cannot do so, and have no desire to make a business out of them. In fact even businesses are not particularly keen to protect their intellectual output. For instance, Johnny's Selected Seeds is an employee - owned organic seed development company that also creates and promotes tools to support the types of agriculture associated with their primary products. Several of these tools emerged through the slow tools events over the years and they often feature instructional videos and designs in their platform as their business model does not depend on exclusivity of the tools. Instead their motivation is to nurture a production system that allows them to sell their seeds. Having the slow tools featured in the FH platform could allow more people to have access to them.

Again returning to the FH events, the guide for events has been developed to this end which provides an outline for what a FH event entails. People who use the FH banner are expected to use it and update it with their experience in order to figure out what works Dorn says.

A typical FH event may be facilitated by individuals (farmers), non-profit organisations or even universities, usually with minimal resources and volunteer work. Basically "an individual and/or local organization that is willing to co-organize and take on most local logistics" according to the guide. They would need to be "self-funded, or locate local funding or sponsorship themselves" with connections to the local farmer community. The mission statement is to "bring people together to document tools and empower independent future documentation. Provide materials and structural support for community members to independently organize and host Farm Hack events that bring community members together, recruit new community members, promote knowledge and skill exchange and result in new, complete documentation of tools".

Before the event, certain steps are proposed to ensure a fruitful outcome. A first step is to establish the local needs and goals of the event as well as the scale and scope in order to achieve the continuation of activity after the event. To do so, early discussions with relevant individuals and organisations of the local community should take place for ideas and suggestions. Larger state organisations or associations are also to be approached for potential support. Then, suitable hosts for the event should be located who will add to and benefit from the event. These can be particularly inventive farmers or experts with certain knowledge and skillsets. After the scope of the event is determined then appropriate venues are located like a host farm in combination with a space (community or university) for brainstorming and documentation. Meals and lodging (since these events may last several days) are ideally delegated to the community. As the guide puts it "…get food donations to prepare meals with the group, or make it a potluck. Take advantage of the open source community whenever possible – crowd source places for people to stay the night through the event forum; have cooking and other volunteer signups". Last outreach tools are set up to ensure participation, with a focus on diverse representation of skillsets and groups like farmers, engineers, designers, students, etc.

The form and components of the events themselves are varied as discussed above. Typically, there are demonstrations of farmer equipment, tools, and techniques usually on location in the farm. Additionally they might feature design processes or hacks, like for instance converting an old washing machine into a salad spinner which is useful to small scale market gardeners. An important aspect is the idea brainstorming and design sessions which is followed by breaking down into groups to focus on specific projects or problems. Tutorials for proper documentation and use of the platform are also suggested always. Last community building components are an important element of the events with collective preparation of food, discussion, music and other activities that boost a sense of kinship which in turn would help sustain activity after the event.

Documentation is emphasised across all stages of an event. The guide reiterates the goal for independent activity from community members and documentation is mentioned multiple times. Given the lack of control over user activity documentation is arguably the most important aspect of the type of activity FH engages in. As the guide puts it "Documentation is the technology's DNA that enables it to be reproduced and adapt, evolve and hybridize with other technology so make sure that the event and the outcomes are well documented".

Several tools have emerged through these events. One of the most emblematic ones is probably the culticycle which was one of the first introduced. I attended one of its continuing build workshops as part of my fieldwork. Events like that one are not usually publicised in the FH calendar. The reason for this, according to Dorn, is because the maximum number of people has already been reached in advance by people that already know each other and their goal. As he puts it they "shift it from an open design event into build events or very specific design questions that the gathered people want to work on… so it goes from completely open to a bit closed". The have discussed how they could completely open up such events but it requires a lot of work and they lack the infrastructure to manage it, which he thinks is a shortcoming and partly the reason they invite other organisations to take up certain activities.

The concept of the culticycle was introduced by Tim after he came into the realisation that small scale agriculture does not require the horse power of even the smallest tractor available in the market, while at the same time spending a lot of time sitting in the tractor seat may give farmers back (much like a desk job) and knee injuries. This insight, according to the FH blog, is connected to the general principle of FH, “that innovation often stems from looking critically at the way things are and the way they are always done, and synthesizing from a rich repertoire of knowledge new and old to figure out how to do things better”.

So he decided to build his own less resource intensive, pedal powered tractor which would be suitable for the type of farming he was engaging in. He was familiarised with FH through “bikes not bombs”, a non-profit that repairs used bikes and sends them to economic development project around the world, and after exploring the project further he decided that his idea should be developed further through FH. Patenting was not a viable option for him as it would require significant resources to prove that the design is unique and “somehow miraculously based on nobody’s work” as he puts it. It would also require funds to defend that patent should it be infringed upon. Developing the tool through FH provided him with plenty of feedback and ideas, both through the online platform and the events, on how to further improve it by people that have built their own versions as well as the input and diverse skillsets of those attending the build workshops.

Inspiration for the original design was drawn from a simple wheel hoe he tinkered with and the schematics of an open source cultivator. The first version of the tool used walking power which was enough to do the work but was quite tiring. Pedal power was soon introduced in the design and the basic structure was defined. Earlier iterations were created using spare parts from tractors, bikes and other vehicles. Over time and several builds the basic structure became modular and modified with a focus towards standardisation and universalisation of materials shape and size, while improvements were made to improve its robustness and functionality. The various versions of the tool are generally named according to the location they were built.

A toolbar is being developed with various configurations which were created by other members, like a flame weeder, a seeder etc. The idea is to also standardise the toolbar as well which is mounted underneath the culticycle to conduct each farming task adding to the modularity of the design. Interoperability of the various FH tools has, in fact, reached such a level that it includes modern desktop fabrication technologies. For instance, another member has designed 3D printed rollers (components containing and distributing the seed) to be used with a type of seeder which can be attached to the culticycle. While yet another member developed a piece of software which can be used to create customised versions of the roller (i.e. changing the size, depth, shape, number and offset of seeds).

Documentation for the tool evolved accordingly. Originally Tim created sketches and took photographs in order to track the development process. One of these photographs led to the connection with FH. After Tim uploaded the design in the FH platform documentation became more systematic with detailed pictures and videos explaining the construction process since he lacks the knowledge to use CAD software. In order to make this type of documentation accessible to other users he had to consider how to best combine images and text using simpler software. CAD files were created and added in later stages after Tim's design was recreated by other members of the FH community.

The event I attended took place in the bikes not bombs headquarters in Boston. The people present had participated in previous workshops so they were already familiar with the culticycle. There were also a couple attendees via VoIP, one of which is Michael. Michael, a former computer engineer, is a farmer - engineer who creates and sells tools and carts for small scale farming. He came into contact with FH in the slow tools summit and quickly embraced the FH philosophy as it resonated with his own values. Up until that point he never considered patenting his tools or the licencing matter in general but at the same time did not consider sharing designs and information openly either. Eager to exchange knowledge and know-how he joined the event and shared his design approach which utilises wheel hub motors. The group was intrigued by his input and in turn he received insight from everyone else's know-how. Through this process, new ideas for further development of the culticycle collectively emerged and at the same time individual participants acquired information and formed partnerships that will help them in their personal projects.

Farm Hack platform

Plans for a FH web platform emerged early on, with its basic outline discussed in the first events and building it started soon after. Among the people attending those events were developers, like RJ, who were familiar with Drupal. So the decision was made to build the platform with it. The structure was similar to a simple wiki where users can create profiles and post about their tools and gradually new features were implemented. Several core members found the earlier version of the website too technical to use and were impressed by the fact that the number of people using it increased anyway. After the previously discussed organisational changes it became clear that for FH's activity to be more independent and managed by the community, the platform would need to be more user friendly and almost intuitive, otherwise farmers would not use it Kristen points out.

To improve the platform's functionality a grant was received by SARE, the sustainable agriculture research and education program of the U.S. Department of Agriculture, in collaboration with the University of Vermont where Chris Callahan works as an assistant extension professor of agricultural engineering. Chris is an active member of the FH community contributing tools he has collaboratively created with farmers. The grant would not only improve the platform for its users but would also be used to better document and disseminate other tool innovation projects funded by SARE which by that point were featured in a (not user-friendly) PDF database on the SARE website.

The direction of the updating was decided upon through surveys conducted with FH users and other SARE grantees. Changes were made to make the platform smart phone and tablet friendly and the event calendar was updated for easier accessibility. The most important updates, however, have been made in the tool aspect of the platform. Searching through the hundreds of tools was made easier with metrics on tool views and downloads and the documentation process of new tools was made more prominent and intuitive. The "create a tool" section was divided into categories that include: a problem statement; the documentation which made posting multimedia content easier allowing farmers to post information in whatever form is easier for them; a user manual illustrating how to use the tool; related tools within the platform to improve synergy and inspiration points; skills required to build and use the tool (like soldering or welding); and a commerce option for those that are willing to sell the tool or parts of it. This streamlined process is designed to tackle the problem of limited documentation by enabling users to record their information on a tool according to their resources and time. This can be interpreted as FH's approach to systematise, as much as possible, the rich and highly diverse tool development processes taking place in the community that are poorly documented or potentially not documented at all.

According to Dorn this is their agile approach to developing the platform that extends beyond tool documentation. He says “with the FH platform we’re attempting to express our social system. The way we prioritise tools and what people post is an expression of what the community believes is important and useful. It’s an iterative process, we didn’t come up with a list of what it looks like”. In this sense most of the content, like the event guide, is editable. The point is to put everything up in real time, whether it works or not, and expect the community to help make it better. Otherwise there would be the assumption that they are providing a service rather than something for everyone to work on. This approach is reflective of the FH’s general philosophy regarding technology. While technological artefact commerce is not frowned upon, the goal is “to shift that mentality and have more empowerment at the farmer level” he adds, to feel like they are building something together. In other words, enable farmers to acquire the skills and knowledge to build tools themselves or in collaboration with someone in the community and most importantly to document it for others to learn and benefit from.

Having said that, the platform does feature an “open shops” function. This commerce section is still under development but they are being careful not to push it too fast in order to make sure that they are providing solutions first and then featuring resources like components and locating the relevant skills. They have had offers to sponsor certain component suppliers, Dorn says, but they have rejected them because while they do wish to enable commercial activity they do not wish to promote it. To begin with, through this function farmers and other organisations or local fabricators may construct certain tools or parts which are featured in the FH library. They may also offer their services to teach others certain skills or help them build their own tools.

The tool library itself, does not feature only schematics for ready to build machinery or even commercial products made available by community members for those that are unable to recreate them on their own (under the condition that open source licences are used).

These may be prototypes under development like the culticycle or the Fido, a data (like temperature and humidity) measuring system that notifies farmers about problems in their greenhouses through text messages. The project was brainstormed in in the early FH events and was taken up by three FH members to be developed. The tool was conceptualised as a much cheaper way to measure conditions in greenhouses located in remote locations where an internet or phone connection, usually required by commercial monitors, could not reach. So they used an Arduino microcontroller, a mobile phone and some soldering instead. To proceed with the prototyping they applied and received some small support from the SARE program as well. After extended experimentation and testing, the full documentation for the tool was posted in the platform. However that was not the end of the prototyping process as a new iteration using Wi-Fi signal instead of cellular began development in parallel, for when Wi-Fi is available and soldering skills are not.

The tools may also be do-it-yourself fixes or hacks. After all, limited resources mean there is more improvising and repurposing material, hacking and adapting older equipment. As several FH members have pointed out, their situation in the US feels like going “back to the point where farm technology took a turn towards the conventional farming we know today and give it a different trajectory rather than simply use that old technology” in Tim’s words. One very prominent example of this is the Allis Chalmers G. A small tractor whose production ended more than 6 decades ago the G is still utilised by many farmers to this day due to its simplistic mechanical system which allows for easy repairing and tinkering. Farmers have been sourcing parts and implements for these tractors from wherever they can be found (auctions, scrap yards, even Craigslist). Kristen says that they have adapted such an old tractor to cultivate in her own farm while others, like Grant, have converted the tractor from diesel to electric power. FH has enabled the wider dissemination of these hacks and improvements as well as the exchange of information regarding resources.

Due to this activity, small farming companies have recently been developing new versions of the G to cater for the demand. One specific company, which employs an open system design, has been in communication with FH. This approach allows for connectivity of components created by various manufacturers, using “off the shelf” parts and standards, rather than producing exclusive - proprietary parts that add complexity and costs. In essence the company has built a base power system, which can then be sourced out to other companies and individuals to utilise in compiling a tractor using generic parts or in any type of machinery they wish. In this regard, the potential synergy between the company and the FH community is obvious as farmers would be able to acquire an affordable and easy to repair tractor while the company would be able to receive feedback and tap into the knowledge produced by the users (adapting the farmer designed implements into the tractor).

Carrying on with the tool library, a tool may further be a concept design, a process or even an idea submitted for collective brainstorming. For instance farmers with a specific problem put up a request for potentially existing solutions or propose a certain solution which others in the community might help them develop further. It may also be a call for supporters in the prototyping of a new tool. For instance one of Lu's future projects is a versatile, scalable, low cost, mechanical weeder (such a tools has not produced in the US for the past few decades due to the proliferation of herbicides). So the project was posted on the platform as a call for the community to crowdfund the prototyping process.

Finally, in a similar vein the FH platform itself is a tool featured in the library whereby users are invited to participate in its further development and content enrichment. FarmOS is another open source platform featured which is co-developed by FH members. It provides farmers with tools for mapping and planning in their farms and record keeping, like harvests and soil - water - temperature measures in order to increase soil health as well as crop and animal welfare. At the same time farmers are in control of their own data as opposed to other similar services which aggregate and capitalise on user data. This makes farm data easier to share and control in an effort to improve the tools used. It can be viewed as the FH equivalent concerning virtual farm tools that function in complementarity with the physical tools of FH, like for instance sensors and applications for data gathering and transmission. This illustrates the desire for a systemic approach to agricultural technology not driven by profit maximisation motives.

6.2 Social construction analysis

Having broadly presented the way technology is developed and disseminated in either sub-case, I will now attempt to utilise the constructivist tools in order to provide a more systematised view of this multifaceted activity and at the same time examine how these tools are being adapted in the context of peer produced, open source technology starting with the concept of the technological frame.

6.2.1 Technological action frame

The movement's collective action frame was outlined in chapter four, while chapter five provided an overview of technological frames within the SCOT tradition as well as its appropriation in organisation studies mostly associated with ICT companies and computerisation movements. This thesis employs an amalgamation of these approaches into the technological action frame of the movement. As such this frame is not only the binding material that maintains and limits the technology development network in either sub-case (as in Bijker's conceptualisation) or the shared beliefs, understandings and expectations on the adoption and function of the technology the movement promotes (taking a cue from Iacono and Kling's frames) but it also guides the development trajectory of the technology according to the elements of the collective action frame.

The previous section of this chapter provides multiple examples of how the collective action frame is translated into a technological action frame following clues from its three distinct streams, namely the open source, peasant and organic master frames. Here I will attempt to condense how these frames mobilise people to adopt certain technological processes and behaviours but also shape the technological artefacts themselves.

To begin with, it is obvious that technology produced is made available to everyone through open licenses as per the open source frame. Yet this expands to the design of the tools as well. Modularity and interoperability is sought after when possible to allow users to alternate between components in the same machine or utilise different parts and machines in combination. The development of an ecosystem of complementary tools and approaches is desired in order to tackle specific types of agriculture systematically, like for instance the various tools developed by others that are adapted to fit into the culticycle's toolbar. Furthermore, new technological artefacts usually utilise knowledge developed by others in an adapted or improved manner, much like open source software forking (the process of copying a piece of software code and developing it independently).

Further, a significant portion of the technological artefacts are conceptualised and created collaboratively and often remotely with individuals contributing to the further development of components or updated iterations of tools. Last, in combination with the previous characteristic, stigmergy can be observed in the development of tools which is also a key characteristic of open source software (Elliot, 2006). Stigmergic behaviour, observed in ants and termites, is a social mechanism in which an actor may deposit a seed, like an idea or a base project, which is then picked up by other actors who modify and develop it further into a more elaborate project. A good example of this is the 3D printed seeder roller which was conceived independently as an idea by several individuals. The design file for the product was created by one of those individuals and was then developed further by another user who created a script which adds the capacity to alter the shape and form of the roller.

The influence of the peasant frame is also evident. Primarily, it can be found in the human centric approach followed in the development of tools. The desire to enhance human communication through development is stated clearly in either sub-case. Dorn says for FH: “interpersonal relationships are important and giving members the tools to talk about what they’re doing and why. And to use that in their own events and design process. That can later be expressed online but it is really about person to person interactions. That is where most of the creativity lies”. Fabrice similarly says “sometimes I think to myself that this is a pretext to bring people together. There is something very human about the workshops, it is not just about the tools. I think this is what is most important, the collective adventure”.

Technical choices, then, seem to favour ease of reproduction, accessibility of (often repurposed) materials and reduced costs which promote communication and autonomy within the community rather than potentially embracing more complex options which create dependencies to external inputs and expertise. This can be identified in the repurposed or retrofitted older equipment which are given new functions as exemplified by the washing machine turned salad spinner, old bicycle parts turned into a small tractor and old tractors and tools (decades after they have been discontinued from production) which have been given new life. It can also be seen in the focus for small scale technological applications that enable farmers to rely on their own resources and practices for farming. Solutions influenced by the peasant frame ultimately place emphasis on the well-being of the farmer through tools that promote a healthy, scale appropriate and sustainable lifestyle and more meaningful connections within the farmer community as well as the earth itself.

Last, the organic frame can be traced in the development process as well primarily evidenced in efforts geared towards tools and processes suitable for small scale, resilient

- regenerative farming. Organic agriculture is not a condition for participation and several members are even critical of certified organic practices as either not environmentally radical enough or too technocratic, rigid and expensive to accommodate the ever evolving resilient practices of farmers. However values regarding the protection of the ecosystems and the regeneration of soil, or as one of the FH principles puts it "biology before steel and diesel", are influencing technical choices. For instance, pedal or horse power are prioritised when possible. When more power is required, electric motors are also preferred over fossil fuel alternatives. Mechanical solutions for weeding are produced, either inspired by past practices or newly conceptualised ones, over chemical ones. Similarly holistic and system based approaches to rejuvenating the soil rather than industrial fertilisers are preferred.

Animal welfare is another factor featured in technical choices. While both communities are primarily invested in plant agriculture, technology for animal husbandry and holistic market gardening systems featuring animals are also devised and shared. Here, options that allow animals some comfortable living by utilising their natural behaviours and characteristics are considered rather than adopting profit maximisation methods designed to supress or bypass them. The mobile pigsty developed by AP is such an example as it allows pigs to have relative freedom within the farm while at the same time using their foraging and manure to revitalise the earth. The sty itself is designed to accommodate the temperature preferences of the pigs (by having enough ventilation to avoid high temperatures which pigs find uncomfortable) as well.

In practical terms, the three framings presented above are not easy to distinguish as they share several elements and are better expressed through the unified frame explored earlier in this thesis. In other words they represent the three sets of values which are combined in order to provide the immaterial components for the technology development process. The frame allows for varying configurations of components in terms of prioritising characteristics according to the values each actor deems most important.

Contradicting approaches and opinions are of course ever present. The level of commitment to the different elements of the frame in combination with the level of willingness for compromises create technological artefacts that might satisfy certain desires and needs (like building a tool for resilient, environmentally conscious agriculture) and ignore others (like making this tool available as a component for a diesel powered tractor). Technical choices in fact have quite a wide variety, ranging from those that aspire to create tools which completely minimise externalities, in the context of an extremely resilient and autonomous paradigm established outside the (perceived as corrupt and unsustainable) dominant system, to those that seek to cleverly utilise this system in order to access the necessary resources to change it from within.

At any rate however, the communities in both sub-cases of this thesis are keenly aware of technology's impact in their activity allowing them to critically evaluate their situation, available resources and options to make informed technical choices. That is, technical choices within the limits of the technological action frame.

6.2.2 Relevant social groups

As for social groups involved in the development process of technological artefacts, the sub-cases are fairly straightforward. The most important groups are those of the farmers and their technical choices over specific problems. In many instances the technological artefact was developed solely by this group. Of secondary importance are the groups comprised by the organisations and individuals that provide technical assistance in the attempt to come up with solutions for these problems or simply to systematise the solutions which would make the dissemination to others easier. In any case, the shape of the artefacts seem to be defined less by the opposing visions of the social groups or their differing definitions of problems - solutions and more by a problematique set by one social group (that of the farmers) and the aligning interests under a shared set of values which are expressed in the technology action frame explored above.

Through the previous section, it is fairly evident that there are significant differences in the technology development processes of either sub-case. AP employs a straight forward model. The coop's operational group is the social group in the centre of most, if not all, activity. However, their capacity to produce novel technological artefacts is determined by farmers' groups and at the same time restricted by the coop's mission (which in turn is articulated by the community that created and sustains it). In other words they provide technical skills and design knowhow in order to assist other social groups to create technological solutions. These may be either groups of individual farmers working in similar agricultural activity or farmer associations (in some rare instances they may be other organisations and individuals which have been inspired by AP to create their own tools which are then promoted in the AP tool list). The AP group initiates and facilitates the process at every stage. However, it is the other social group involved, no matter what its structure might be, that is determining what the shape and function of the technological solution will be.

The same condition applies to solutions already produced by farmers which then AP will document and disseminate. Only certain technical types of solutions are selected, and when adjustments are made, they follow the same set of principles. These are, again, curated in accordance to the ethos and values of the cooperative, i.e. those of the farmer social group. Essentially the AP group functions as design guides or 'Sherpas' providing certain skillsets, like software assisted 3D design or engineering and architecture knowhow, to enable farmers to apply their own knowledge in the creation of artefacts. In the early days of AP those providing these skillsets were mostly young people, fresh out of universities, seeking work experience through paid volunteer programs. As such, they needed to be properly familiarised with the intricacies of this type of agriculture and farming technology. For this, they had to rely on their experienced peers in AP and, more importantly, the farmer groups they were working with. Over time, AP has acquired the resources to also employ individuals with more specialised and diverse skillsets regarding agricultural technology which contributes in the development of more sophisticated tools.

Despite its simplistic network of actors, the community is open, if not welcoming, to input by other social groups. As discussed earlier in chapter four, the coop tends to prefer giving out shares that represent groups rather than individuals. These need not necessarily be agricultural groups. They may be other socially aware groups that find the activity of AP worthy of support. One such group is the Cigales. A social investment federation with clubs (chapters) all over France which provides funds for initiatives that promote sustainable development and localised alternative models of production. The clubs are active for 5 years (they then disband and perhaps create new clubs) and beyond funds they offer expertise and advice. Several clubs have recently joined the shareholders in AP. I met three elderly gentlemen representing one such club who offered to give me rides to the AP gathering location. Their justification for joining AP was that their group is very critical of unsustainable modern farming methods and machinery available in the market while it deems AP's social innovation model worthy of support and expansion.

In the presentation area of the gathering two farmer groups presented their respective collaboratively developed tools. One received assistance by AP to improve certain elements of the tool while the other was completely independent with a strong focus on autonomy. During the discussion (after the presentations) which was about the ways they collaborate and possibly inspire other groups to engage in similar activity, a point was made, by a member of the cigales groups, to expand the notion of innovating together even further. Specifically, to include the consumers and supporting groups in the technical choices made. The reasoning behind this was that these choices determine the form of the agricultural production system which is tightly linked (or even synonymous) with the food systems, hence it is imperative for all actors to be associated with the process. The AP briefing for the event condenses the outcome of discussion in the following sentence: “it would therefore be necessary to create spaces for design with more people than peasants alone, for technical choices that forge viable, resilient and sustainable farming and food systems” (translated from the French language by myself). This is, arguably, a deeply nuanced interpretation of technology in society considering how, quite possibly, all participants in the discussion formulated their opinions on experience rather than the theoretical examination of technology.

The FH case boasts more diverse configurations of social groups involved in the development process which echoes the same sentiment. While many of the tools within the community are developed by individual farmers or groups of farmers, the primary goal as stated in the mission statement of FH is to involve other social groups like designers, engineers and activists in the process. As Kristen puts it, how farmers manage to work the land should be everyone’s concern rather than farmers struggling alone to provide food to the world. In this sense, some of the most active members of the community are not (or are part time) farmers. They may be engineer research groups like that of MIT which participated in the early FH events. They may be engineers like Lu who work closely with farmers or academics like Chris who finds that his employment in the university’s agricultural extension program can produce more fruitful outcomes when working with farmers rather than through one way technology transfer from the university to the farm. Much like AP however the driver of activity is, yet again, the farmers themselves. In Chris’s words “the first thing for me is a demonstrated need… it does no good to have a bright idea if there is no need for it”.

Lu, as an engineer who was familiarised with FH through his brother Chris (who is a farmer) says “if I can’t get vigorous feedback by the people who might consider using the tools, then I will not do a good job” and his wish is that people would be more critical about their tools as he thinks that this would produce the right environment for further development as well as repairs of equipment. For one of his latest projects he developed three pedal powered tools. A thresher, a fanning mill and a bicycle powered dehuller - flour mill. He had to become a "student" of grain processing for two years and immerse himself in order to create them. To do so he worked with three farms participating in the process which provided both raw material for experimentation but also valuable feedback.

For instance, his original plan was to use electric motors for the tools. However, the farmers suggested they be human powered for varying reasons. One farm had safety concerns. Another thought that pedal power would make a good marketing narrative and the third simply objected to the motor idea because farms might not have electricity on the site. Furthermore, they decided to develop it on standardly available lumber dimensions so that farmers could easily access and experiment with local lumber. This allowed for affordable material substitutions, adaptations and modifications.

Likewise Chris, as part of his work in the extension program says that his role is "to bridge research and practice. So the open source path is good for understanding what needs are out there and what solutions". In this spirit he has developed a hop harvester in collaboration with farmers. On the development process compared to mainstream approaches he says "it's totally different. I like to think it as democratisation of design. Users are invited into the process in a very intimate and collaborative way, whereas generally in the private sector approach - if you're lucky – a marketing team might have had a focus group to collect user requirements that are fed to the design team. It's a very disconnected approach". The inclusion of farmers in the process led to design choices that improved the utility, in the form of portability and robustness, as well as the capacity to manufacture and repair the machine.

On the other hand, people involved in FH recognise the limitations of involving non farmer allies (mostly engineers and software developers) in their attempt to come up with technological solutions to their problems. While collaborations might be forged with the best of intentions, lack of first-hand farming experience and misaligned interests reduce the chances for a project to reach completion or even properly launch sometimes. In other words, without the necessary resources it is difficult for non-farmer groups to invest a lot of time and effort to fully comprehend the problem and ideal parameters for a solution.

Design approaches in the collaborative development between the various groups also present difficulties. Rob being both a farmer and an engineer struggled with collaborating due to his specific style of conceptualising and prototyping as well as the limited skills of others within the community to keep up and contribute significantly. On a similar note, Chris says that "in some ways it makes the job more difficult for those trained in traditional design approaches but in my experience it makes for a better solution". Grant, also remarks that a systems-based approach of developing tools cannot be comprehended easily by engineers lacking knowledge of the basics in agriculture. So he thinks only those passionate enough to commit to the agrarian goals, or at the very least with the necessary funds to allow them to engage full time, are able to truly collaborate with the farmers in a meaningful way.

Severine has observed instances where designer, architect and engineer groups would join the farmer group in events and while intense collaboration would be sparked, there would be no follow up by the "urban dwelling open source theoretical community" as she puts it. Leaving the farmers stuck with the same problem. Though she adds that there have been cases where "beautiful friendships and bonds were made in order for projects to continue and thrive". Those were a result of a culture of commitment and not one of experimentation: "A factor in the success of open source farm technology is the relationship that farm technologists have with one another. The respect they give to the user (farmer) and the insight the user has in a situation where there's little to no money".

This may be observed on the other side as well. Don as a non-farmer member of FH finds sustainability an important issue with this type of activity. "Certainly people designing tools for themselves is going to avoid many problems" Don says but he admits that "increasingly, for many technologies, it is becoming hard to design all the things that are useful to use". Recalling conferences and events where there were either no farmers present or a considerable gap of understanding between farmers and developers regarding the utility of certain tools he adds "you get into the scenario that someone will need to design it for you or with you. So there is the question of what your relationship is to that designer". As far as he is aware, some of these designers join FH as they aspire to become farmers, hence investing their personal resources in order to eventually achieve that personal goal. He says his case is a coincidence of his technical skills, his scientific interests and the usefulness (impact) of the projects for the farmers – a congruency of values and skills between those involved.

The same can be observed in Lu's case where, despite the very limited resources for him to continue doing this work, he is still actively engaged when possible. Often in very unfavourable conditions. For instance, he usually works in much lower rates than those of the market which forces him to cut corners where he can (like not heating his workshop during the winter period). It cannot be avoided though, he says, as he needs to make it cheaper for farmers to create and, more importantly, repair their equipment or else they will just buy new equipment, contributing to the unsustainability of the current system. In turn, the farmers appreciate his efforts and often offer him their surpluses of produce. A relationship which is again based in mutual understanding and support.

6.2.3 Interpretive flexibility – black box or perpetual openness?

Having presented the frame within which technology is development in the movement as well as the social groups involved in the process it is now time to explore the particularities of the development process. Specifically the interpretive flexibility of artefacts as they progress from conception to their potential closure. This aspect of the movement also presents interesting particularities as opposed to mainstream development processes.

As was discussed in chapter five, differing conceptions of problems along with varying ways to solve them among the relevant social groups lead several iterations of an artefact developed as a solution. Over time stabilisation starts to kick in with the various versions converging according to agreement reached amongst the participating social groups. Ultimately closure comes when this brewing ends. This black box (to use the ANT term) state is deemed as the ideal one and no further changes are required or, in many cases, allowed. As we've seen before this black box may be quite literal with both physical and legal restrictions preventing any type of change to the tool – machine – artefact. The black box obscures technical specifications and all relevant information forcing end users to invest considerable effort and sometimes engage in illegal activities to "unbox" the artefact.

Hacker culture is built on this premise. Individuals altering the properties of technological artefacts to imbue them with new uses. Furthermore, free and open source software is, in essence, immaterial technology that is offered freely for users to alter and adapt as they like. More recently microcontrollers and other open source hardware are pieces of technology which have reached certain closure before they are introduced in the market but offer relative flexibility with regards to how they are ultimately used, especially as components in a system. Technology within the two sub-cases displays a similar, more prominent, irregularity. The artefacts created are often purposely embracing the interpretive flexibility at any point of development. As we've seen, that point may coincide with the conception of the tool or any stage all the way down to the "finished product". Yet even that very last stage, closure is not claimed. The sub-cases provide several examples of this.

Like the Fido which allows for different configuration depending on the setting of each farm and the specific preferences of its users. The most prominent example however is quite possibly the culticycle. An interesting contrast to Bijker's historical study of bicycle, which is used to exemplify how closure is reached, the culticycle illustrates how closure is not desired. Tim, its main contributor in the FH community, claims that his goal is for the tool is to reach certain maturity as a commercial product in order for him to be able to make some income out of. Meaning to reach a level of guaranteed operability for its users. But, beyond that, the tool's development is never ending. New iterations, implements and overall uses for it are constantly introduced. The tool itself is the polar opposite of a black box with all of its components exposed to provide easy access for modifications and repairs (figure 12).

Figure 12: one of the many iterations of the culticycle.

Beyond the various iterations of the tool developed by Tim and his FH collaborators, others have appropriated the tool and differentiated it significantly. For instance the conception of a Belgian group which uses two bicycle seats for power. And the similar yet quite different Aggrozouk which has been co-developed by AP adopts a very dissimilar philosophy on the sitting position on the tool. The French version employs a recumbent position, using electric assistance in order to make the tool easier to manage in larger fields, whereas the FH version uses the more traditional bike riding position which allows the rider to adjust their position according to the effort required (see figure 13).

Figure 13: an iteration of the Aggrozouk built in the gathering.

There is communication and exchange of opinions amongst these groups around technical characteristics, though each one is following a different trajectory of development (with these trajectories coexisting without any competition amongst their proponents). Technical characteristics are imported from other artefacts and vice versa. For instance, the four wheeled weeder which allows users to weed in more comfortable positions than simply crouching down. It is another tool which exists in a multitude of shapes and sizes according to the developer - user's preferences on the general conception. Some are pedal powered, other electric or simply pushed. Some employ the sitting position and others the prone one. A FH forum post catalogues the wide deviations of some of its iterations[3]. How such a variety is made possible however and why?

The hop harvester developed by Chris in collaboration with hop farmers offers some possible insight. It being a collaborative development project, works began in winter when there were no new crops to test prototypes with. Hence, they developed the design with utilising insight by the farmers. Hydraulic power was selected over electric because it was easier to repair and troubleshoot as well as (according to a paper about the tool co-authored by Chris which offers interesting observations) "because variable speed control is inherent in hydraulic systems and we were not sure what speed we wanted various sub-systems to operate at" (Callahan and Darby, 2014, p.4). In addition "the structural frame was made more robust than necessary in case we found certain members had to be removed to accommodate a design change in the field" (ibid.). In other words, the conception of the artefact itself retains its high degree of flexibility allowing for a considerable design margin in order for its potential fabricators to adapt it to their specific production volume and equipment configurations.

Lu's pedal powered grain processing tools offer some further clues through the interactions with other users in the FH platform. The tool blueprints don't feature a bill of materials. The justification for this according to Lu is the following:

"There are so many materials substitutions and adaptations (like plywood for 1X pine) that what I recommend is printing out the instructions and then on each page of the instructions write in the materials you will use. If you plan to acquire the materials all at once you can collate the pages to make a master list. This exercise will also help you get familiar with each step in case modifications you make in your design (example: substituting 3/4" plywood for 1" pine) cause changes in dimensions and other possible changes in the instructions which will need to be pencilled in to your instructions."

Likewise, the blueprints don't feature specific instructions regarding several components (like for instance the type the bike unit used to power the tools) allowing the user to experiment with further development to achieve a desired utility of the tool. The design

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3 http://farmhack.org/forums/prone-weeder-lay-down-weeder-bed-weeder-collection-ideas

of the tools have a built in indetermination to allow for user preference (and material availability) which may affect their final form. Yet another example of preferred flexibility which also conforms to the values represented by the collective action frame.

So it is obvious that various iterations of artefacts can be developed concurrently. However, many of those may exist in obscurity. A lot of innovation in the form of different technical choices is created but not disseminated in both communities according to the interviewees in either side. The core team of FH believes that lack of time and resources limit farmers' capacity to do so. This is the reason why FH has developed educational resources and web tools which endorse a documentation culture and simplify the production of high quality blueprints of tools within the community.

Similarly in the case of AP, which employs a more structured research and development model, only some of the tools in their list catalogue various version. Usually the latest one produced by the operational group is the one featured as to keep track of all of the versions would require significantly more time and resources. At the same time the community itself, as discussed earlier, lacks the drive to participate in this aspect. Still, while the true breadth of maintained interpretive flexibility cannot be determined this sub-chapter illustrates how the perceived natural evolution of technological artefacts into closure is deliberately overcome in the context of alternative technologies. In Julien's words "even if there is consensus on the technology it can always be improved and tailored to the particular needs of local farmers. We always encourage those farmers to give back their modifications so everybody can take advantage of them".

6.3 Critical considerations

Broadening the scope on the bird's eye view, beyond the interactions amongst those social groups involved in the development process, I will now be exploring the structural consideration affecting the two sub-cases. The first section of this chapter has, at several stages, pinpointed the various societal forces or the underlying technical technological rationale as manifested in the technical codes. It has also pointed to the biased social structures enforcing limitations and standards which contradict the values and principles of these endeavours. Building on those cues I will attempt to provide a systematised account of these factors which will benefit from the, in some aspects, distinct contrasts between the US and France contexts. To do so I will be using the critical theory rubric as it was presented in chapter five starting with those technical codes that are in conflict with those values the technological action frame seeks to solidify as the new codes.

6.3.1 Technical codes

Clues of technical codes having a direct impact on the sub-cases' technology development can be found all over the previous sub-chapter. Technical codes that either completely exclude users or trap them in a technological system whose values directly oppose their own. Given the fact that the incumbent underlying technological culture is fairly universal, at least as far as agriculture is concerned, clear parallel lines can be drawn between the two sub-cases.

The most prominent theme is the treatment of environmental considerations as externalities which need not be accounted for in modern agricultural systems. Technical codes embedded in the processes then lead to a harmful and wasteful impact on the environment. The definition of efficiency and resilience for individuals in either sub-case, on the other hand, contains explicit goals for environmental sustainability if not regeneration. In this sense the technological artefacts created by the groups are at constant odds with regards to interoperability and compatibility at a systemic level. As discussed earlier this leads to, on the one hand, attempts to establish an alternative agricultural system and, on the other, the leveraging and repurposing of existing infrastructure for their own goals.

An indicative illustration of the latter is the use of standardised basic material, generic manufacturing equipment as well as parts, components and certain basic tools. All of which are mass produced (and are therefore deemed external inputs) in often questionable conditions. A significant concession for those determined to achieve autonomy in terms of dependence for material and infrastructure in a globally interconnected world. At this point it cannot be avoided according to Lu. He says "right now we are not ready for how expensive life would be without mass production". For instance, while making any size of metal can potentially be made by a blacksmith this option would not be available or affordable for many. Owning the land and having the capacity to decide what to do with it is the focus of the struggle for autonomy now he thinks. Julien from AP also believes that some tools like the tractor are too complex for farmers to build themselves so large enterprises need to build them. Yet he believes that they too should be cooperatives owned by the workers and they should be serving social goals rather than making profits.

So the idea, for now, is to utilise mass production until the point of the "farm factory interface" as Lu puts it, meaning a garage, a workshop or a farmer's shop. There the basic elements of technological artefacts (including the mass produced ones) are arranged or re-contextualised in the social world, to use Feenberg's secondary instrumentalisation terminology, to match the environmental conditions and demands of each area and the values – ethical considerations of farmers rather than attempting to solve unique problems with the mass production model. Which, as Lu puts it, "is to make a million of the same tool for every farmer".

This leads to another point of incongruity with the dominant system. Proprietary configurations of technologies that, one the one hand, push farmers to purchase specific tools and implements and, on the other, prohibit them from appropriating or adapting them as they wish. This situation forces them into a vicious cycle of having to constantly upgrade in the latest version of marketed machinery or risk compatibility issues. Expensive and time consuming repairs along with relatively cheap and disposable replacements of equipment contribute to this condition. A clear case of planned obsolescence for artefacts by manufacturers. The outcome of this is unwilling reliance on manufacturing companies and wasteful practices. To counter the effect these groups design, as mentioned above, holistic and system-based approaches with regards to their technological artefacts, which are instead aiming to achieve robustness (for long term use) and ease of reparability. At the same time, those professionals (like Lu and Tim) willing to provide assistance with this process are forced to extreme measures in order for it to make economic sense. After all, adopting a research and development model similar to that of for profit large companies is not an option.

Last there are technical and legal specifications enforced by the state on behalf, as is perceived by those in these groups, of big companies. These specifications, that are designed to facilitate industrial and market interests, make alternative practices difficult or impossible to create either by providing incentives for adopting conventional practices or by applying restrictions which independent initiatives simply cannot comply with. The wider right to repair movement in the US has been sparked through agriculture and is in direct opposition to these restrictions. Restrictions that even question the very definition of ownership of the tool the farmers have purchased. Similar restrictions through legislations and incentives are found in the French sub-case as well. Fabrice says they wish to introduce a public debate on the tool sector "as there is a lot of support for the private industry and we wish to question this system". As an example he mentions that when farmers buy a new tool then can engage in fiscal optimisation of 130% of the cost. So in essence these purchases are considered tax deductible. The same, of course, does not apply when they build their own tool or when they invest funds for the maintenance of their existing ones.

The previous examples have hopefully provided enough evidence that profit maximisation and control of the farmers are the key values embedded in the conventional agriculture technological regime. They are realised by removing them from the development process of technology which contributes to their deskilling. As many interviewees have noted, conventional farming is now like a "desk job" in the sense that farmers are not actively engaging with the land but rather sit behind a wheel as passive users - consumers of the technology they are being fed. Worse still, some point to the trend of highly automated machines that will completely remove humans from the fields. Others might embrace these technologies but only on condition that they are there for menial and repetitive tasks which will improve the farming experience. Though they fear it is not currently the case. The connection with the soil is severed and the instruments to care for it are set aside and replaced with those that exploit it. However unlike other industries where deskilling of workers has taken hold and become the norm, many farmers have either retained their traditions with regards to technological expertise and skills or at least are leveraging the global knowledge around agriculture to re-imbue their values in the way they do their work.

6.3.2 The role of the state, the economic system and national culture

Feenberg, in his otherwise extensive analysis of technology in society, (2002) tends to gloss over the massive power asymmetries between capitalist and alternative technologies as well as the role of the state in this equation. While the potential of social movements and alternative technologies to induce systemic change should not be underestimated, the opponent they are pitted against is clearly in a vantage position. Capitalist technologies are embedded within the economic system and enjoy an abundance of resources, whereas the alternative ones operate in intense precarity and antagonistic conditions. Thus the role of the state could be crucial in their development. These asymmetries are blatantly obvious in the case of agricultural technologies as numerous studies have illustrated their adverse effects both in a social and environmental context. The two sub-cases provide interesting insights in this regard. The socio-political environment is quite different between the US and France affecting the development of alternative technologies in both subtle and less so way.

Starting with the AP sub-case I will first illustrate how the national context of France influences and even shapes, to a large degree, the community's activity. While the state predominantly provides support for conventional agriculture and market facilitated relations, AP manages to secure financial support through a mix of sources. A portion of it comes from national or European organic and small scale farming funds. About 40% of their operations are covered this way. A significant amount indeed. The rest comes from the coop's equity and other organisations which support their work like the cigales clubs, crowd funding campaigns for their equipment, as well as the participation fee paid by those attending the workshops. Beside the direct support for agriculture, they also manage to acquire state resources through worker vocational training in the form of tax reductions and funds for the participants. This can cover for up to 80% of the fee paid by farmers making the services AP offers both highly affordable and sustainable.

At the same time, AP identify what they do as being for the public good and what they produce as commons, which they say completely justifies whatever state support they receive. As Julien puts it "we are not selling machines so we cannot have the same research and development model as big companies". However they are aware that these conditions are heavily dependent on the political climate of the country and the situation may and, judging by recent developments, is likely to change. So they desire for their future activity to become more autonomous and reliant on the farmers themselves.

Indeed, political change may affect such initiatives in dramatic ways. The Lucas plan which was hatched in the 70s argued for the right to socially oriented production. It was offered as an alternative created by the employees of Lucas Aerospace under the threat of shutting down manufacturing. The plan sparked an entire movement that questioned the determinism of technology and called for the participatory development of socially and environmentally conscious technology. A leftist local government in the then Greater London Council provided resources and infrastructure for the Technology Networks, early versions of makerspaces with community managed tools (Smith, 2014). However the hostile neoliberal policies of the Thatcher government as well as the abolishment of the council striped their resources and all the spaces from the movement (ibid). So shielding against shifting political climates is an imperative for initiatives like AP.

At any rate, the importance of this multifaceted support cannot be understated. To begin with, the AP coop acquires enough resources to employ individuals providing the required assistance full time as well as invest on other activities that actively promote the interests of these farmers and enhance their alternative practices. These individuals are either seasoned experts on the field or young practitioners which have the luxury to fully comprehend the agricultural problems they are called to help solve as well as the philosophy and values of the farmers. French farmers, on the other hand, have access to reliable assistance with the development of tools tailored to their unique practices without having to invest excessive personal resources. Furthermore they enjoy all the benefits a welfare state can offer, however limited those may be compared to the privileges powerful actors and industries enjoy. Healthcare, life insurance and other state subsidies that allow them to have the time (they are even exploring ways to help farmers when they wish to take some time away from their farm activities), the resources and the appropriate disposition to engage in activities other than those that directly provide their livelihood.

Last, while France was (and still is) at the forefront of large scale and industrialised agriculture, small scale farmers have managed to retain the agrarian ethic and culture of the past through the many associations and organisations that promote small scale and organic practices. The peasant identity, which comes with a sense of long history to uphold, has led to a radical perception of technology which is tied to autonomy, cooperation and collective action. As well as an aversion towards market relations (at least in the production aspect of agriculture) stemming from critiques towards globalisation and large agribusiness. Furthermore, artisan (the French term closely associated with that of craft) work and the culture associated with it is considered valuable in the society especially with regards to food and the peasant culture. Hence there is a market for the artisanal bread, cheese and other products (which are considered healthier, tastier and better for the environment) as well as a touristic appeal for that way of living and producing. In fact it is so appealing that many young city people become disillusioned with their way of life and decide to become néoruraux (neorurals). I have met some of those in the AP events as they were eager to acquire the skills and knowledge to become sustainable in their new role.

According to some of the people I talked to, the above provides a possible explanation for why the French farmers in the AP community are so keen to invest the time and energy to learn how to produce and maintain their own tools instead of seeking someone to manufacture for them. However, some also say that AP's success may also explain why individual initiative is limited outside the umbrella of AP. Or at least there is limited documentation and dissemination of such activity. Indeed, since the organisation is so meticulously structured and oversees most of the development and outreach processes, many of the people in the community may not feel that their independent efforts are not required for the movement to continue thriving.

The FH organisation sets out to accomplish the same goals as AP but in a very different political, economic and cultural setting. So naturally, this setting does influence its activity in distinct ways. Agriculture in the US is much more geared towards large scale, energy and input intensive practices. The sector is heavily consolidated and the market often does not offer basic machinery suitable for alternative practices, which are imported from Europe. In Grant's words "I think that the capital tends to aggregate with regards to technology development. That aggregations is deployed towards technology that is applicable to industrialised agriculture. There are no incentives for small alternatives because the market is small". Those engaging in small scale agriculture, often do so in precarious conditions. In fact the term resilient agriculture used by FH carries a connotation that goes beyond strictly about the crops. It refers to the "bounce back" and adaptive spirit of farmers in adverse situations.

As an organisation FH receives no steady funding beside a couple of SARE grants to develop the web platform and to fund two volunteers (Kristen and Daniel) for a year. Beyond that it relies almost completely on the volunteer work of individuals and associated groups. The form of the organisation, the technology development model, and the community events are partly shaped by this fact. Activity is quite decentralised and sporadic due to lack of funds for fully employed people to build certain decision making institutions and coordinative capacity. Action then, appears flexibly where and when community members gather the resources and collaborators to mobilise without any particular central coordination. A lot of individual activity takes places also. The platform is designed to facilitate that type of organisation. It provides the necessary framework, information and know-how for users to take into consideration when acting within the community. It also provides a conduit for remote collaboration, in a decentralised and asynchronous way, and the database for all the technology produced within the community. In this regard, FH embodies the full definition of a peer to peer, open source organisation.

The actions of the individuals within the community are similarly influenced by the local context. Industrialised agriculture has been more successful in eliminating traditional forms of agriculture in the US. Small scale farms are re-emerging but in a very different political landscape. Several people I talked with have mentioned the feeling of disconnection from the agricultural roots. “The small farm never went away in Europe” Kristen says while “in the US it feels like we are reinventing a lot of things”. Dorn thinks that it is up to them to create a public record of all knowledge and technology in order to ensure that future generation will not have to duplicate the work of generations past. As is, to some degree, the case with them. They need to go back to the point when agricultural technology shifted into what it is today and re-appropriate it. Give it a new direction as they put it.

Furthermore, many farmers do not enjoy the same security as their peers in France. With minimal state support it falls to them to secure proper healthcare, funds for educational courses and at the same time maintain their livelihood in case of unforeseen disasters. Farming is a high risk, low return venture after all. Within this context of conducting their day to day activities, their involvement in FH is more conditional as well or as Kristen puts it “emergency mode all the time”. Activity is possible when time and resources allow it thus the threshold for participation is kept to a minimum with a goal to at least cultivate a documentation culture for the tools people develop in their farms. “There is a lot of innovation in the farms that is isolated. It’s inspiring to see what other have built” Dorn says. Still this is a time consuming endeavour. Since there are no available resources at the moment to employ people to do it, Dorn mentions that a possible solution could be drawn from their model of utilising the resources of collaborating organisations. In this instance, university students looking to get some practical experience could potentially help with the documentation process of under-documented tools developed in the community.

Considering the general political and economic environment, activity in FH is inadvertently more liberal than France with a more prominent focus on the role of the individual in the whole endeavour. However as Don puts it “it assumes a form of community structure that brings together diverse expertise which is not the ragged individualist farmer celebrated by American culture". The focus on autonomy through self-construction is less prominent than in AP as well, with more people willing to either employ someone else to build the tools available in the platform for them or at least help them do it. Grant thinks part of the reason is that many small scale farmers are not from farming families so they lack the fundamental mechanical background and acquiring these skills is not easy. Kristen says that they may simply lack the time and resources to invest.

In general commercial activity is more wide-spread in the periphery of the more dedicated FH community members than in AP even though the ultimate goal is to shift the mentality and provide the necessary knowledge (by bringing experienced and novice farmers together) to do it themselves. It is encouraged in order for people like Lu, Rob and Grant, which invest significant personal resources and time, to be compensated and remain active in the long term. The quality of the work done is better when there are resources available as well. In the instances where funds were allocated through a SARE grant for the development of a tool, the prototyping process was more thorough and the documentation more detailed. That is because there were more materials to experiment with and funds to compensate certain people for their work rather than everyone volunteering whatever time they have available. But these grants are the exception rather than the rule.

Thus commercial activity enables prototyping. Tim may sell some kits with essential parts for the culticycle (and people would complete them with local materials) to secure funding for further development. Lu offers repair and maintenance services and occasionally is commissioned by farmers to help them develop tools. Grant would like to develop his tools and practices further so that others could take lessons in his farm. Don would rather position himself as a "research and development guy" working with the farmers and securing sustainability through a grant or a foundation rather than selling tools (much like how the operational group of AP is supported). Occasionally these tactics will fail and losses will occur. This is a topic which is under constant debate in the community and no clear cut solution has been offered given the lack of institutional support. For some, the ideal solution would be for these individuals that are more proficient and active than others to be compensated through workshops where farmers would learn how to build tools themselves (again similarly to what AP does). But so far this has not been accomplished even though some have considered it. Part of the reason is the large geographic dispersion of members and, yet again, the general lack of time and funding.

What is obvious however is that these individual are attempting to create a small “market” which would embrace the ideals of openness and experimentation as well as sustainability within the community’s ecosystem as Tim puts it (for lack of a better term). Not through competition but through collaboration and knowledge exchange. There aren’t enough resources and demand for that anyway they say. Instead, they are developers that have been working in this because they believe in it and they would engage full time had they secured sustainability. So for some it might be a side project and for others a budding full time job with all the growing pains that come with it.

Funds are not offered openly to anyone willing to engage so competition between groups and individuals is not fostered. Instead people work together or on different parts which may interoperate in a larger system as activity grows organically (that is horizontally in a network rather than vertically around these organisations). For Grant this type of development might not be as efficient as the industrial one but “when you operate inside constraints you oftentimes come up with a more elegant and effective solution than if you had a lot of capital to deploy”.

The previous illustrate how the socio-economic context has a profound impact on the way technology is developed in the two sub-cases. The shape and nature of the technological artefacts themselves is more often than not similar, in accordance to the technological frame. After all knowledge, as it would be expected, is often exchanged despite barriers like distance, language and differing stock material specification. How the technology is developed; the output volume and the peripheral activities are quite different however.

Three general observations can be made on this alternative technological trajectory. First, that such initiatives are indeed able to emerge and proliferate with minimal material resources in a system of technological development that excludes them. In Kristen’s words “in order to replace that system of research and product development system we have to be scrappier about it. Organise ourselves and share information using tools available to us”.

Second, when institutional and state support are provided, even at an insubstantial degree and for seemingly unrelated purposes, these initiatives are allowed to redirect them into mobilising their untapped resources (alongside those that are mobilised, farmers often have both the infrastructure and know-how for self-fabrication after all) in a more effective way in the development of alternative technologies. Kleiner and Gottlieb (2015) have coined the term transvestment to indicate a process of reverse co-optation or how value may be channelled out of capitalism and into alternative communal organizations. It can be argued here that through their business model initiatives like those presented in this thesis manage to accumulate resources from the state/market system and utilise them to create their tools in a similar way. Thus it extracts resources from the capitalist mode of production and economy and transfer it into the alternative ones.

Third, and most important, that truly democratised technology development is quite possible but complex and often messy. It is difficult to condense in some bullet points or create one size fits all blueprint of practices for all sectors of activity. The unique values and other local specificities of each community engaging in technology development are to be accounted for even when potential contradictions don't allow for a streamlined and efficient (strictly economically speaking) model.

In other words, democratic participation can be achieved in all aspects of the process by not privileging certain powerful social groups with excessive control over technical choices. Instead it is possible by allowing those that are working with and are mostly affected by certain technologies to provide input which translates their interests and values in the form of the technology. Or better yet, by empowering them to engage in the activity themselves. These sub-cases are indicative of this self-mobilised potential which is uniquely adapted in two relatively different, but similarly antagonistic, social settings. The thesis itself is an attempt to voice the diverse contemplations and concerns of those actively engaged in this endeavour. And to do so with some academic rigor and cohesive narrative structure.

The following chapter is an attempt to look at the bigger picture. How the alternative technological configuration explored here may be positioned and even thrive in a socio-economic production mode that is similarly emerging from within the capitalist one.

CHAPTER SEVEN

7. Beyond open source agriculture

Since the proliferation of the capitalist system there has been no other large scale alternative to its technological systems. Even socialist regimes imported technology and management methods that in some aspects were more aggressive than capitalism. The Soviets, in fact, employed industrial agriculture methods that directly mirrored the American ones (Fitzgerald, 2003)! The sub-cases in this thesis provide insight on how democratised technological processes might look like. But what would be the right conditions for this experience to be recreated elsewhere? After all, individuals in either sub-case indicate that their aspiration is for their activity to evolve into a global, organically developed, network of technology communities. This chapter will present an emerging alternative mode of production, made possible through democratised technologies as they are presented in this thesis, which could provide the conditions for this goal.

The truly emancipatory potential of information technology has yet to be realised. And it will likely continue to be the case until it is applied in a production and organisation mode other than the capitalist - industrial one. It has, however, made grassroots cooperation and information exchange possible on such a scale that it enables the emergence of new production models through its appropriation by technological communities (Feenberg's Minitel example presented earlier and the multitude of hacker projects are indicative of this). "Commons-based peer production" (hereafter CBPP), a term coined by Benkler (2006), appears to be in tune with this potentiality, not as a directly competing mode but rather as one emerging from within capitalism. This type of production is distinguished from the capitalist form of production because it involves distributed structures and its productive output is a commons. While one may claim that capitalism is able to adapt and adopt distributed and open source forms as well, CBBP boasts a qualitative change rather than a quantitative one. In this sense it questions the basic mainstream economics mantra that humans seek maximum individual profit maximisation when engaging in productive activities. It also challenges the conventional organisational structures of property based, market-regulated, hierarchical organisations.

One organisational and economic configuration for CBPP is interchangeably described as both Design Global – Manufacture local and Cosmolocalism. The basic features of its framework are described in its name. It reverses the industrial logic of restrictive intellectual properties and global supply chains feeding into economies of scale (Kostakis et al, 2015). Instead intellectual property is, as a commons, accessible by everyone with knowledge production taking place openly in a global scale. Actual manufacturing can take place locally by communities or enterprises quite often through shared infrastructures and with regional biophysical conditions - needs under consideration. It embraces the idea of circular economies rejecting the decontextualisation of inputs – outputs and related externalities. Thus production is oriented towards sustainability and well-being rather than economic growth. The role of information and small scale fabrication (both precision tools like 3D printers and laser cutters as well as more affordable traditional equipment) technologies is obvious for this configuration to be feasible.

Its dynamism cannot be denied, as exemplified by multiple collaborative open source projects from around the world that exceed the limits of digital commons (like open source software), from low cost 3D printed prosthetic arms to small scale wind and hydro-electric power generators (Kostakis et al, 2017). In fact the commons can also be seen as the point of convergence for the wide variety of, seemingly dissimilar, projects. It provides a clarified political, economic and cultural space for collaboration. This is evident in the sub-cases examined in this thesis as well. People I spoke to have been appropriating the commons as a strategic term to engage with other communities that may not be active in the same field as they but share similar views against the incumbent mode of production.

This thesis explores a technological development system emanating from initiatives which can be inscribed in this model emerging from within the capitalist mode. However capitalism is extremely successful at adapting and capturing common resources to lower its operational costs, so how would this emerging mode be allowed to flourish? There have been various proposals to ensure the reciprocity cycle towards the commons, both legally (like open source licenses modified to provisionally allow free use only for applications that add to the commons (Bauwens and Kostakis, 2014)) and organisationally (in the form of open cooperativism which include stakeholders in all levels of management and are geared towards the common good rather than profit (Pazaitis et al, 2017)).

Taking the argument further, the thesis posits that radical technological change (meaning the democratisation of the underlying technological base) would also be necessary. And for this to happen we need to have a critical evaluation of the democratic deficit of contemporary technological systems as well as the development of alternative technological artefacts whose conception is based on a clearly defined set of values. Values that are different from those of efficiency and profit.

Several critical theorists of technology have highlighted that technical, beyond merely economic, elements have been incorporated in modern industrial systems in order to exert control over those directly working with the technology of production (see for instance Noble, 1986; Beniger, 1986). As Feenberg puts it "the rights of workers must be structured into the design of production technology at the expense of control, not purchased at the expense of efficiency" (Feenberg, 2001, p.182). In other words, the codes embedded in the technological artefacts and systems should reflect values, goals and interests that are exemplifying a substantive democratic orientation, besides the obvious argument of open source artefacts being available to everyone. Alternative conceptions of technology ought to be actively promoting democratic goals such as equality and political agency, rather than simply successfully challenging established technology within the framework of market rationalisation.

CBPP presents the capacity for such alternative technological systems as it is presented in through sub-cases' of this thesis. The is due to the characteristics of this type of small scale farming as well as the easily identified points of contention of the agricultural system it is pitted against. These farmers are not operating under the contemporary labour regime as it has been formulated over years in the capitalist industrial production model. Their interests and goals are much less fragmented than those of their peers in other productive sectors and their awareness with regards to the underlying rationale of the technology they are being offered by the market is heightened because they experience its consequences directly. It can be claimed that technical codes calcified within the market model are especially influential in peer production initiatives in other sectors, ultimately reducing their emancipatory power.

Farming as conducted in these sub-cases is, much like all professional farming today, entangled with market relations. Yet farmers have a long history of creating, maintaining, adapting and even sharing in a limited capacity (there have been publications containing farmer inventions spanning many decades in the past) their technology according to their needs and desires. The advent of high tech, large scale agriculture has severely limited this practice but it did not disappear. Either by maintaining it through strong cultural ties (as in the French case) or by slowly rediscovering it (as in the US case) farmers utilise the new ways to communicate and collaborate to elevate their centuries long traditions. The technical codes in the farming systems, practices and technological tools employed in both sub-cases, as they were translated from the collective action frames presented in chapter four into the technological action frame in chapter six, may be viewed as a radical reassertion of excluded values, in a much more globalised context, which can form the foundation for a substantive change in agriculture.

This is evident in the technology itself which exhibits certain particularities which set it apart from mainstream technology (as discussed in the previous chapter). Of particular interest is the fact that stabilisation and closure in the artefacts developed within the movement. While market based technology tends to follow the trajectory observed in multiple SCOT studies, here artefacts remain purposely flexible with only temporary and conditional stabilisation. This marks a significant break from the theoretical conceptualisation for the development of novel technological artefacts which may be attributed again to the core element of this research project. The interactions amongst individuals and groups are not primarily driven by profit, but are built on the aforementioned set of values. These dictate that the tools need to be adaptable, easy to fix and intercompatible in order to match the needs and operational capacity of their users as well as provide optimal utility in a high risk and antagonistic environment. Thus closure is, in this context, moot.

The technological action frame is then what guides these initiatives through adverse conditions while at the same time attempting to avoid co-optation or loss of their radical vision. Thus, in the French case were funds may be secured, relatively, easily the frame ensures that the intense activity around technology development retains its strong focus on the values of the movement for openness, sustainability and autonomy. After all, as Fabrice pointed out, their organisation is a political project not a service. The frame also informs the expansion of the development model towards horizontal, small scale structures rather than responding to the demand for scaling in a vertical way. On the other hand in the US, the frame cautions against employing tactics to secure funds which dilutes the radical vision and, as Kristen put it, “changes the nature and spirit of the work”. At the same time it provides the (open, low-maintenance, distributed and collaborative) structure and the tools to continue producing alternative technology tapping onto those resources and partnerships which are, to quote Severine once more, based on a culture of commitment and respect in a situation where there’s little to no money.

In this context, open source agriculture lies squarely within the Design Global – Manufacture local framework of CBPP. Previous research on the topic tends to gloss over the local aspect and focus primarily on the sexier global connectivity aspect. This thesis sheds light on the messy local manufacturing capacities as well. Developing and building a tool for specialised farming practices is not an easy task. The level of expertise amongst those involved is typically very wide. It may vary from “grizzled” farmers with extensive experience (both in manufacturing and farming) to “greenhorns” eager to acquire skills. When conditions are favourable (resource-wise), activity can wield impressive results. Diverse people aggregate in the same space and produce a complex piece of machinery within a brief timeframe with knowledge transfer taking place in a thoroughly organic way. It is the frame, meaning the set of values - beliefs and tacit knowledge, which informs and enables this capacity. As far as the discussion around CBBP is concerned, this offers an important insight regarding the adaptation of the mode in the different productive sectors and locations. The specific dynamics, idiosyncrasies and historical collective knowledge of any potential case need to be accounted for and integrated in the organisational and productive process to ensure viability and a radical output. A simplistic, one size fits all viewpoint does a disservice to the suppressed, by the capitalist productive imperatives, capacities of grassroots communities.

The above may sketch out the blueprint for how a new technical base for society can be formulated, one that will allow workers at least some control over design decisions for the technology they manufacture and use. It may also show how to bridge the gaps and build solidarity amongst different social groups with different technological experiences and interests. After all, it can be claimed that agriculture, as the most basic element of the primary sector, presents “fertile ground” to “plant the seeds” for change in the highly complex and interdependent techno-socio-economic system. The polar opposite of technical innovations introduced by more powerful actors in the advanced sectors dictating how the base is transformed. Continuing with the nature analogies, Dorn offers the example whereby if you think civilization as a tree then agriculture is the roots and the population is the trunk. Arts and commerce are the branches and if they break they may regrow because the roots are intact. If the roots are attacked, then the system withers and dies. An apt metaphor for the current techno-economic system attacking (altering) its roots with destructive consequences.

CHAPTER EIGHT

8. Concluding remarks and future research

The overarching goal of this thesis has been to explore how different sets of values, beyond control and profit, are imbued into technological artefacts and create alternative technological trajectories. As far as academic undertakings are concerned this may be classified as an overly ambitious one, far too complex to be managed within a doctoral thesis. Hence, I decided to focus on agricultural production (for reasons discussed throughout this thesis) and examine self-mobilised communities engaging in technological development to support their activity. These communities are reviewed as the social movement which I call open source agriculture. That is, a social movement whose aim is to promote collaborative development and dissemination, without any restrictions, of technology for alternative agricultural practices.

To accomplish this I've devised a methodological combination of social movement and technology theories informed by similar attempts of other researchers, primarily Iacono and Kling's frames (discussed in chapter five) which explore social movement activities to promote certain technological solutions in organisations. Here, collective action frames and technological frames are linked adding an important element. While the former attempt to aggregate the values and preferences of those involved in the movement (as informed by Snow and Benford's work) and the latter provide the foundations which support and bind the technology development network (following Bijker's conceptualisation), the technology action frame formulated here guides the development trajectory of the technology according to the elements of the movement's collective action frame.

The following table encapsulates how the theoretical framework developed for this thesis is applied in the case through a correlation of relevant conceptual tools and their implementation in the thesis.

Concept	Implementation
Resource mobilisation	A review of the operational model and resource distribution of either subcase of

	the movement. This is crucial since unlike most movements activity here includes manufacturing capacities.
Master frames	The historical underpinnings of the movement are aggregated under three thematic umbrellas as master frames of wider movements whose values are embraced
Collective action frame	The common values, beliefs and material considerations are distilled into the frame that informs the activist work and organisational model of the movement.
Technological action frame	This frame is developed in parallel to the above mirroring its characteristics into specific features of the technology developed in the movement.
Social Groups	Social groups is employed to explore the key actors involved in the technology development activity. Congruency is achieved by prioritising the interests of the group most affected by the technology, that of the farmers.
Interpretive flexibility – Closure	These concepts are employed to examine the evolution of the technological development. The findings indicate that technology developed within the movement does not follow the typical trajectory observed in marketable technology
Technical Codes	Codes are utilised to explore embedded values in a systemic level that are incompatible with those of the movement.

More specifically, under the social movement lens the aforementioned values were systematised and classified under three collective action master frames which encompass a multitude of objectives and ideologies of social groups. The adherents in the two social movement organisations of the open source agriculture movement examined in this thesis employ elements of each master frame according to their specific socio-economic context in order to elicit participation and support for their cause. This synthesis of elements formulates the open source agriculture collective action frame which is the binding element for the individuals and social groups participating in the movement.

Being a movement that does not rely solely on advocacy as a form of action these social movement organisations are also technological communities boasting unique development configurations. These configurations are, to a large degree, defined by the aforementioned sets of values and so are the artefacts themselves (meaning how they are constructed and utilised). Similarly, the collective action frame is translated into a technological frame which holds the DNA of these various processes. The descriptions in the previous chapters hopefully illustrate the diverse ways this translation takes shape in the various artefacts presented.

However, this is not the only defining factor. Taking a cue from Feenberg's call (as discussed in chapter five) for the bridging of grounded empirical research and macro level analyses this thesis looked into the structural considerations within the case study. A comparative view of the two sub-cases provides enough evidence for the effect of economic, political and cultural factors in the form of each organisation. These structural elements are accordingly noticeable in the technology development models affecting the way individuals cooperate to produce new artefacts as well as the intensity and distribution of activity. The role of the state more specifically seems to have a profound impact in this regard. Whenever the state tolerates this kind of fringe activity or even (primarily in the French sub-case) supports it, then production is allowed to flourish. It struggles when obstacles are present either in the form of direct hostility towards such initiatives on a policy level or as calcified technical codes that come into conflict on a value-driven goal level.

At any rate though, farmers still manage to find ways to produce technology which allows them to sustain themselves according to their beliefs and values. Frequently, contrary to the homo economicus mantra of maximum utility and profit. This kind of behaviour cannot be explained away with the notion that technology follows certain paths according to the increase of efficiency in strict economic terms. This, as they will be quick to point out, has always been the norm in agriculture. Up until the advent of capitalist, industrialised technology anyway. At the individual and very local level, of course, many farmers managed to still maintain their independence and expertise on their way of doing their work. But it was the development of ICT technologies that permitted larger scale exchange of knowledge and cooperation. That is, to a degree which could provide the capacity for a shift in the underlying technological rationale in society. At the very least, a vision for a potentially more democratised alternative which would allow users of technology to impart their personal values to it towards a more sustainable and egalitarian version.

As far as the theoretical framework itself is concerned a couple of interesting observations have been made through its application in the sub-cases of this both on the micro and macro level. First, the traditional conception of a technological artefact's evolution can follow more diverse paths than what the constructivist research indicates. While the concepts of stabilisation and closure may be applied to the majority of marketable technologies developed within the capitalist framework, those emerging in this open source framework present increased flexibility with only temporary and partial stabilisation taking place in favour of adaptability and user preference. And second, when viewing the structural forces within society through critical theories of technology, particular focus should be placed on the role of the state and local culture to either hinder or enable the ecosystem developing alternative technologies.

More research on the topic explored here is of course necessary. As mentioned in the research design, exploring similar farmer projects in other countries may provide useful insight with regards to different socio-economic environments, especially in the context of non-western societies. Initiatives within the CBPP ecosystem active in other productive sectors should similarly be explored in order to identify more diverse values codified in technological artefacts. Longitudinal research would also be beneficial so as to test the radical potential or its subsequent co-optation of the technology over a longer period of time, in line with Hess and Feenberg's inquiries regarding the long term evolution of radical SMO's and the emancipatory potential of movements (presented in chapter three and five).

While such questions would without a doubt enrich this thesis, their scope would greatly exceed its limitations. In fact, my immediate goal after the completion of the thesis is to continue this research in the pilot project (mentioned at the very beginning of this thesis) set up in my hometown which seeks to mobilise the local farmer community into recreating the experience of AP and FH. Furthermore, I will be participating in a much larger project which aims to research CBPP initiatives active in varying productive fields in multiple countries (non- western ones included).

A point of criticism one may level against this thesis is the lack of extensive theorisation which, I admit, was a concern of mine nearing its end. However, I remain faithful to my original goal of presenting this story through the voices of those creating it while adding my own (I like to think as an insider of this movement as well) to provide a unifying narrative regarding its theoretical implications. Academic research is not, and never was, separate from politics or else it would have been of no use (and boring as far as I am concerned). Agriculture as a point of departure for constructive critical work and exploration of alternatives seems less complex than, let’s say, pollution by industry affecting a certain community. As Don who has engaged in both forms of research/activism puts it “when you use food as the topic you can bring people together to talk about contentious issues”. Issues that are difficult to navigate and act towards the perceived common good. In this regard, it is relatively straight forward to distinguish which technologies and practices have a close affinity to the incumbent mode of production (and thus requiring critical examinations) and which are reinforcing radical alternative visions.

My greatest aspiration with this work is to expose these communities (and others) to a wider academic audience. After all, I have several times been told that they would appreciate more researchers to work with them in a number of their own questions. These are ranging from the mostly academic, like exploring the true added costs of the patent system for the users of technology, to the more normative, like methods of eliciting more active contribution from their peers. Fine research questions indeed.

APPENDICES

PARTICIPANT INTERVIEWS

Name	Organisation	Interview Type
Fabrice Clerc	AP	Face - to - face
Joseph Templier	AP	Face - to - face
Julien Reynier	AP	Face - to - face
Nicolas Sinoir	AP	Face - to - face
Jonas Miara	AP	Face - to - face
Gregoire Wattine	AP	Face - to - face
Etienne Escalier	AP	Face - to - face
Lucas Liette	AP	Face - to - face
Robin Drieu	AP	Face - to - face
Alexandre Hyacinthe	ARDEAR	Face - to - face
Dorn Cox	FH	Face - to - face /videoconference
Severine Von Tscharner Fleming	FH	Videoconference
Chris Callahan	FH	Face - to - face / videoconference
RJ Steinert	FH	Face - to - face
Rob Rock	FH	Face - to - face
Lu Yoder	FH	Face - to - face / videoconference
Kristen Loria	FH	Videoconference
Grant Schultz	FH	Videoconference
Daniel Grover	FH	Videoconference
Don Blair	FH	Face - to - face / videoconference
Tim Cooke	FH	Face - to - face / videoconference

INITIAL INTERVIEW GUIDE

1. Could you tell me a bit more about your history at [initiative name] and your current position (main roles and duties)?
Personal background of interviewee:

- Rural or other background
- Involvement in other forms of activism

2. Can you tell me about your role at [initiative name]?

3. What are you ultimately trying to achieve through the [initiative name]'s work (in your own opinion)?
Background to initiative:

- Size and general nature of activities
- Challenges / goals when getting established
- Future plans
- Management / coordination
- Role in initiative and length involved
- Motivation for involvement

4. What have been your challenges and barriers to progress?
Challenges regarding success and survival:

- Ongoing challenges (environmental, social, economic)

5. What are your relationships like with funding/public/agribusiness sector bodies?

- Stance/views on agriculture policy
- Receipt of funding, importance of this
- Barriers/support from authorities

6. Do you have relationships with other initiatives?

- Local, national, international
- Community engagement

7. How is technology developed/used/shared in your project?
Perception/nature of technology:

- Attitude/views towards technology
- Development process
- Degree of involvement
- Utility/ dissemination of artefacts
- Other groups/individuals involved in the process

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