Document	Content
	Executive Summary [1 page: 300-500 words]
Core	Introduction and focus: general background [1 page] Critique to capitalist models [1 page] Alternative models [1-2 pages] Case Study 1 [1 page] Case Study 2 [1 page] Preliminary general principles for policy making [1 page]
Ecuadorian framework	The Ecuadorian political framework (National Plan) [2 pages]
Ecuadorian policy recommendations	Ecuadorian policy recommendations with institutional participation
Economy	Economic Viability Study

Stream #2 – Phase II document: Imagining Utopia[1]

GEORGE DAFERMOS
<george@floksociety.org>

1st draft version (10 Feb 2014)

[1]This work is licensed under the *Creative Commons Attribution-Share Alike 3.0 Ecuador*. To view a copy of this license, visit https://creativecommons.org/licenses/by-sa/3.0/ec/ or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

Table of Contents

EXECUTIVE SUMMARY

This document examines the application of social knowledge economy principles to the primary (agriculture) and secondary (manufacturing) economic sector. The first part of the Introduction dissects the concept of the knowledge economy, highlighting the role of access to knowledge as the fundamental criterion for determining the specific character of a knowledge economy: in contrast to capitalist knowledge economies which block access to knowledge through the use of patents and restrictive IP rights, social knowledge economies use inclusive IP rights to provide free access to knowledge. In the second part of the Introduction, we look at how the use of restrictive IP rights has been theoretically justified: in short, IP rights are supposed to promote innovation and increase productivity. However, the available empirical evidence on the effect of IP rights on innovation and productivity furnishes no such proof. On the contrary, looking at the way in which capitalist firms actually use IP rights reinforces the conclusion that they do not promote innovation but are in fact hindering it.

The next section, *Alternatives to Capitalist Models*, as its title implies, introduces the FLOK (Free, Libre and Open Knowledge) model, which has emerged in the course of the last two decades as a powerful alternative to cognitive capitalism and describes briefly its main features: (a) the practice of free sharing of knowledge undergirding it, (b) the pervasive involvement of the surrounding community and (c) the use of the Internet as a platform for distributed collaboration.

In the follow-up section, *Open knowledge commons in the primary and secondary economy sectors,* we illustrate the FLOK model and its features through a series of case studies. The first two – the Open Source Ecology project and the case of community-managed, sustainable agriculture in India – focus on the primary sector: they exemplify ways in which the open knowledge commons (in the form of freely shared seeds and open source farm machinery) enable modes of agricultural production that are both environmentally and economically sustainable, especially for small farmers. The next two case studies, which look at the RepRap 3D printer and the Wikispeed car projects, respectively, provide examples of how the secondary sector could be transformed in the direction of a post-fossil fuel economy through the development of distributed manufacturing structures.

The last section, *Preliminary general principles for policy making*, concludes by putting forward some general policy

recommendations.

INTRODUCTION AND FOCUS: BASIC PRINCIPLES

This policy document examines the application of principles of social knowledge economy to the primary (agriculture) and secondary (manufacturing) sectors of the economy. But before we proceed to an in-depth exploration of those principles and their economic application, in the next section we clarify the concept of the knowledge economy and draw a distinction between social knowledge economies and capitalist economies.

The concept and forms of the knowledge economy

In contrast to traditional conceptions of the economy which centre on land, labour and capital as the three factors of production, the concept of the knowledge economy emphasises the role of knowledge as the key driver of economic activity (Bell 1974; Drucker 1969; for a critical analysis of the concept, see Webster 2006). This implies, of course, that the decisive means of production in a knowledge economy is *access to knowledge*. From this standpoint, it is precisely the question of how access to knowledge is being managed that determines the character of an economic system. Capitalist knowledge economies use the institution of intellectual property to create conditions of scarcity in knowledge: so, knowledge is privatised and locked up in property structures which limit its diffusion across the social field. A social knowledge economy, by contrast, is characterised by *open access to knowledge* (Ramirez 2014) and so reconfigures the application of intellectual property rights to prevent the monopolization and private expropriation of knowledge: 'knowledge must not be seen as a means of unlimited individual accumulation, nor a treasury generating differentiation and social exclusion' but as 'a *collective heritage* [which] is...a catalyst of economic and productive transformation' (National Plan for Good Living, p. 61, italics ours) and 'a mechanism for emancipation and creativity' (Ibid, p. 41). In a nutshell, a social knowledge economy is an economy in which knowledge is seen as a public, common and open good; an economy which thrives on the '*open commons of knowledge*' (National Plan for Good Living, spanish version, italics ours, p. 67).

A CRITIQUE OF COGNITIVE CAPITALISM

Intellectual property rights and their supposed role in cognitive capitalism

Capitalist knowledge economies use intellectual property (IP) rights as means of enclosing knowledge and as mechanisms by which to realise the extraction of monopoly rents from knowledge that has been thus privatised. That is ideologically justified as follows: exclusive IP rights provide incentives for individuals and companies to engage in research and develop new products and services. That is, they promote innovation: the expectation of profitable exploitation of the exclusive right supposedly encourages economic agents to turn their activities to innovative projects, which society will later benefit from (e.g. Arrow 1962). But is that actually an accurate description of the function of IP rights in capitalist knowledge economies? Do they *really* spur innovation?

A synopsis of empirical evidence on the effect of exclusive intellectual property regimes on innovation and productivity

To answer this question, it is instructive to look at the available empirical data on the effect of exclusive IP rights on technological innovation and productivity. The case of the United States is indicative of a capitalist knowledge economy in which the flow of patents has quadrupled over the last thirty years: in 1983 the US Patent Office granted 59.715 patents, which increased to 189.597 in 2003 and 244.341 in 2010 (US Patent Office 2013). Looking at these numbers begs the question: how has the dramatic increase in the number of patents issued by the US Patent Office over time impacted technological innovation and productivity in the US? Well, according to the US Bureau of Labor Statistics, the annual growth in total factor productivity in the decade 1970-1979 was about 1,2%, while in the next two decades it fell below 1%. In the same period, R&D expenditure hovered around 2,5% of GDP (***). In short, what we see is that the dramatic increase in patents has *not* been paralleled by an increase in productivity or technological innovation. No matter which indicator of productivity or innovation we use in the analysis, we are invariably led to the conclusion that 'there is no empirical evidence that they [patents] serve to increase innovation and productivity, unless productivity [or innovation] is identified with the number of patents awarded' (Boldrin and Levine 2013, p. 3; also, see Dosi et al. 2006).

Another argument often voiced by proponents of exclusive IP rights in defense of patents is that they promote the communication of ideas and *that*, in turn, spurs innovation. They claim that if patents did not exist, inventors would try to keep their inventions secret so that competitors would not copy them (e.g. Belfanti 2004). From this standpoint, the solution to the problem is a trade between the inventor and society: the inventor reveals his innovation and society gives him the right to exploit it exclusively for the next twenty or so years. Hence, the argument goes, to the extent that they replace socially harmful trade secrets, patents promote the diffusion of ideas and innovations (Moser 2013, pp. 31-33). In *reality*, however, patents have exactly the opposite effect, encouraging ignorance and non-communication of ideas. In what has become a standard practice, 'companies typically instruct their engineers developing products to avoid studying existing patents so as to be spared subsequent claims of willful infringement, which raises the possibility of having to pay triple damages' (Boldrin & Levine 2013, p.9; Brec 2008). Even if that were not always the case, the way in which patent documents are written actually renders them incomprehensible to anyone except lawyers (Brec 2008; Mann & Plummer 1991, pp. 52-53; Moser 2013, p. 39).

The real function of intellectual property rights in cognitive capitalism: how do capitalist firms actually use them?

What, however, more than anything else disproves the claimed positive effect of patents on technological innovation and creativity is the way in which patents are actually used by capitalist firms. In a capitalist knowledge economy, patents are used primarily as:

1. means to signal the value of the company to potential investors,
2. as means to prevent market-entry by other companies (so they have *strategic* value independently of whether they are incorporated in profitable products) and
3. as weapons in an 'arms-race', meaning they are used defensively to prevent or blunt legal attacks from other companies (Boldrin & Levine 2013; Cohen et al. 2000; Hall & Ziedonis 2007; Levin et al. 1987; Pearce 2012).

It would take a heroic leap of logic for any of these applications of patents to be seen as productive. On the other side, there is a plethora of cases in which the effect of patents on innovation and productivity has been undoubtedly detrimental. Indicatively, consider how Microsoft is currently using a patent (*no. 6370566*) related to the scheduling of meetings in order to impose a licensing fee on Android mobile phones (Boldrin & Levine 2013***). In this case, patents become a mechanism for sharing the profits without any participation in the actual process of innovation. As such, they discourage innovation and constitute a pure waste for society. Interestingly, not that long ago, Bill Gates (1991), Microsoft founder, argued that 'if people had understood how patents would be granted when most of today's ideas were invented, and had taken out patents, the industry would be at a complete standstill today...A future startup with no patents of its own will be forced to pay whatever price the giants choose to impose'. It is ironic, of course, that Microsoft, not being able to penetrate the mobile telephony market, is now using the threat of patent litigations to raise a claim over part of Google's profits.

The manner in which patents are used in capitalist knowledge economies makes it blatantly obvious that 'in the long run...patents reduce the incentives for current innovation because current innovators are subject to constant legal action and licensing demands from earlier patent holders' (Boldrin & Levine 2013, p.7). This becomes readily understood, considering that technological innovation is essentially a *cumulative process* (Gilfillan 1935, 1970; Scotchmer 1991): Cumulative technologies are those in which every innovation builds on preceding ones: for example, the steam engine (Boldrin et al. 2008; Nuvolari 2004), but also hybrid cars, personal computers (Levy 1984), the world wide web (Berners-Lee 1999), YouTube and Facebook.

But if patents have at best no impact and at worst a negative impact on technological innovation and productivity (Dosi et al. 2006), then how is it possible to explain – especially from the legislator's side – the historical increase in patents and the expansion of IP-related laws? Many analysts have pondered this question. The conclusion to which they have been led is rather unsettling: the actual reason behind the proliferation of patents and the expansion of IP-related laws consists in the *political influence of large, cash-rich companies* which are unable to keep up with new and creative competitors and which use patents to entrench their monopoly power.

ALTERNATIVES TO CAPITALIST MODELS

The real enablers of innovation

Since, as we have seen, restrictive IP rights do not promote innovation, then *what* does? In our capacity as authors of this policy document, we are siding with a multitude of researchers and practitioners from around the world in whose view what promotes innovation is exactly the opposite of restrictive IP rights (e.g. Bessen & Meurer 2008; Boldrin et al. 2008; Drahos & Braithwaiter 2002; Ghosh 2005; Von Hippel 2005; Moser 2013; Pearce 2012a; Weber 2005). To elucidate this point, we will discuss several case-studies in the following section which demonstrate that innovation thrives on openness and free sharing of knowledge as well as that IP rights can be used in a way that is diametrically opposed to their application in capitalist knowledge economies so as to *include* – rather than exclude – the global community in the innovation process. In other words, the case-studies can be seen as working examples of an *alternative model* of economic and technological development enabled by (inclusive IP regimes founded on) the open knowledge commons. But before we proceed to the case-studies, let us briefly examine the general outlines and organising principles of this model.

The FLOK model

The FLOK model is an alternative to capitalist models of economic and technological development. It has three main features: (a) it is based on the practice of free sharing of knowledge, which is sustained and reinforced by an innovative and, arguably, subversive use of IP rights; (b) it is community-driven and (c) it leverages the Internet for distributed collaboration.

Open knowledge commons

The cornerstone of the FLOK model is the practice of free sharing of knowledge underlying it. Its founding credo is that technology is most efficiently developed in conditions of openness and collaboration, rather than secrecy and knowledge hoarding. To set up such open and collaborative structures for the development of technology, the FLOK model has evolved legal mechanisms (known as open source licenses [Wikipedia 2014c] or simply as open licenses) which ensure that anyone is free to use, modify and redistribute technologies produced through the FLOK model. By democratising access to technology and knowledge through open licensing, the FLOK model effectively empowers the global community to participate in the productive process. There is only one limitation: improvements and modified versions should be made available under the same conditions. Thus, technologies and knowledge released under open licenses form an open, yet *protected*, knowledge commons that anyone can use but none can expropriate. In this way, open licensing serves as a protection against the danger of private expropriation and commercial co-optation (Dafermos & van Eeten 2014; Kloppenburg 2010; Moglen 2004; O'Mahony 2003).

Community-driven development
The FLOK model challenges the dominant view that the institutional environment most conducive to the development of knowledge and innovation is that provided by large, hierarchically-organised corporations. Instead it suggests that open, community models trump corporate ones in accommodating creativity and delivering innovation. In practical terms, this means that anyone can participate in the development process of a FLOK project but none can exercise heavy-handed control over the project or the other participants (Benkler 2006, p. 105; von Krogh & von Hippel 2006). Tasks are self-selected by participants, while decision-making is collective and consensus-oriented. Consequently, the direction of development of FLOK projects derives from the cumulative synthesis of individual contributions from community members, rather than from a central planner (P2P Foundation 2012; Wenden de Joode 2005).

Internet-enabled collaboration
The FLOK model leverages the Internet for massively distributed collaboration. For example, as we shall see below, the development of the RepRap 3D printer is distributed across hundreds of hardware hackers and hobbyists from all over the world, who share improvements and coordinate changes over the Internet. Same goes for the energy-efficient car developed by the Wikispeed project and the industrial farm machines built by the Open Source Ecology network, which we will discuss in the next section to illustrate the FLOK model through its application into farming, building, and manufacturing.

OPEN KNOWLEDGE COMMONS IN THE PRIMARY AND SECONDARY ECONOMY SECTORS

Transforming the primary sector

Case-study 1: Open Source Ecology

Open Source Ecology (OSE)[2] is an open source hardware[3] project

[2]URL: <http://opensourceecology.org>
[3]All design information related to the technologies developed by OSE (e.g. schematics, 2D fabrication drawings, circuit diagrams, 3D CAD files,

focused on manufacturing a set of fifty industrial machines, called the 'Global Village Construction Set' (GVCS), which the OSE considers to be sufficient for creating a small civilisation with modern comforts from locally available resources. The development of the machines is distributed across a global network of parsimoniously linked, self-regulating groups of hardware hackers and hobbyists who share design information through the Internet and build prototypes, which are then tested in a farm in Missouri, USA.

Fig. 1: The 50 OSE-developed industrial farm machines

The history of the project starts with a young PhD named Marcin Jakubowski. Fresh out of his PhD in energy physics, Jakubowski decided to commit himself to an enterprise of a less theoretical nature. That is why he started a sustainable farm in rural Missouri, USA. However, he soon came to realise that the machines which are commercially available to farmers did not suit his needs. Tractors, for example, are not only expensive to buy but also difficult to modify and repair, despite their repetitive break-downs. To Jakubowski, the problem was clear: this kind of machines were not designed to empower farmers but to keep them in a relationship of dependency to the companies manufacturing them. Armed by the determination that farmers need machines that are low-cost and easy to build in a do-it-yourself (DIY) fashion, he took it upon himself to re-design these machines from scratch. So, as a start, he designed a new tractor and posted the design on the Internet. This attracted the attention of the Internet community and of hardware hackers and hobbyists around the world, who soon started to

machine-readable CAM files, instructional videos and user manuals) is licensed under the *OSE License for Distributive Economics*, which adapts the *Creative Commons CC-BY-SA 3.0* license to hardware.

contribute improvements and build prototypes. And thus, the Open Source Ecology (OSE) network was born in 2003. With the help of this network of contributors, Jakubowski identified the fifty machines – from cement mixers to 3D printers and moving vehicles (see Fig. 1 above) – which are supposed to be necessary to build a sustainable modern village community and embarked on a collective effort to manufacture them. To accommodate the enlarged scope of work, the OSE was officially launched as a platform for coordinating the enterprise and Jakubowski's farm was repurposed into a site for building and testing the prototypes developed by project members from all over the world, many of whom would come to the farm on 'dedicated project visits' to help with the work (Thomson & Jakubowski 2012, pp. 53-70).

Fig. 2: title (Source: Thomson & Jakubowski 2012, p. 58)

To date, of the fifty machines that make up the GVCS, eight have already been successfully manufactured, while development of the rest is currently underway.[4] By tapping into the contributions of a global community of hardware hackers and afficionados, the OSE project has achieved significant cost reductions. To its credit, the machines built by OSE have a much lower cost of production than their industrial counterparts, being at least eight times cheaper to manufacture. For example, the OSE tractor costs about $5K to build, whereas tractors made by commercial manufacturing firms

[4]Those eight machines include a bulldozer, rototiller, multi-purpose tractor, backhoe, universal rotor, drill press, multi-purpose 'ironworker' (which incorporates the functionality of a punching machine, a plate shear, a section shear, a punch and shear machine and a coper-notcher), and a CNC torch table.

cost ten times more. The same goes for the OSE compressed earth brick press, the soil pulverizer and the rest of the machines that have been prototyped and tested by the OSE network (see Fig. 3, 4 below) (Open Source Ecology 2014; Thomson & Jakubowski 2012).

MACHINES	OPEN SOURCE ECOLOGY (Materials Cost)	INDUSTRY STANDARD (New Purchase)
Tractor with loader, up to 54 hp, hydraulic drive	$6k	$40k +
Compressed Earth Brick Press, up to 16 bricks per minute, fully automatic, 2"-6"x6"x12" bricks, 700 psi	$4k	$40k +
Soil Pulverizer, 5 ton per hour capacity	$800	$20k +
2 Hydraulic Power Units, self-contained, 27 hp, 14 gpm @3000psi	$4k ($2k each)	$15k +
TOTAL	**$15k**	**$115k +**

Fig. 3 (Source: Jakubowski 2011)

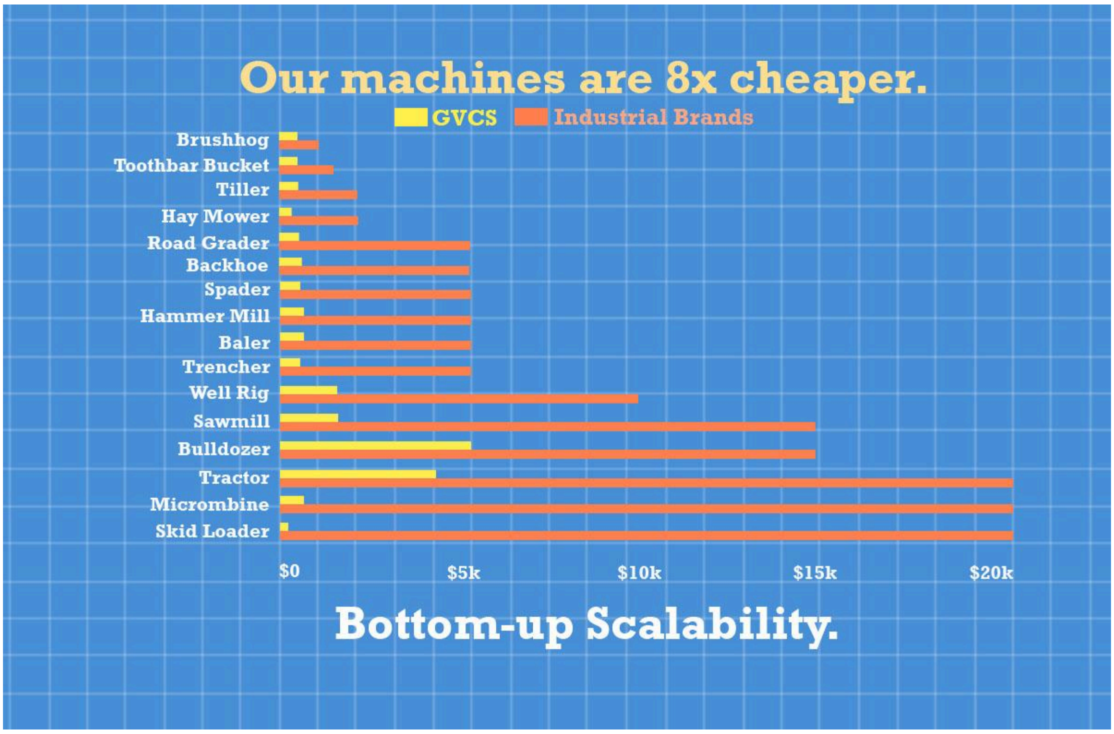


Fig. 4 (Source: Thomson & Jakubowski 2012, p. 54)

Although community contributions raised through crowdfunding campaigns have hitherto been OSE's main source of financial support (Jakubowski 2011), the aforementioned production cost savings allow the OSE project to finance its activities by selling its machines directly to farmers. Indicatively, it estimates to make about $80K a month by selling its tractors at a price of $10K (Jakubowski 2013).

However, the sustainability of the OSE enterprise extends well beyond its business model: OSE furnishes a working example of how farming – and the manufacturing of industrial machines, more broadly – can be carried out in a way that is not only productive but also *environmentally sustainable*. For example, the electricity that Jakubowski's farm consumes, which now includes a 4000 square foot fabrication facility and a 3000 square feet living unit, comes from renewable energy resources, using methods like closed-loop manufacturing (which recycle waste materials into livestock for other production processes; for a detailed discussion, see Kelly 1994, ch. 10) and technologies that the OSE project itself has built such as photovoltaic panels and wind turbines (Open Source Ecology 2013). Equally important, OSE-manufactured machines are designed with the principle of durability in mind and in such a way as to be easily repairable and modifiable by end-users. In that regard, OSE machines are paradigmatic of what is called *sustainable design*: they are designed to last for a lifetime, rather than throw away and replace by newer machines, 'they use less energy, fewer limited resources, do not deplete natural resources, do not directly or indirectly pollute the environment, and can be reused or recycled at the end of their useful life' (Wikipedia 2014a).

To sum up, the example of OSE demonstrates how a project can leverage the open knowledge commons (in the case of OSE, that being everything from machine designs to user manuals) and the Internet for distributed development by a global community of volunteer contributors. Furthermore, OSE furnishes a concrete example of how *open source appropriate* technology (Pearce 2012b) can be used to enhance the autonomy of farmers and transform agricultural production in the direction of economic and environmental sustainability alike.

Case-study 2: Community-managed, sustainable agriculture in India

An interesting example of how the FLOK model can be applied to the primary sector is the *community-managed, sustainable agriculture model* that is practiced by millions of farmers in Andhra Pradesh, one of India's largest states with more than 70% of the population engaged in agriculture. To comprehend the rising popularity of this model in India, we have to look at the historical circumstances which gave birth to it. Throughout the 2000s a wave of suicides shook the country: more and more smallholder farmers were taking their lives because they had no money to repay their debts, which were largely attributable to the cost of chemical pesticides, fertilisers and genetically modified (GM) seeds. The crisis, which took on epidemic proportions in 2004-2005, rendered imperative the trying out of alternatives. NGOs and agricultural activists like *SECURE (Socio-Economic and Cultural Upliftment in Rural Environment)*[5] and the Hyberabad-based *Centre for Sustainable Agriculture (CSA)*[6] sprung up to promote modes of sustainable farming that do not use industrial pesticides and GM seeds. With their help and guidance, some farmers started to experiment with non-pesticidal management in their cotton fields.[7] The results were remarkable: their yield remained in the same levels, but the quality of the crop was higher now and so could be sold at a higher price in the market. At the same time, they saved money that they would have spent on procuring industrial pesticides, fertilizers and seeds (see Fig. 5, 6 below)(Centre for Sustainable Agriculture 2006; Raidu & Ramanjaneyulu 2008).

Table 3 Non-pesticidal and conventional management in cotton, 2001–2 (8 farmers in Punukula)

	Average yield (t/ha)	Cost of plant protection (Rs/ha)	Net income (Rs/ha)
Non-pesticidal management	1.56	4301	3420
Conventional management	1.47	8596	–5201

Fig. 5 (Source: Centre for Sustainable Agriculture 2006, p. 44)

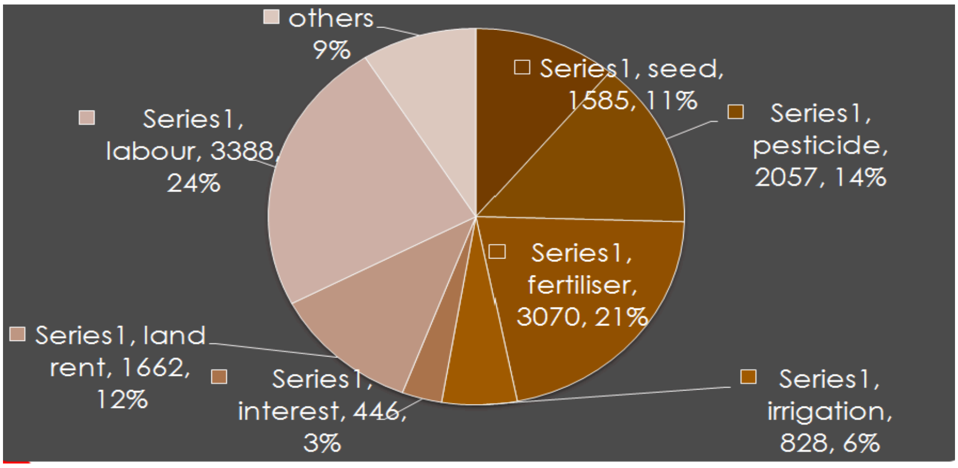


Fig. 6: Agriculture cost of production for small farmers in AP (Source: Centre for Sustainable Agriculture 2013)

[5]URL: <http://www.securengo.org>
[6]URL: <http://csa-india.org>
[7]For example, by replacing chemical pesticides with biological ones such as neem seed-kernel extracts and chilli-garlic extracts.

So, convinced about the merits of no-pesticide farming, they spread the word to nearby villages. Soon (2004-5), an entire village in Andhra Pradesh called *Punukula* declared itself to be pesticide-free, stating that pesticide dealers are undesirable. By switching to sustainable farming, farmers in this village community had managed not only to pay off their debts but also to increase their profits, while restoring ecological balance in their fields. As a result, Punukula became the symbol of a nascent sustainable agriculture movement: its success influenced increasingly more neighbouring villages to switch to non-pesticidal management and ecological farming, reaching 92 villages with more than 5000 farmers by 2004. But Punukula's success attracted also the attention of the state government, which committed itself to supporting the scaling-up of no-pesticide farming across 5000 villages from 2005-6 onwards. To this end, a collaborative initiative was set up to provide an institutional platform for concerted action by public institutions (like the state-run Society for Elimination of Rural Poverty), cadres of farmers, village representatives, NGOs and community-based organisations like the Centre for Sustainable Agriculture. In the context of this initiative, over 450 farmer field schools were set up in villages to provide training in sustainable agriculture to more than 20000 farmers. In parallel, community seed banks and seed sharing networks were established so farmers could produce and share their own seeds, while farmer-consumer cooperatives were set up to coordinate the production and distribution of agricultural products (Centre for Sustainable Agriculture 2006; Raidu & Ramanjaneyulu 2008). The results of this intervention programme have been extremely positive: in villages that adopted organic farming, there are no more suicides or cases of pesticide-induced disease, while agricultural incomes have improved in tandem with the health and livelihood of farmers (see Fig. 7, 8 below)(Centre for Sustainable Agriculture 2013; Ratnakar and Mani 2010).

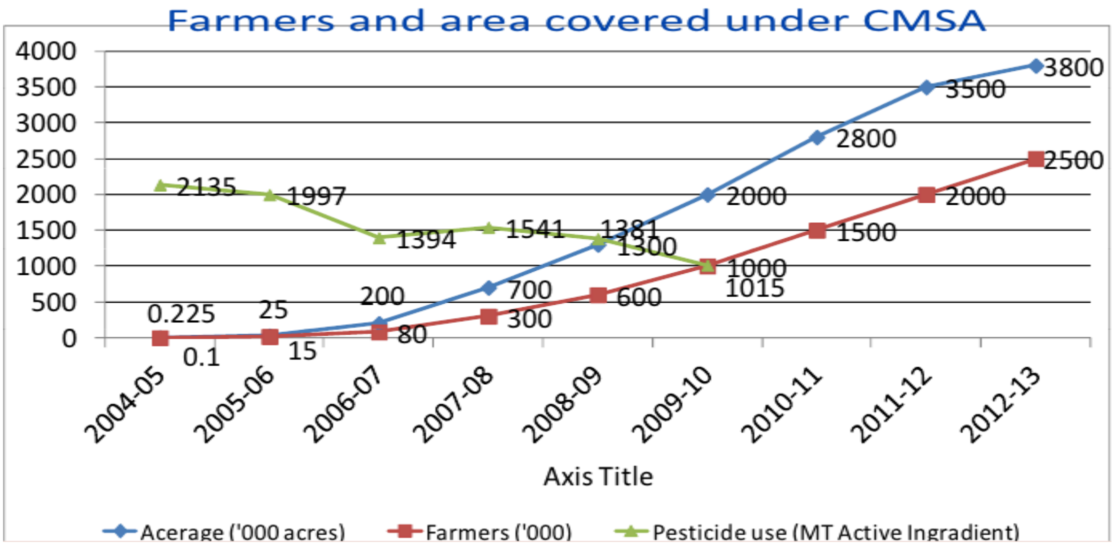


Fig. 7: (Source: Centre for Sustainable Agriculture 2013)

Crop	Cost of cultivation (Rs/Ac.)		Yield (Q/Ac.)		Gross Returns (Rs.)		Net returns (Rs.)	
	Organic	Non-Organic	Organic	Non-Organic	Organic	Non-Organic	Organic	Non-Organic
Paddy	11950	14340	32	32.2	29340	29630	17390	15370
Maize	7922	8314	21.8	19.6	19620	17640	11698	9326
G.Nut	9270	10340	9.8	9.8	24500	24500	15230	14160
Chickpea	4800	5650	5.5	6.5	11270	12300	6475	6650
Chilli	48918	72237	24.5	26.5	147000	117000	98082	47013
Onion	13200	15400	71.6	67.6	28800	26000	15600	10600
Cotton	10980	10380	4.5	4	13500	11600	2520	1220

Fig. 8: (Source: Centre for Sustainable Agriculture 2013)

Although the community-managed, sustainable agriculture model might best be understood as a unified system for the production and distribution of agricultural products, there are two aspects of the model on which we would like to lay more emphasis: (1) the development of open source seed sharing networks and community seed banks and (2) the setting up of producer-consumer cooperatives with their own meeting grounds.

Open source seed networks and community seed banks. For many centuries, seeds were considered 'the common heritage of (hu)mankind' and so were freely shared among farmers. The introduction of various IP limitations throughout the 20th century, however, by turning seeds into an object of intellectual property, had the effect of severely destabilising this tradition of producing seeds and sharing them, while forcing farmers into a relationship of dependency upon the companies now manufacturing and selling them (Aoki 2009; Brush 2004; Centre for Sustainable Agriculture 2012; Kloppenburg 2010). As a solution to this problem, the sustainable farming community in Andhra Pradesh set up community seed banks in several villages and established open source seed sharing networks[8] which made it once again possible for farmers to produce their seeds and share them (Centre for Sustainable Agriculture 2006; Raidu & Ramanjaneyulu 2008). Thus, these community seed banks and open source seed sharing networks served to create a *knowledge commons* for the conservation and revival of existing varieties as well as for practices of participatory plant breeding aimed at evolving new varieties.

Producer-consumer cooperatives. A common problem for small farmers around the world is the lack of direct access to markets and distribution channels for their products, which keeps them dependent on intermediaries. The way farmers in Andhra Pradesh addressed this problem was by setting up *Sahaja Aharam*,[9]a farmers-consumers cooperative federation which is active through direct retailing in ten cities (*mandals*).[10] The meeting grounds of the co-ops allowed them to sell their products directly to consumers and develop a relationship of collaboration with them based on mutual trust. Thus, they were able to use this form of organising the production and distribution of agricultural products through farmer-consumer cooperatives – which is known in many parts of the world as *community-supported agriculture* (Wikipedia 2014b; Zizania 2013) – as the stepping stone towards a mode of agriculture that is not only sustainable but also open and participatory, broadening the participation of consumers in the process of agricultural exploitation through locally-organised, bottom-up community structures based on trust and knowledge sharing.

To recap, the case of the Indian state of Andhra Pradesh illustrates a model of transformation of the agricultural sector from a system of monoculture, chemical pesticides and GM seeds towards one based on intercropping, natural pesticides and freely shared seeds, which

---

[8]Open source seeds are distributed under open source licenses like the GNU GPL. The rationale is that 'there will be no restriction on using [seeds licensed under an open source license] to develop new varieties or experiment with but it is essential that the variety derived from this should also be available without any monopolistic claims and restrictions on further development' (Centre for Sustainable Agriculture 2012).

[9]URL: <http://www.sahajaaharam.in>

[10]URL: <http://www.csa-india.org/institutions>

has come to be known in India as community-managed, sustainable agriculture. But more than that, it demonstrates that organic farming is not only environmentally sound but also viable as a business model for small farmers on a much larger scale than is currently practiced in most parts of the world. In fact, the adoption of such a model of organic farming has a particularly beneficial and empowering effect on small farmers, as it eliminates their dependency on the 'all-in-one dealer' and limits the extent of 'debt trap' problems such as those that in the past plagued Andhra Pradesh's small farmers.

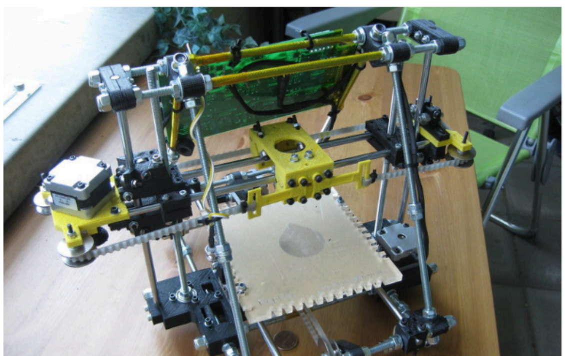
Transforming the secondary sector: open design commons for distributed manufacturing

If people can make anything for themselves what's the point in going to the shops?
A. BOWYER (quoted in Randerson 2006)

Case-study 1: RepRap

RepRap[11] is an open source[12] printer which can be used to manufacture three-dimensional objects. The project which spearheaded its development was launched in 2005 by Dr. Adrian Bowyer at Bath University in the UK, with the aim of developing an open source 3D printer that can replicate itself by re-producing its own componets, ultimately creating a small-sized, affordable, 'homebrewed' manufacturing device that can be used to produce most of the objects people use in daily life.

Open licensing and distributed development
From the very start, the project leveraged the Internet for distributed collaboration: it open-sourced the design and all technical specifications of the RepRap technology so that others could experiment with it and improve it. A loosely-coupled network of hobbyists and enthusiasts sharing ideas and modifications soon formed, resulting in rapid and significant improvements. The first version of RepRap, codenamed 'Darwin', was released in May 2007; version 2 (called 'Mendel') followed in 2009 and version 3 ('Huxley') a year later (see Fig. 9 below). By 2010, the project had evolved in a global community of about 5000 members and community size is doubling every six months (de Bruijn 2010).



[11]URL: <htt
[12]The RepRa

Fig. 9: Rep Rap v. 3 ('Huxley'), May 2007
Source: <http://reprap.org/wiki/Huxley>

Effect of IP rights on development of 3D printing

What accounts for such a remarkable community growth? First of all, to put the development of RepRap into perspective, one must look at the effect of IP rights on the historical development of 3D printing technology. 3D printing has been used in the manufacturing industry for about forty years but the fact that it was a patented technology effectively excluded the global community from participating in its development. Then in the mid-2000s the expiration of a set of relevant patents galvanised the emergence of the open source 3D printing movement, which coalesced around the RepRap project. As a result of this influx of contributors, the project soon managed to improve RepRap's design and performance and slash the production cost of 3D printers down to about $500 (Banwatt 2013a, 2013b, 2013c). In parallel, several start-ups as well as major companies began to make low-cost 3D printers based on the RepRap design for the consumer market.

Fig. 10: Stratasys is a 3D printing company co-founded by Scott Crump, who was granted in 1992 a key patent for 3D printing. The patent expired in 2009. MakerBot Industries was founded in the same year (Source: von Hippel 2011, p.59)

Implications

The involvement of the open source 3D printing community in the development of RepRap is not confined to experimentation with its design parameters but also extends into the range of objects that RepRap printers can manufacture. To date, RepRap 3D printers have been used to make clothes (Materialise 2013), wind turbines (Kostakis et al. 2013), prosthetic body parts (Molitch-Hou 2013), wearable technologies (e.g. wearable mobile phones [Cera 2012]) and even guns (Greenberg 2013). In fact, the spectrum of objects that 3D printers could manufacture is potentially infinite: for example, a group of architects called 'KamerMaker' is currently using a 3D printer to build a canal house in Amsterdam, the Netherlands (KamerMaker; Holloway 2013), while the European Space Agency is planning to build lunar space stations using 3D-printed bricks made from moon dust (Carter 2013; European Space Agency 2013a, 2013b). As US President, Barack Obama, says, '3D printing has the potential to revolutionize the way we make almost everything' (quoted in Gross 2013).

The implications of such a paradigm shift in manufacturing for environmental sustainability are enormous. 'Because they only use the exact material required, 3D printers could eliminate waste from traditional manufacturing – in which up to 90% of raw material is discarded' (Webster 2013). In addition to realising economies in the use of raw materials, the type of distributed manufacturing undergirded by RepRap-like 3D printing implies a massive reduction in global transportation costs attendant upon the localisation of production (Rifkin 2011).[13] Clearly, large-scale industrial infrastructures and the mass production model itself are no longer needed if people are able to micro-manufacture whatever they need in the comfort of their homes. And that is good for the environment: unlike large-scale industrial manufacturing, which is based on the cheap availability of fossil fuels, 'home 3D printing' is illustrative of an on-demand manufacturing model which emphasises application that is small-scale, decentralised, energy-efficient and locally controlled. Thus, the diffusion of small-sized, affordable 3D printers promotes a model of environmentally sustainable technological and economic development.

To sum up, the RepRap 3D printer is paradigmatic of a case in which the open design commons enabled a global community to engage in distributed, participative development which, in turn, resulted in significant technical improvements and production cost reductions, paving the way for the rise of a new market in low-cost 3D printers. In parallel, the RepRap project illustrates the workings of a distributed manufacturing model that is germane to a post-fossil fuel economy.

Case-study 2: Wikispeed

Wikispeed is a project focused on the development of an energy-efficient car (see Fig. 11 below).[14] What is especially interesting about the Wikispeed car is that it is developed by a global network of volunteers, who, by using methods drawn from the realm of open source software development, have managed to reduce development time and cost down to a fraction of that which conventional car manufacturing requires.

[13]As Jerem … tep of the manufa… ess energy expende… l economy, adds u… d anything imagina…

[14]URL: <htt…

Fig. 11: The Wikispeed car
(Source: Wikispeed Project 2013)

The birth of Wikispeed can be traced back to the 2008 Progressive Insurance Automotive X-Prize competition for the development of energy-efficient cars, which captured the attention of Joe Justice, a Seattle-based software consultant. What set Justice apart from the other participants in the competition was his strategy and his resolve to apply open source software development methods to car manufacturing. In the beginning, he was alone. But as he announced his plan on the Internet, volunteers came to help and in three months he had a team of forty-four volunteers and a functioning prototype (Denning 2012; Halverson 2011). Now the project is jointly developed by more than 150 volunteers distributed around the world, who aim to deliver Wikispeed as a complete car for $17,995 USD and as a kit for $10,000 USD (Wikispeed 2012).

To speed up the development process and reduce its cost, the Wikispeed team, inspired by the *lean manufacturing* and *open source* philosophy, evolved an approach that constrasts sharply with conventional manufacturing. First, the entire manufacturing process is designed with a view to minimising the expenditure of resources that do not add any value to the end-product from an end-user's point of view. For example, while an average manufacturer uses 'a $100M CNC milling machine...WikiSpeed uses a $2.000 machine found in the average FabLab...While modern cars embed various costly, non-interoperable, proprietary computers to manage various features ranging from airbags, to gas levels, to air conditioning, WikiSpeed uses a single $20 Arduino circuit board' (Tincq 2012).

Second, *modularity* (for a literature review, see Dafermos 2012, ch. 2) is the core design principle: Wikispeed is made up of eight components that can easily be removed and re-assembled (see Fig. 12 below). Such a product architecture makes it easy to modify and customise the car, for individual components can be modified without necessitating changes in the rest of the car. As a result, 'the whole car can transform from a race car, to a commuter car, to a pickup truck, by changing only the necessary parts' (Tincq 2012).

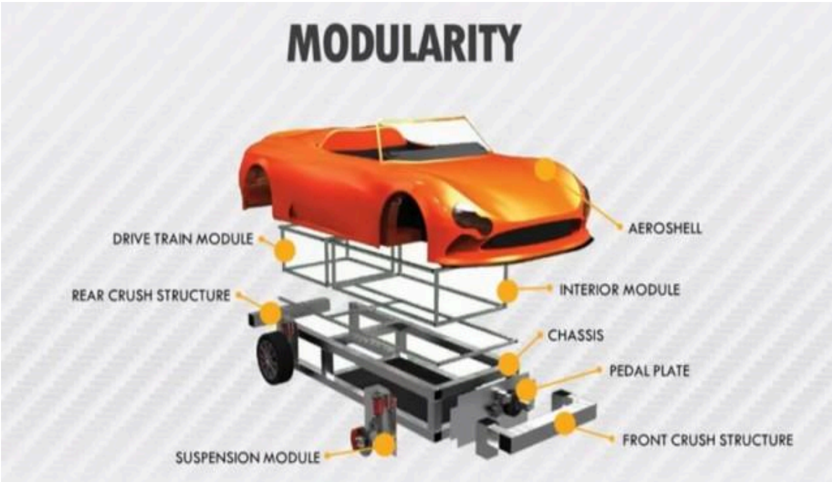


Fig. 12: Wikispeed modular design (Source: Tincq 2012)

Third, *scale* is not important to Wikispeed: 'cars are produced on-demand, when a client offers to pay for it. This implies almost no capital investment upfront to produce a Wikispeed car' (Tincq 2012). Through the use of on-demand manufacturing and lean production methods, Wikispeed has achieved significant development cost reductions. But the production of Wikispeed is not only 'lean' and 'on-demand', it is also *distributed*: Wikispeed is being developed by a distributed network of largely self-managing teams – each working at its own garage – who coordinate their work through the Internet. This kind of computer-mediated collaboration is enabled by the modular structure of the Wikispeed car, as product components can be developed autonomously and independently of each other by different individuals or teams with little, if any, need of central coordination. The resulting distributed organisational structure, according to the Wikispeed team, is key to realising remarkable *economies of scope* and *flexibility*: and so, to reinforce distributed manufacturing, 'WikiSpeed members are currently practicing to build cars within a rectangular space marked on the ground. By achieving this, micro factories could be encapsulated within containers, and shipped to where there is demand for local production. Once the work is done, a micro factory could be moved to a surrounding area to meet new demand' (Tincq 2012). The sustainability implications of such a paradigm shift in manufacturing are obvious: just like RepRap-like 3D printing, Wikispeed is proposing a model of distributed manufacturing which leverages the global open design commons for local production. Unlike large-scale industrial manufacturing, which depends on the cheap availability of fossil fuels, Wikispeed's on-demand manufacturing model emphasises application that is small-scale, decentralised, energy-efficient and locally controlled. In that sense, it promotes a model of sustainable development that recognises the limits to growth posed by finite resources and so organises material activities accordingly (Bauwens 2012b).

Fourth, the development of the Wikispeed car is built around the defining hallmark of open source software production: all *technical specifications are shared freely* with the community so that anyone can contribute to its development. In this way, by opening up the product development process, the Wikispeed project can tap into the contributions of a global community of volunteers. But for the Wikispeed team, freely sharing design information is not only a means of engaging the global community in the collective development of the Wikispeed car, but also the basis of a model of *distributed entrepreneurship* which allows hobbyists and enthusiasts from all over the world to download the blueprints of Wikispeed and use them as a springboard for developing their own cars at their garage. Wikispeed considers itself to be such a *distributive enterprise*: 'a transparent enterprise that promotes—at the core of its operational strategy—the capacity for others to replicate the enterprise without restrictions...[a kind of] an open franchise system that focuses on being replicated by others' (Open Source Ecology 2012; Thomson & Jakubowski 2012: 62).

To date, the Wikispeed project has financed its operation mainly through crowdfunding campaigns and small donations from sympathisers (the so-called 'micro-investors'). For its long-term sustainability, however, it aims to sell the cars it makes. The price for a Wikispeed prototype is 25,000 USD and the project is currently working on the development of a commuter car which will be launched as a complete car for $17,995 USD and as a kit for $10,000 USD. In recognition of its community character, the Wikispeed project has announced that the proceeds from sales will be redistributed back to the community of contributors.[15]

To sum up, the case of Wikispeed, just like that of the OSE and RepRap, demonstrates how a technology project can leverage the open design commons and the Internet to engage the global community in its development. Most important, Wikispeed proposes a model of distributed manufacturing that is well-suited to a post-fossil fuel economy: a model which is small-scale ('on-demand'), decentralised, energy-efficient and locally controlled.

[15]Wikispeed has devised an interesting method of remunerating community contributions to the project. According to the project website: 'If I give money, time, cookies, or supplies to WIKISPEED and WIKISPEED is profitable, WIKISPEED will pay me back the value of what I put in plus interest commensurate with their level of success' (<http://wikispeed.org/join-the-team/our-ethics/>).

Case-Study 3: The case of generic AIDS drugs in Brazil

--- Section to be added, largely based on Amy Nunn's (2009) Politics and History of AIDS treatment in Brazil

Case-study 4: Distributed energy project

--- Section to be added. small community scale: Kythnos micro-grid, city scale: Utrecht

Preliminary general principles for policy making

Through the above case-studies, we have come to identify a set of enabling conditions, from which we can draw several general principles to guide policy making efforts aimed at reinforcing the development of a social knowledge economy.

We have seen how patents in specific and restrictive IP rights in general run counter to the aims and needs of a social knowledge economy. In contradistinction, as our case-studies demonstrate, the kind of inclusive, yet protected, commons regimes established by open source licenses are indispensable to the development and operation of a social knowledge economy. Against the background of this analysis, we propose:

1. The abolition of the patent system. More specifically, following the proposal by Boldrin and Levine (2013, pp. 18-19), the transition can be implemented gradually by phasing in ever shorter patent durations and placing limits on patentability.
2. The implementation of a legal framework based on the GNU GPL for the licensing of (a) all kinds of technology artefacts, (b) knowledge and (c) natural and biological resources (e.g. germplasm and seeds) as protection against the danger of private enclosure and commercial co-optation. Nota bene, the application of this general principle to the field of plant varieties and farm machinery has been developed into full-fledged policy proposals by Michaels (1999) and Srinivas (2002) and more recently by the Centre for Sustainable

Agriculture (2012) and Kloppenburg (2010).

3. The release of publicly funded research and innovation under the GNU GPL. For an extensive discussion of this proposal, which is heavily supported by the academic and research community (e.g. see Drahos & Braithwaite 2002), see Boldrin and Levine's (2013, p.19) as well as Pearson's (2012a) recent contribution in the *Journal of Economic Perspectives* and *Nature* respectively.
4. The provision of special economic incentives for productive enterprises which are (a) commons-oriented and (b) environmentally-sustainable. This can be implemented in a variety of ways: for example, through (state-supported) micro-credit systems,[16] tax benefits or subsidies.
5. The creation of a community-managed Commons Fund along the lines proposed by Kleiner (2010, pp. 23-25) for commons-oriented projects.
6. The creation of a Community Investment Fund for farmers engaged in community-managed, sustainable agriculture, such as that proposed by Raidu & Ramanjaneyulu (2008, p.183) for the support of organic farmers in India.
7. The development of a legal framework that provides co-ops and collectivist organisations operating in the social and solidarity economy with the organisational autonomy as well as institutional support which is required for their operation. For an elaborate discussion of what that task entails and how it can be achieved, see the FLOK policy document authored by Restakis (***).
8. The development of policies which support the setting up of so-called hackerspaces, hackerlabs, medialabs and co-working spaces as a territorial infrastructure for distributed cognitive work. To this end, a fully-developed proposal can be found in the FLOK policy document by Figueiredo (***).
9. (The adoption of the policy proposal by the Centre for Sustainable Agriculture [2012], Raidu and Ramanjaneyulu [2008] and Ratnakar and Mani [2010], among others) for the development of community seed banks and open source seed sharing networks as a shareable infrastructure for agricultural production.
10. The democratization of access to medicine through the issue of compulsory licensing for foreign-owned patents, as has been successfully practiced in Brazil (Nunn 2009; Nunn et al. 2009).

[16]Indicatively, the State Bank of India developed in 2006 a micro-credit system to help farmers switch to no-pesticide farming (Raidu & Ramanjaneyulu 2008; also, see Centre for Sustainable Agriculture (2013; 2006) and Ratnakar & Mani 2010).

11. The promotion and implementation of distributed energy infrastructures (such as those exemplified by micro-grids and energy-autonomous buildings) as key enablers for the development of a post-fossil fuel economy based on distributed manufacturing structures (Rifkin 2011).

THE ECUADORIAN POLITICAL FRAMEWORK

The *National Plan for Good Living (2013-2017)* proposes a set of policies that support the transformation of the productive structure of Ecuador in the direction of a social knowledge economy characterised by a distributed capacity for participation and a commitment toward open access to knowledge, environmental sustainability, social self-organisation and experimentation with diverse forms of economic organisation.

In recognition of the importance of *distributed (ownership of) means of production* in undergirding a social knowledge economy with a strong focus on broadening participation in productive activities, Policy 2.4 of the National Plan focuses on the need 'to democratize the means of production [so as to] generate equitable conditions and opportunities [for participation in the economy]'. Of course, the decisive means of production in a knowledge economy is *access to knowledge*. In capitalist knowledge economies, the institution of intellectual property is being used to create conditions of scarcity in knowledge: so, knowledge is privatised and enclosed by exclusive intellectual property structures which limit its diffusion across the social field. A social knowledge economy, by contrast, is characterised by *open access to knowledge* and so reconfigures the application of intellectual property rights to prevent the monopolization and private expropriation of knowledge: 'knowledge must not be seen as a means of unlimited individual accumulation, nor a treasury generating differentiation and social exclusion' but as 'a *collective heritage* [which] is...a catalyst of economic and productive transformation' (National Plan, p. 61, italics ours) and 'a mechanism for emancipation and creativity' (Ibid, p. 41). Considering, therefore, that the management of knowledge is more efficient when knowledge is seen as a public, common and open good, the National Plan proposes the development of an '*open commons of knowledge*' (National Plan, spanish version, italics ours, p. 67).

Equally important, the transformation of the productive matrix should encourage social self-organisation (*Policy 1.12*)(Ibid, p. 53) and economic experiments with respect both to form and size of organisation. Characteristically, to support pluralism and diversity in the economy, the National Plan proposes:

1. To strengthen the popular and solidary economy (EPS) and micro-, small-, and medium enterprises (MSMEs) within the productive structure (*Policy 10.5*).

Another recurrent theme is *sustainability*. Crucially, its importance implies that 'the economic system does not automatically come first; on the contrary, it is subordinated and serves the lives of human beings and Nature' (Senplades [2009: 329] quoted in National Plan, p. 73). The energy sector is a focal point: 'Energy is the lifeblood of the production system, so it is essential to increase the share of energy obtained from renewable sources...in order to achieve long-term sustainability' (National Plan, pp. 43-44). As energy is the lifeblood of the production system, transforming the latter implies a corresponding transformation of the former in the direction of distributed, renewable energy. The National Plan therefore proposes 'to restructure the energy matrix under criteria of transforming the productive structure, inclusion, quality, energy sovereignty and sustainability, increasing the share of renewable energy' (*Policy 11.1*). Such a restructuring of the energy sector, as the National Plan underlines, must demonstrate a strong commitment to sustainability by promoting:

- 'efficiency and greater involvement of sustainable renewable energies, as a measure to prevent environmental pollution' (*Policy 7.7*);
- measures 'to prevent, control and minitage environmental pollution in extraction, production, consumption and post-consumption' (*Policy 7.8*);
- 'conscious, sustainable, efficient consumption patterns with a criterion of sufficiency within the planet's limits' (*Policy 7.9*).

In the same vein, the National Plan emphasises the importance of sustainable-alternative technologies like agroecology (Ibid, p. 39) in the context of the transition towards 'eco-cities' (Ibid, p. 43), that is, energy-autonomous urban and rural communities.

Taking the policies of the National Plan as its starting point, this research will focus on models of transformation of the Ecuadorian productive matrix which thrive on the open knowledge commons and sustainable, appropriate technologies. To this end, it will consult both local and global experts to identify successful implementations, models and practices in fields as diverse as distributed manufacturing and open, sustainable agriculture, which will enable

Ecuador to evolve into a social knowledge economy.

ECUADORIAN POLICY RECOMMENDATIONS WITH INSTITUTIONAL PARTICIPATION

[*Section to be added*]

References

Aoki, K. (2009) “Free Seeds, Not Free Beer”: Participatory Plant Breeding, OpenSource Seeds, and Acknowledging User Innovation in Agriculture'. *Fordham Law Review* 77 (5): 2275-2310

Arrow K. (1962) 'Economic Welfare and the Allocation of Resources for Invention'. In Arrow, K. (Ed.) *The Rate and Direction of Inventive Activity: Economic and Social Factors* (pp. 609- 625). Princeton University Press

Banwatt, P. (2013a) 3D Printing Patents Expire–RepRap Moves In. Retrieved from http://lawitm.com/3d-printing-patents-expire-reprap-moves-in/

Banwatt, P. (2013b) Part One: Patents and 3D Printing. Retrieved from http://lawitm.com/post-one-part-one-patents-and-3d-printing/

Banwatt, P. (2013c) Part Two: Making Printers! And then Getting Sued! (3D Systems v. Formlabs). Retrieved from http://lawitm.com/pauls-post-one-part-two-making-printers-and-then-getting-sued-3d-systems-v-formlabs/

Bauwens, M. (2012a) 'The 'welfare state' is dead - long live the 'partner state'?' *Aljazeera* (Mar 15). Retrieved from http://www.aljazeera.com/indepth/opinion/2012/03/20123111423139193.html

Bauwens, M. (2012b) 'Scope, not scale: What do medieval monks, Cuban socialists and Wikipedia have in common?' *Aljazeera* (Mar 22). Retrieved from http://www.aljazeera.com/indepth/opinion/2012/03/2012319125340857774.html

Belfanti, Carlo (2004) 'Guilds, Patents, and the Circulation of Technical Knowledge: Northern Italy during the Early Modern Age'. *Technology and Culture* 45(3): 569-589

Bell, D. (1974) *The Coming of Post-Industrial Society*. London: Heinemann

Benkler, Y. (2006) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press

Berners-Lee, T. (1999) *Weaving the Web*. Texere

Bessen, J. & Meurer, M.J. (2008) *Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk*. Princeton University Press

Boldrin, M. & Levine, D.K. (2013) 'The Case Against Patents'. *Journal of Economic Perspectives* 27(1): 3-22

Boldrin, M., Levine, D.K. & Nuvolari, A. (2008) 'Do Patents Encourage or Hinder Innovation? The Case of the Steam Engine'. *The Freeman* Oct., pp. 14-17

Brec, E. (2008) 'NIHilism and Other Innovation Poison'. *MSDN Blogs*, Nov 1. Retrieved from http://blogs.msdn.com/b/eric_brechner/archive/2008/11/01/nihilism-and-oth

er-innovation-poison.aspx
de Bruijn, Eric (2010) *On the viability of the Open Source Development model for the design of physical objects: Lessons learned from the RepRap project*. MSc dissertation, Tilburg University
Brush, S.P. (2004) *Farmers' Bounty: Locating Crop Diversity in the Contemporary World*. Yale University Press
Carter, J. (2013) 'The key applications for 3-D printers will be in engineering, not the home'. *South China Morning Post* (Dec 12). Retrieved from http://www.scmp.com/lifestyle/technology/article/1379071/key-applications-3-d-printers-will-be-engineering-not-home
Centre for Sustainable Agriculture (2013) *Learning from Experiences of Non Pesticidal Management in Andhra Pradesh*. Retrieved from http://www.cseindia.org/userfiles/Ramanjaneyulu%20%20Out%20of%20Trap.pdf
Centre for Sustainable Agriculture (2012) *Open Source Seed Systems*. Retrieved from http://www.csa-india.org/sites/csa-india.org/files/Open_Source_Seed_Systems_1.0.pdf
Centre for Sustainable Agriculture (2006) 'Redefining pest management in Punukula'. In GTZ Sustainet (Ed.) *Sustainable Agriculture: A pathway out of poverty for India's rural poor* (pp. 40-49). Eschborn, Germany: Deutsche Gesellschaft fur Technische Zusammenarbeit. Retrieved from http://www.sustainet.org/download/sustainet_publication_india_part1.pdf
Cera, B. (2012) Making 'Glove One'–a 3D-printed, wearable cell phone. Retrieved from http://www.instructables.com/id/Making-Glove-One-a-3D-printed-wearable-cell-p/
Cohen, W.M., Nelson, R.R. & Walsh, J.P. (2000) 'Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)'. *US National Bureau of Economic Research Working Paper 7552*. Retrieved from http://www.nber.org/papers/w7552
Dafermos, G. (2012) *Governance Structures of Free/Open Source Software Development*. Delft, the Netherlands: Next Generation Infrastructures Foundation. Retrieved from http://www.nextgenerationinfrastructures.eu/index.php?pageID=17&itemID=605217
Denning, S. (2012) 'Wikispeed: How A 100 mpg Car Was Developed In 3 Months'. *Forbes* (Oct 5). Retrieved from http://www.forbes.com/sites/stevedenning/2012/05/10/wikispeed-how-a-100-mpg-car-was-developed-in-3-months/
Dosi, G., Marengo, L. & Pasquali, C. (2006) 'How much should society fuel the greed of innovators?: On the relations between appropriability, opportunities and rates of Innovation'. *Research Policy* 35(8): 1110-1121
Drahos, P. & Braithwaite, J. (2002) *Information Feudalism: Who Owns the Knowledge Economy?* Earthscan
Drucker, P. (1969). *The Age of Discontinuity*. New York: Harper and Row
European Space Agency (2013a) Building a lunar base with 3D printing (Jan 31). Retrieved from http://www.esa.int/Our_Activities/Technology/Building_a_lunar_base_with_3D_printing
European Space Agency (2013b) 3D printing for space: the additive revolution (Oct 16). Retrieved from http://www.esa.int/Our_Activities/Human_Spaceflight/Research/3D_printing_for_space_the_additive_revolution
Gates, B. (1991) 'Challenges and Strategy'. Memo, Microsoft Corporation, May

16. Retrieved from http://www.std.com/obi/Bill.Gates/Challenges.and.Strategy
Ghosh, R.A. (Ed.) (2005) *Code: Collaborative Ownership and the Digital Economy*. MIT Press
Gilfillan, S.C. (1935) *Inventing the ship*. Follett publishing
Gilfillan, S.C. (1970) *Sociology of Invention*. MIT Press
Greenberg, A. (2013) 'Meet The 'Liberator': Test-Firing The World's First Fully 3D-Printed Gun'. *Forbes* (May 5). Retrieved from http://www.forbes.com/sites/andygreenberg/2013/05/05/meet-the-liberator-test-firing-the-worlds-first-fully-3d-printed-gun/
Gross, D. (2013) 'Obama's speech highlights rise of 3-D printing'. *CNN* (Feb 13). Retrieved from http://www.cnn.com/2013/02/13/tech/innovation/obama-3d-printing/
Hall,B.H. & Ziedonis, R.H. (2007) 'An Empirical Analysis of Patent Litigation in the Semiconductor Industry'. *University of California at Berkeley Working Paper.* Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.69.5271
Halverson, M. (2011) 'Wikispeed's 100 Mile Per Gallon Car'. *Seattle Met* (Dec 23). Retrieved from http://www.seattlemet.com/issues/archives/articles/wikispeeds-100-mpg-car-january-2011/1
von Hippel, E. (2011) Democratizing Innovation. Retrieved from https://aquila5.iseg.ulisboa.pt/aquila/getFile.do?method=getFile&fileId=184643
von Hippel, E. (2005) *Democratizing Innovation*. MIT Press
Holloway, J. (2013) '6-meter tall KamerMaker to 3D print Amsterdam house by year's end'. *Gizmag* (Mar 25). Retrieved from http://www.gizmag.com/kamermaker-3d-printed-house/26752/
Jakubowski, M. (2013) *The Open Source Economy*. Retrieved from http://www.marioninstitute.org/videos/2013/marcin-jakubowski-open-source-economy
Jakubowski, M. (2011) *Global Village Construction Set Kickstarter Campaign*. Retrieved from https://www.kickstarter.com/projects/622508883/global-village-construction-set
Kelly, K. (1994) *Out of Control: The New Biology of Machines, Social Systems, and the Economic World*. Basic Books
Kleiner, D. (2010) *The Telekommunist Manifesto*. Amsterdam: Institute of Network Cultures. Retrieved from http://www.networkcultures.org/_uploads/%233notebook_telekommunist.pdf
Kloppenburg, J. (2010) 'Impeding dispossession, enabling repossession: biological open source and the recovery of seed sovereignty'. *Journal of agrarian change* 10(3): 367-388
Kostakis, V., Fountouklis, M. & Drechsler, W. (2013) 'Peer Production and Desktop Manufacturing: The Case of the Helix_T Wind Turbine Project'. *Science, Technology & Human Values* 38(6): 773-800
von Krogh, G. & von Hippel, E. (2006) 'The Promise of Research on Open Source Software'. *Management Science* 52 (7): 975-983.
Levin, R.C., Klevorick, A.K., Nelson, R.R. & Winter, S.G. (1987) 'Appropriating the Returns from Industrial Research and Development'. *Brookings Papers on Economic Activity* 3 (Special Issue on Microeconomics): 783–820
Levy, S. (1984) *Hackers: Heroes of the Computer Revolution*. New York: Anchor Press/Doubleday
Mann, C.C. & Plummer, M.L. (1991) *The Aspirin Wars: Money, Medicine, and 100 Years of Rampant Competition*. New York: Knopf

Materialise (2013) 'Wearable Stratasys and Materialise 3D Printed Pieces Hit Paris Fashion Week at Iris van Herpen Show'. Retrieved from http://www.materialise.com/cases/wearable-stratasys-and-materialise-3d-printed-pieces-hit-paris-fashion-week-at-iris-van-herpen

Michaels, T. (1999) 'General Public License for Plant Germplasm: A Proposal by Tom Michaels'. Paper presented at the 1999 Bean Improvement Cooperative Conference, Calgary, Alberta

Moglen, E. (2004) 'Freeing the mind: Free software and the death of proprietary culture'. *Maine Law Review* 56(1): 1-12

Molitch-Hou, M. (2013) 'As Father and Son Activities Go, Building Prosthetic Hands Wins Hand Over Foot'. *3D Printing Industry* (Nov. 6). Retrieved from http://3dprintingindustry.com/2013/11/06/father-son-activities-go-building-prosthetic-hands-wins-hand-foot/

Moser, P. (2013) 'Patents and Innovation: Evidence from Economic History'. *Journal of Economic Perspectives* 27(1): 23-44

Nunn, A.S. (2009) *The Politics and History of AIDS treatment in Brazil.* Springer

Nunn, A.S., da Fonseca, E.M., Bastos, F.I. & Gruskin, S. (2009) 'AIDS Treatment in Brazil: Impacts and Challenges'. *Health Affairs* 28(4): 1103-1113

Nuvolari, A. (2004) *The Making of Steam Power Technology: A Study of Technical Change during the British Industrial Revolution*. PhD Dissertation, Eindhoven University of Technology

O'Mahony, S. (2003) 'Guarding the commons: how community managed software projects protect their work'. *Research Policy* 32: 1179–1198

Open Source Ecology (2014) *GVCS Comparison to Industry Standards*. Retrieved from https://docs.google.com/spreadsheet/ccc?key=0ArpE5Y9PpJCXdDZfZE4wb0xsaWZjeS00bjlPMTVvSmc#gid=1

Open Source Ecology (2013) *OSE Shop 2011*. Retrieved from http://opensourceecology.org/wiki/OSE_Shop_2011

Open Source Ecology (2012) 'Enabling Emerging Markets to Manufacture Their Own Ultra-efficient Transportation, WIKISPEED and Open Source Ecology Announce Partnership in Open-Hardware Movement'. Retrieved from http://blog.opensourceecology.org/2012/03/press-release-ose-wikispeed-collaboration/

Pearce, J.M. (2012a) 'Physics: Make nanotechnology research open-source'. *Nature* 491: 519–521

Pearce, J.M. (2012b) 'The case for open source appropriate technology'. *Environment, Development and Sustainability* 14(3): 425-431

Raidu, D.V. & Ramanjaneyulu, G. (2008) 'Community Managed Sustainable Agriculture' in Venkateswarlu, B., Balloli, S.S. & Ramakrishna, Y.S. (Eds.) *Organic Farming in Rainfed Agricultuire: Opportunities and Constraints*. Hyderabad: Central Research Institute for Dryland Agriculture.

Ramirez, R. (2014) 'Hacia la independencia intelectual'. Retrieved from http://reneramirez.ec/del-capitalismo-cognitivo-a-la-economia-social-del-conocimiento/

Randerson, J. (2006) 'Put your feet up, Santa, the Christmas machine has arrived'. *The Guardian* (Nov 25). Retrieved from http://www.theguardian.com/science/2006/nov/25/frontpagenews.christmas2006

Ratnakar, R. & Mani, M.S. (2010) *3rd Party Evaluation of Rashtriya Krishi Vikas Yojana (RKVY): Community Managed Organic Farming implemented by SERP*. Ministry of Agriculture, Government of India. Retrieved from http://www.csa-india.org/sites/csa-india.org/files/ANGRAU_evaluation_final.pdf

Rifkin, J. (2011) *The Third Industrial Revolution: How Lateral Power is*

Transforming Energy, the Economy, and the World. Palgrave Macmillan
Scotchmer, S.(1991) 'Standing on the Shoulders of Giants: Cumulative Research and the Patent Law'. *Journal of Economic Perspectives* 5(1): 29-41
Srinivas, K. (2002) 'The Case for Bio-Linuxes: And Other Pro-Commons Innovations'. In Vasudevan, R., Sundaram, R., Bagchi, J., Narula, M., Lovink, G. & Sengupta, S. (Eds.) *Sarai Reader 2002: The Cities of Everyday Life* (pp. 321–328). New Delhi: Center for the Study of Developing Societies
Thomson, C.C. & Jakubowski, M. (2012) 'Toward an Open Source Civilization'. *Innovations* 7(3): 53-70. Retrieved from http://opensourceecology.org/w/images/4/4e/Innovations.pdf
Tincq, B. (2012) 'From Henry Ford to Joe Justice: WikiSpeed, Manufacturing in the Age of Open Collaboration'. *OuiShare* (Oct 25). Retrieved from http://ouishare.net/2012/10/wikispeed-agile-manufacturing/
US Bureau of Labor Statistics (***)
US Patent Office (2013) *U.S. Patent Activity: Calendar Years 1790 to the Present*. Retrieved from http://www.uspto.gov/web/offices/ac/ido/oeip/taf/h_counts.htm
Weber, S. (2005) *The Success of Open Source*. Harvard University Press
Webster, F. (2006) *Theories of Information Society*. Routledge
Webster, G. (2013) 'Dawn of a revolution: how 3D printing will reshape the world'. *CNN*. Retrieved from
http://edition.cnn.com/TECH/specials/make-create-innovate/3d-printing/?hpt=hp_c2
van Wendel de Joode, R. (2005) *Understanding open source communities: An organizational perspective*. PhD Dissertation, Delft University of Technology
Wikipedia (2014a) *Sustainable design*. At https://en.wikipedia.org/wiki/Sustainable_design#Sustainable_technologies
Wikipedia (2014b) *Community-supported agricultur*e. Retrieved from https://en.wikipedia.org/wiki/Community-supported_agriculture
Wikipedia (2014c) *Open-source license*. Retrieved from https://en.wikipedia.org/wiki/Open-source_license
Wikispeed (2012) 'WIKISPEED, first car-maker in the world to accept Bitcoin'. Retrieved from http://wikispeed.org/2012/07/wikispeed-first-car-maker-in-the-world-to-accept-bitcoin-press-release/
Zizania (2013) *Community-supported agriculture*. Retrieved from http://zizania.tolabaki.gr/csa_full/