CHAPTER 2

P2P and a New Ecosystem of Value Creation

The P2P capacity to relate to each other over the Internet entails the emergence of what Yochai Benkler (2006) has called 'commons-based peer production' (CBPP). CBPP is a new pathway of value creation and distribution, through which P2P infrastructures allow individuals to communicate, self-organize and, ultimately, co-create non-rivalrous use-value, in the form of digital commons of knowledge, software, and design. Think of the free encyclopedia Wikipedia, the myriad of free and open-source projects (e.g. Linux, Apache HTTP Server, Mozilla Firefox, Wordpress) or open design communities such as WikiHouse, RepRap, and Farm Hack.

2.1. Diverse Skills and Motivations

CBPP is fundamentally different from the incumbent models of value creation under industrial capitalism. In the latter, the owners of the means of production hire workers, direct the work process and sell products for profit maximization. Such production is organized by allocating resources through price signals, or through hierarchical command.

In contrast, CBPP is in principle open to anyone with the skills to contribute to a joint project: the knowledge of every participant is pooled. These participants may be paid, but not necessarily. Precisely because CBPP projects are open systems in which knowledge can be freely shared and distributed, anyone with the right knowledge and skills can contribute, either paid by companies, clients or not at all. In these open systems, there are many reasons to contribute beyond or besides that of receiving monetary payment.

CBPP allows contributions based on all kinds of motivations, but most importantly on the desire to create something mutually useful to those contributing. People generally contribute because they find it meaningful and useful.

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For the productive communities as well as simple users, the orientation of their work is most often on use-value creation, not exchange-value.

2.2. Transparent Heterarchy

In CBPP some contributors may be paid/employed but all (in collaboration with groups and individuals that are not) produce commons. Hence, the work is not directed by corporate hierarchies, but through the mutual coordination mechanisms of the productive community. CBPP is based on open and transparent systems, in which everyone can see the signals of the work of others, and can, therefore, adapt to the needs of the system as a whole.

CBPP is often based on *stigmergic* collaboration. In its most generic formulation, stigmergy is the phenomenon of indirect communication among agents and actions (Marsh and Onof, 2007, 1). Think how the ants or the termites exchange information by laying down pheromones (traces). Through this indirect form of communication, these social insects manage to build complex structures such as trails and nests. An action leaves a trace that stimulates *the* performance of a next action, by the same or a different agent (ant, termite or commoner in the case of CBPP).

Stigmergy has been used to analyze forms of complex self-organization in various domains, from insects to robotics and the social web, where planning, control, communication, simultaneous presence and even mutual awareness are not required to coordinate collective action (Heylighen, 2016). In CBPP, stigmergic collaboration enables 'collective, distributed action' by mediating social negotiation via Internet-based technologies (Elliott, 2006). For example, see how free and open-source software code lines and Wikipedia entries are produced in a distributed and ad hoc manner through the contributions from large numbers of people.

Further, CBPP projects do have systems of quality control that represent a kind of benevolent hierarchy or heterarchy. These 'maintainers' or 'editors' protect the integrity of the system as a whole and can refuse contributions that endanger the integrity of the system. However, and this is crucial, they do not coerce work.

To recap, CBPP is based on the open input; a participatory process of coordinating the work; and a commons as output.

2.3. A New Ecosystem of Value Creation

2.3.1. On Value

In capitalism, value is almost exclusively perceived in the exchange of commodities. Markets are the primary institutions enabling and regulating exchange

and, hence, the creation and distribution of value. In antiquity, Aristotle offered one of the first treatises on value in *The Nicomachean Ethics* (2009). He too held that value is expressed in the exchange of two goods, but claimed that it is the usability of those goods that make them desirable in an exchange. Aristotle, thus, had already evinced one of the fundamental dichotomies of economic affairs: use-value and exchange-value.

However, Aristotle's distinction of use-value and exchange-value already implied their close interrelation, whereas the former was arguably held to be a prerequisite to the latter. Value was, then, defined by the desire or need for the products of human labour (things or actions). Exchange was all but an institution crystallizing this interaction.

Similarly, in the medieval times, markets were also present. However, the value of goods, as perceived at the time by philosophers like Albert the Great and Thomas Aquinas, served a broader social necessity, bound to ethical and legal constraints (Baldwin, 1959; Sewall, 1901). For instance, the price of grain was regulated so that everyone had food in a medieval city, whereas speculative traders were put to death. This is still exchange-value, but it is not related to a 'rational' economic aim; instead, it is embedded in social constraints.

The pursuit of economic affairs before the industrial revolution was not merely some efficiency in equating the value of commodities. There was a notion of a 'just price' reflecting the true value of goods in exchange, one that provided fair compensation for all the agents involved. Subsequently, economics as a discipline subsisted as part of justice and moral philosophy. It was not until the classical political economists and under the influence of established capitalist institutions that elements like a 'natural' order (Smith, 1776), scarcity (Ricardo, 1821) and command of possession (Mill, 1848) were associated with commodity exchange. With ensuing generations of economists, theoretical discussion on value gradually abated, and the concept became almost interchangeable with the market price. An exaggerated version of this trend has developed in finance terminology, with value acquiring one superficial attribute wholly divorced from productive activities.

Since the aftermath of the 2007 crash, a reintroduction of theoretical explorations on the topic of value has surfaced. This trend is connected to the intensified contradictions between what is being 'valued' in economic affairs and what is perceived as valuable. Many of the classical debates have been revived, such as between objective and subjective perceptions of value. In this direction, a substantial body of theoretical inquiries has delved into the relevance of the labour theory of value and its Marxist interpretation, with special reference to the digital economy. Some scholars (e.g. Rigi, 2015; Fraysse, 2015) consider the disconnect of surplus value from labour processes. Other approaches (e.g. Hardt and Negri, 2011; Arvidsson and Peitersen, 2013) have focused on the breadth of 'social production' and the subsequent dismissal of labour time as a relevant measure. Lastly, a stream of critical analyses (e.g. Fuchs, 2015) contest

the purported post-capitalist shape of the digital economy and thus reaffirmed the relevance of the labour theory of value.

From a different angle, Mazzucato (2018) touches upon some very timely issues by revisiting the dispute about productive and unproductive activities through the graphically presented colloquy between 'makers' and 'takers'. Stemming from the heterodox tradition, she attempts to debunk the financialized interpretations of value creation and re-connect it to material production. Most importantly, Mazzucato emphasizes the influence, even in their absence, of ideas on value on policymaking.

The common element in all the above insights is a general suggestion of a 'crisis of value' (Arvidsson et al., 2008), signalling a turning point in the dominant value regime and the way it recognizes new value and how it is created.

Elsewhere (Pazaitis et al., 2017a) we have observed a tentative transition of value regimes evident on three layers: (a) production of value; (b) record of value; and (c) actualization of value. The first layer refers to the mode of production that provides the basis for meaningful contributions to societal needs. The capitalist mode of production has been associated with private ownership and control of the means of production, hierarchical command of labour and the production of surplus value. In contrast, CBPP is characterized by collective ownership and management of resources, horizontal coordination, and the production of social value.

The second layer concerns a systematic assessment that provides the means to motivate and nourish such interaction, allowing the system to scale and become sustainable. In this layer, the chosen method to track and record the produced value, by and large, crystallizes the logic of the established economic system. Sombart (1902) discussed the role of double-entry bookkeeping in unleashing and stimulating the business activities of capitalism. Double-entry bookkeeping conveyed the logic of mathematical precision and abstraction to business operations and hard-wired it into the price system. Similarly, seed forms of commons-oriented coalitions have developed their systems of value representation to encapsulate the polycentricity, fluid coordination, and multiplicity of contributions found in CBPP (Bauwens and Niaros, 2017a).

The third layer includes the development of the systems of institutions that guide meaningful interaction within the logic of the dominant economic system. It is where value becomes real, justifying people's choices and struggles. In capitalism, the fundamental value of goods is expressed through their quantitative relation with money, which allows them to be exchanged as commodities (Fuchs, 2010). Their representation in monetary units determines both the means and the ends of the productive process and money becomes the primary commodity acquiring exchange-value. Conversely, in the commons economy, exchange serves the circulation of the commons. The commons thus rationalize new types of social relations, along with the institutions that make the accompanying value forms perceptible.

However, this does not necessarily mean that exchange as a social practice or exchange-value is not relevant to the commons. Polanyi (1957) implied a clear distinction between exchange, markets and a 'market economy', i.e. an economic system controlled, regulated and directed by markets alone. The practice of exchange alone does neither presuppose nor determine a market system as the central locus of value in society. Polanyi viewed markets as merely one of the available forms of resource allocation, along with redistribution and reciprocity. While all the various forms can operate simultaneously, it is when a bulk of human livelihood becames dependent on markets that compels the shift to the market economy.

As already argued, CBPP is socially embedded and oriented towards the creation of use-value. It does not rely on individual motives to gain from barter and trade to allocate resources; sharing freely is considered virtuous. However, our argument is not that we don't have exchange-value in a commons economy, but that exchange-value is not necessarily the value of capitalist commodities. Not all exchange of value is capitalist exchange-value.

There is of course no consistent definition of value in different societies and times. Value as a term alone has no concrete meaning, but it is to be interpreted within a broader social whole (Graeber, 2001). In capitalism, value is mostly related to things, that is, commodities, and is expressed in their exchange for one another based on a nominal representation as money. In the realm of P2P, value is attributed to contributions as a shared effort among peers, and is reflected in the shared significance of those contributions as recognized by those peers.

Hence, value for us is self-determined by communities as contributions. The labour theory of value indeed rules capitalism, yet it co-exists with various forms of value in non-capitalist modes. Therefore, the aim is not a shift from one monolithic value regime to another one, excluding all previous activities. Instead, we make the case for value sovereignty, that is enabling communities and societies to self-determine value for themselves and develop accounting practices to allow this recognition to take place.

In a transition period, there is value competition: a dominant form of value operates under the capitalist logic, and a new social logic of value is emerging in seed forms. Additionally, there is the environmental underpinning of value, integrating a critical recognition of both ecological and social value. Positive and negative externalities have to be re-integrated in our economic system. Hence, recognition of different forms of value is necessary.

2.3.2. The Ecosystem

Through CBPP we observe the emergence of a new ecosystem consisting of three institutions: the productive community; the commons-oriented entrepreneurial coalition(s); and the for-benefit association. Our description cannot be all-inclusive because each ecosystem is unique. Moreover, it cannot be

Productive community	Linux	Mozilla	GNU	Wikipedia	Wordpress
Entrepreneurial coalition	e.g. Linux Professional Institute, Canonical	e.g. Mozilla corporation	e.g. Red Hat, Endless, SUSE	e.g. Wikia company	e.g. Automatic company
For-benefit association	Linux Foundation	Mozilla Foundation	Free Software Foundation	Wikimedia Foundation	Wordpress Foundation

Table 1: CBPP Ecosystems.

definite since we are dealing with a rapidly evolving mode of production. The aim is to offer a birds-eye-view of the expanding universe of CBPP. The following table includes just five of the eldest and well-known CBPP ecosystems:

The productive community consists of all the contributors to a project, and how they coordinate their work. The members of this institution may be paid or may volunteer their contributions because of some interest in the use-value of this production. However, all of them produce the shareable resource.

The second institution is the commons-oriented entrepreneurial coalition, which attempts to create either profits or livelihoods by creating added value for the market, based on shared resources. The participating enterprises can pay contributors. The digital commons themselves are most often outside the market because they are not scarce.

What is crucially important in the relations between the entrepreneurs, the community and the commons on which they depend, is whether their relationship is generative or extractive. Of course, extraction/generation are polarities, and every entity is expected to present a mixture. Nevertheless, this dichotomy infers a break between entrepreneurship and capitalism: one can be an entrepreneur without (or with less) capital, while capital accumulation and the profit motive are no longer imperative. Entrepreneurship in our times can be seen as an expression of the desire for autonomy contrasted with the repression of inhibited salaried work. There is an emerging class of autonomous and precarious workers, often involved in auto-entrepreneurship, which are potential allies, not enemies of the commons.

Entrepreneurship, like many notions, has changed vastly in meaning over time. Today the dominant vision of the entrepreneur is someone who is independent and takes all the risk to play the capitalist lottery. In contrast, if one wants a salary, she needs to obey. So, if one is a worker, she has a contract of subordination. The notion of autonomous workers is associated with the freedom to decide and interact with the market and the commons as one wishes in a permissionless manner.

The roots of the term 'entrepreneurship' in economics are found in Cantillon (2010). Etymologically it derives from the French word 'entreprendre', which

translates to 'undertake', i.e. to set about/attempt; to assume responsibility or obligation. Therefore, in economics entrepreneurship is associated with various individual and collective functions entailing these properties (Tsaliki, 2006), including coordination and organization of (existing) knowledge and capabilities (Say, 1803) and the bearing of uncertainty (Knight, 1921). German Historical scholars (von Schmoller, 1989; 1901; Weber, 1920, Sombart, 1909) have attributed an institutional dimension to the term that became interwoven with the capitalist spirit (Ebner, 2005).

Schumpeter (1934) exaggerated this view by portraying entrepreneurship as an almost mythical function beyond the confines of the capitalist political economy. For him, the spirit of the entrepreneur would manifest itself in any particular social and institutional setting, in the assumption of a leading position, associated with dynamic change and novelty. Schumpeter often criticized Marx for not having a theory of entrepreneurship, since in Marxian thought the entrepreneur is indistinguishable from the capitalist, as the owner of the means of production.

However, Marx's concern was not the function of the entrepreneur, but the source of his reward for fulfilling this role, i.e., the profit. The remuneration of the entrepreneur and thus the rationale for his very existence is rooted in social relations of production that allow for the appropriation of surplus value from unpaid labour. Especially in the 'digital economy', the Schumpeterian quasi-heroic entrepreneur has been disfigured into a false narrative that on the surface celebrates economic freedom, openness and individual excellence, but which merely serves as a smokescreen for precarity and (self-)exploitation.

From a different perspective, an alternative narrative has been developed by commons-based initiatives, spurring a series of entrepreneurial activities, in which the pursuit of economic profit is not the primary motivation, when present at all. Conversely, these entrepreneurs explicitly aim to secure a livelihood and the sustainability of their contribution to a social mission, that they hold as meaningful in itself. Simultaneously, they contribute to the commons (e.g. by sharing knowledge and free software) and create the conditions for more commoners to emancipate themselves and earn their livelihood through their contributions.

Commons-oriented entrepreneurial coalitions can thus be viewed as transitional livelihood organizations. Livelihood is understood as the human capacity to reproduce oneself and acquire the means of life. It varies among different people and different contexts, but it is not necessarily restricted to subsistence. It is also connected to the 'good life' or often referred as 'thrivability'.

This notion of entrepreneurship arguably goes beyond the Marxian critique by introducing a break between the profit motive and the entrepreneurial function. It is the antipode of those neo-liberal convictions viewing entrepreneurship as some sort of 'excellent' quality, with which certain privileged people are born. Leadership in commons-oriented initiatives is a function and a responsibility that can be assumed ad hoc and permissionlessly by those most

capable and motivated in a given situation. Novelty and change are normative, and they are connected to the circulation of the commons and the empowerment of commoners. Commons-based entrepreneurial coalitions thus serve to transcend the elements of freedom, autonomy, and creativity associated with entrepreneurship, by placing them in a contributory context.

Of particular interest is John Wood's (1990) proposal to change the language from 'entrepreneur' to 'entredonneur', which hints at this distinction between extractive and generative entrepreneurship mentioned above. This dichotomy signifies a shift from a logic of 'how can I put myself in between and extract a surplus' to 'how can I build a livelihood around my contributions and share it fairly while recognizing natural limits in the process'. In the same direction, Marjorie Kelly (2012) introduces non-capitalist/generative enterprises, which again comes back to the distinction between markets and capitalism. We can have collectively owned market agents that have social and environmental goals and use their surplus for these goals, rather than accumulation.

To demonstrate the difference between extractive and generative, think of industrial agriculture and permaculture. In the former, the soil becomes more impoverished and less healthy, while in the latter case the soil becomes more productive and healthier.

Extractive entrepreneurs seek to maximize their profits, and generally do not sufficiently reinvest in the maintenance of productive communities. Like Facebook, they do not share any profits with the co-creating communities on which they depend for their value creation and realization. Like Uber or Airbnb, they tax exchanges but do not directly contribute to the creation of transport or hospitality infrastructures. So, the problem is that though they develop useful services that reuse unused resources, they do this in an extractive manner. They may facilitate these services, but they also create competitive mentalities: participants of their systems often construct new material infrastructures, e.g. new buildings to rent or cabs to hire, in their effort to maximize profits. Moreover, extractive enterprises may free ride on a whole set of social or public infrastructures (e.g. roads as in the case of Uber).

On the other hand, generative entrepreneurs create added value around these communities. Seed-forms of commons-oriented entrepreneurial coalitions create added value on top of the commons that they co-produce and upon which they are co-dependent. In the best of cases, the community of entrepreneurs coincides with the productive community. The contributors build their vehicles to create livelihoods while producing the commons. They reinvest the surplus in the well-being of themselves and the overall commons system they co-produce.

The third institution is the for-benefit association that can also be called the infrastructural organization. Many CBPP ecosystems not only consist of productive communities and entrepreneurial coalitions, but also have independent governance institutions that support the infrastructure of cooperation and, thus, empower the capacity for CBPP. They enable cooperation to take place autonomously and do not command and control the CBPP process itself. Behind

any commons project, one always finds some infrastructural organization, as commoning cannot exist without infrastructure. For example, the Wikimedia Foundation, as the for-benefit association of Wikipedia, does not coerce the production of Wikipedia producers. Likewise, the free and open-source software foundations that often manage the infrastructure and networks of the projects.

By way of contrast, for-benefit associations differ significantly from both for-profit corporations and traditional non-profits. For-benefit associations are separated from the commons and the productive community. They are not directly involved in the production and do not command its processes. They instead enable and safeguard the basis for the production to take place. Furthermore, for-benefit associations are not profit-oriented, but promote sustainability and welfare in the system as a whole and are usually democratically governed.

Similarly, traditional non-governmental and nonprofits organizations operate in a world of perceived scarcity. They identify problems, search for resources, and allocate those resources in a directive manner to the solving of the issues they have identified. This approach arguably offers a mirror image to the for-profit models of operating.

For-benefit associations operate for abundance. They recognize problems and issues but believe that there are enough contributors that desire to assist in solving these issues. Hence, they maintain an infrastructure of cooperation that allows contributive communities and entrepreneurial coalitions to engage in CBPP processes vital for solving these issues. Not only do they protect these commons through licenses, but may also help manage conflicts between participants and stakeholders, fundraise, and assist in the general capacity building necessary for the commons in particular fields of activity (for example, through education or certification).

2.4. Four Short Case Studies[5]

In addition to the well-documented ecosystems of free and open-source software projects (see indicatively Dafermos, 2012; Harhoff and Lakhani, 2016; Mateos-Garcia and Steinmueller, 2008; Scacchi et al., 2006; Benkler, 2006; von Hippel, 2016), the cases of Enspiral, Sensorica, WikiHouse, and Farm Hack offer new perspectives on the rich tapestry of the increasing number of CBPP ecosystems.

They fit within the parameters of our description, like many free and open-source software projects, Wikipedia and an increasing number of open design projects that build new post-capitalist ecosystems of value creation. The following ecosystems are interrelated through their digital commons (the output of one project can be the input of another) and, thus, CBPP can be seen as a grand ecosystem consisted of diverse smaller ecosystems (see infographic in Chapter 4).

2.4.1. Enspiral[6]

Enspiral is a network of professionals and companies focused on socially oriented projects, or as often mentioned: 'working on stuff that matters'. The network is based in Wellington, New Zealand and was founded in 2008 by Joshua Vial, who was then a freelance software engineer. The primary motivation behind Enspiral was to enable skilful individuals to commit more time to socially-oriented projects. For this purpose, an initial group of freelancers begun developing a form of collaboration that would create enough resources and flexibility, inspired by free and open-source software.

Since then, Enspiral grew to encompass a broad community of diverse professionals (productive community), including software engineers, trainers, legal and financial experts. These pool their skills and energy to create a commons of knowledge and software. They are self-organized, without central coordination, and share resources to initiate and support projects that contribute to the network's social purpose.

Around these commons, a web of business ventures (entrepreneurial coalitions) offers open-source tools and services that enable communities, like- and including- their own, to address particular challenges related to democratic governance and adaptation to the digital age. For example, Loomio is an open-source platform for participatory decision making that was developed by Enspiral with a group of activists from the local 'Occupy' movement in Wellington. Another one of the first ventures of Enspiral is Rabid, which is a company offering expert services on web development.

The picture is completed with the Enspiral Foundation (for-benefit association), a cooperatively governed nonprofit that facilitates collaboration and supports the network as a whole. The Foundation is the entity with which all the professionals and the companies have a formal relationship. It maintains the network's infrastructure, holds the collective property and guarantees its culture and mission. At the time of this writing, about 300 people are contributing to one or several of over 15 business ventures linked to the Enspiral Foundation.

Enspiral ventures generate revenue by offering their software solutions and services to clients. In turn, they distribute this revenue back to contributors and a part of it (usually 20 per cent) is contributed to the Foundation. Almost half of these funds cover the operational costs of the Foundation, while the rest is invested through collaborative funding in projects proposed by the community. Digital solutions developed by the network again support these processes. For instance, a back-end platform called 'my.enspiral' facilitates the distribution of revenue, while a collaborative budgeting tool, 'co-budget', is used for the investment of the Foundation funds.

Enspiral's culture is dedicated to the creation of value for the society rather than for shareholders. It is statutorily oriented towards the common good and is proactively developing the conditions to serve this purpose. New projects can be initiated by anyone from within or outside the network. Multi-stakeholder

teams organize around exciting ideas and iterate potential solutions. The network's companies and professionals offer expertise in all relevant fields, including financial support, either by using the Foundation's funds (via co-budget) or by leveraging external funding. Enspiral thus aims to engage resources from the broader spectrum of the economy to the creation of social value.

One of the core practices that illustrate this approach on value is 'capped returns.' The general idea is to introduce an upper limit (a 'cap') on the total returns that investors may receive on the equity of a business. For this, the shares issued by a company are coupled by a matching call option that requires the repurchase of the shares at an agreed-upon price. Once the company has redeemed all shares, it is then free to reinvest all future profits into its social mission. Through this mechanism, external and potentially extractive capital is 'subsumed' and disciplined to become 'cooperative capital.'

2.4.2. Sensorica[7]

Sensorica is a collaborative network dedicated to the design and deployment of sensors and sense-making systems. It was officially launched in 2011 in Montreal, Canada, inspired by free and open-source projects and the forms of collaboration entailed. The vision of Sensorica is to empower P2P development and the provision of products and services through a business model and proper infrastructure that would make it economically sustainable.

Sensorica offers an open platform for interaction among individuals, with any skills or expertise (e.g. engineers, researchers, developers or lawyers), as well as organizations from the business and public sector and civil society. It is partially a commons-based community and partially an entrepreneurial entity. On the one hand, the individuals and organizations (productive community) pool resources and organize around projects that produce open hardware technological solutions. Those are generally driven by a diverse set of motivations, where financial compensation is not prominent or included at all.

On the other hand, a group of independent business entities (entrepreneurial coalitions), often launched by the community, introduce innovations into the market. All revenue is distributed back to the network and in particular to the people that have been involved. For this, Sensorica has developed a system that facilitates value accounting and resource management in the network, which is called Network Resource Planning–Contribution Accounting System (NRP-CAS). This system records and determines every member's input in every project and redistributes revenues in proportion to each contribution. It simultaneously tracks all activities in the network with the relevant resources that are either used or generated by a project, as a project's output can be another project's input.

All the agents participating in the network are affiliated with a nonprofit organization (for-benefit association), namely the Canadian Academy for the

Knowledge Economy (CAKE), which manages the shared infrastructure and resources. It is a custodian holding all assets and liabilities of the network, based on a 'non-dominium' agreement. 'Non-dominium' reflects the fact that no agent or combination of agents may have dominant control over the shared resources. It illustrates the dynamic and highly adaptable structure of Sensorica that strives to combine open, large-scale collaboration with a fair distribution of the co-created value.

Projects in Sensorica get initiated either internally or externally. In the former case, the network participants, individuals or organizations, broadcast their ideas to the community. When enough people get on board, a collaborative process of design and planning begins where they contribute under various roles. If all goes well, the VAS-CAS is set-up for this project, and it moves to the development stage where everyone starts logging in his or her contributions. In the latter case, external parties contact Sensorica and initiate joint projects outsourcing innovation processes to the network. Other than that, the network still operates similarly in both cases.

For instance, one of the most popular Sensorica projects is called 'Mosquito', which entails the design and production of a force/displacement sensor device with numerous applications in science and biotechnology. The project, according to the publicly available data on Sensorica's NRP-CAS, has been launched in 2012, coordinated by 15 people in various roles, from design, research, and development and experimentations, to marketing, strategy, documentation and accounting processes. In 2013 two Sensorica affiliates launched Tactus Scientific Inc., a company that successfully introduced the Mosquito Scientific Instrument System as a product in the market. The device has been first tested in research in cardiovascular diseases in collaboration with the Montreal Heart Institute. In its next phase, the Mosquito technology has been applied in other domains, such as wearables (e.g. smart sports equipment, assistive technology for disabled) and robotics (e.g. haptics).

Similarly, in 2015 Sensorica has been contacted by a Montreal-based company to assist in the development of an Internet-of-Things solution for the heavy industry. The final product would be a mesh network of sensors gathering data to analyze the life expectancy of products and predict failures. The company has agreed to follow a business model that is compatible with Sensorica's mission and values concerning the openness of the outputs. The company thus has financed CAKE, the network's custodian, which in turn has distributed funds to the people participating in the project to develop the product released under open-hardware license.

Income can be generated in Sensorica through market operations or government grants. The NRP-CAS allows revenue to flow back to all contributors, not just those directly connected to the sources of income, either market or government partners. The system allows the identification and evaluation of the different qualities of contributions, through a combination of self-logging and peer review. It thus succeeds in avoiding rent-seeking behaviour, not just by

external forces, but also by privileged internal agents, which attempt to exploit the common value for their individual gain. On the one hand, the techno-social infrastructure of Sensorica supports the network's operations and its contributors. On the other, it reinforces a specific state of affairs that represents a collective sense of fairness within and beyond the network.

The organizational model of Sensorica has been identified as an 'Open Value Network' (OVN). An OVN has been developed as a generic organizational and business model apt to enhance and support CBPP. It is highly adaptive, fully decentralized and governed through distributed decision-making processes and resource allocation. Inspired by the practices exemplified by free and open-source projects, it supports open participation, with low barriers of entry and is designed to empower permissionless individual action through open knowledge and transparent processes.

The OVN model aspires to create a viable structure that harnesses the advantages of open collaboration and sharing, while it addresses the challenges of digital commons projects related to governance and sustainability. Its economic dynamics are based on economies of scope created by large-scale collaboration and customized production. Sensorica with the OVN model benefits from the diversity of inputs and shared resources. It stimulates and harnesses human creativity while reducing time-to-market for innovations. This way Sensorica's business entities exploit this unique potential to become competitive in the market.

Generally, the OVN model, as demonstrated by Sensorica, carries some decisive solutions for commons-oriented projects. It can support their unique forms of collaboration allowing CBPP communities to interface with the market and the public sector; capture, manage and distribute financial rewards to contributors; deal with trust-related issues; retain and protect a formal legal structure and brand, and formulate and execute a business strategy.

2.4.3. WikiHouse

WikiHouse is an open-source construction kit initiated by the UK-based studio named 'Architecture 00'. It aims to enable a global community of people to share designs and tools related to all the different parts of house construction. Those parts would then be produced with low-cost materials, like plywood, and assembled using digital fabrication tools, such as 3D printers and CNC machines, even by people with no exceptional skills or training. WikiHouse has been inspired by the developments in digital fabrication and parametric automation, conceived as an opportunity to drastically lower the social thresholds regarding skills, time and cost for people to design and manufacture a house.

A global community of architects, designers, engineers and builders (productive community) contributes to the WikiHouse commons of designs and technologies. Participation is open to anyone interested in using, improving,

adapting and sharing existing designs and technologies, and develop new ones. The contributors to the community interact through a stack of online tools that allow them to communicate and share designs and experience.

The WikiHouse library is organized to include different house types, available as ready-designed building layouts, and technologies that constitute the sub-components of a house and its utilities. It also includes the tools necessary for the physical manufacturing of the constructions. At the time of this writing, the library includes one main house type, the 'MicroHouse', a CNC routed frame technology called 'WREN' and two simple tools, a mallet and a step-up stool.

The limited number of designs and technologies is due to the complexity entailed in house constructions and the variety of the possible contexts. The MicroHouse type and WREN were initially designed in the UK and are suitable for these conditions. Therefore, further development of static ready-to-produce designs for other house types would be of limited use. WikiHouse also focuses on the development of parametric design tools that may allow for a broader range of possibilities and different house types. Several research and development teams work on new sets of digitally fabricated technological solutions. A set of design principles are guiding this process, which generally prescribes an open, fail-proof and modular design, low-cost and broadly available materials, and user-friendly layouts.

A UK-registered nonprofit, the WikiHouse Foundation (for-benefit association), is the caretaker of the community. Its mission is to bring together companies, organizations, and governments to promote open technologies and common infrastructures for housing and sustainable development. The Foundation provides for the WikiHouse commons by maintaining the infrastructure and through commons-based licenses. It facilitates cooperation in the ecosystem by coordinating interactions among the contributors and raising funds from donations.

Furthermore, the WikiHouse Foundation collaborates with a global network of companies, called 'providers' (entrepreneurial coalitions), which cover all the relevant services across the building supply chain, from architecture, engineering and insurance services, to loans, construction management and delivery of parts. Those usually participate in research and development for WikiHouse and have thus advanced knowledge of its tools and technologies, while some may specialize in local applications of WikiHouse solutions. For instance, WREN is supported by an architectural design studio (Architecture 00) and a structural engineering company (Momentum Engineering), both based in the UK, but also by a New Zealand-based social housing company (Space Craft Ltd), a multinational expert group (Arup Associates) and several individual contributors. Moreover, a structural engineering student group from the Free University of Brussels (ULB) is also working on the hardware, while another architecture team (Architype-Team Architects) is engaged in the parametric development.

The Foundation does not engage in the design or manufacturing itself. Instead, it ensures compliance with the design principles and sets the criteria for quality assurance, by curating a catalogue of certified solutions and providers. This way, it encourages experimentation, openness, and diversity in community interactions, while maintaining minimum industry standards for the designs and technologies hosted in the WikiHouse public library.

In this perspective, the enabling role of the commons in the WikiHouse ecosystem is twofold. On the one hand, it is socially-oriented with regards to the role of architecture beyond the construction of buildings. It focuses on the development of design solutions that are low-cost, high-performance, sustainable and adaptable. People are thus provided with the tools to reconfigure the public sphere in the area where they live, especially in urban environments. There is a robust socializing element emphasized in the construction of WikiHouse layouts that is reminiscent of pre-industrial vernacular architecture and community-based building.

On the other hand, it introduces a new business strategy for the sector. Apart from high-end, sophisticated construction projects, WikiHouse sees most of the architectural work take place outside the market economy, where everyday people try to solve their problems by themselves. Hence, the challenge for WikiHouse is to provide the tools, the infrastructure, and the institutions to develop architecture in those parts of society. WikiHouse thus strives to expand the availability and relevance of architecture and its related services to the more significant part of the economy, where it is arguably most needed.

In this direction, WikiHouse is in the process of developing a platform that would enable companies to identify new customers for their products and services, coalesced around citizen-driven projects for affordable and sustainable housing. In turn, they would share a part of their revenue for the maintenance and improvement of the shared infrastructure and the building technologies.

2.4.4. Farm Hack

Farm Hack is a community of farmers that build and modify their machinery. It was established in 2011, following a gathering organized by several groups of farmer activists in collaboration with engineers from the Massachusetts Institute of Technology, aimed at discussing and producing solutions to various problems related to farming tools. Gradually, a series of events were held across the USA engaging farmers, activists, designers, researchers and engineers in discussion and exchange of ideas, and the design and prototyping of farming tools. Inspired by open-source culture, soon the idea expanded to the rest of the world and eventually a global community (productive community) was established.

The central node of Farm Hack is its digital platform, where solutions developed in the events are documented. The primary function of the platform

is to host a database of designs, know-how, and ideas shared by the productive community. In addition it serves as a medium of communication and dissemination, while it also facilitates coordination among the members of the community and, to a certain degree, the development of technologies.

Currently, the platform features more than 500 pieces of machinery that have either been collectively created in Farm Hack events or developed by individual members of the community. The platform includes anything from integrated solutions and ready-to-market products to prototypes, fixes and even concept designs or ideas for brainstorming. All artifacts are available under Creative Commons licenses and may be accessed, used, modified, improved and shared by everyone.

A nonprofit (for-benefit association) has been formally established in 2013 to provide Farm Hack with legal status. The primary role of the organization is to monitor, maintain and improve the platform according to the ethos and desires of the community. Further more, it secures funds for its functions and maximizes outreach within and outside the community. The organization has a formal board of directors, in line with legal provisions; however the actual decision-making process is decentralized and meritocratic. Practically any member of the community can be involved, while those most engaged in the Farm Hack activities may have enhanced influence.

Acquiring a legal form has provided the flexibility to strengthen collaboration with other organizations and raise funds from grants. Over time, this has allowed Farm Hack to employ community members on a more permanent basis, thus enabling them to contribute their time and efforts more intensively. However, this cannot be sustained over long periods of time as its non-profit statute does not allow for direct engagement in financial activities. Therefore, a critical challenge for Farm Hack is to create a business ecosystem around the platform that would generate income and improve the overall sustainability of the community and its efforts.

For this reason, the community enables some of its most active contributors to engage into entrepreneurial activities (entrepreneurial coalitions), so that they can continue their contribution to the commons, but also sustain themselves in the process – those are individuals that have invested considerable time and resources in the development and documentation of various tools and have gained substantial experience.

Typically, these contributors commercialize tools that they have contributed to the platform or offer related paid services for individuals or entities that would instead purchase them than directly engage in their development. Farm Hack community members are relatively flexible when it comes to adopting any suitable business model, as long as the fundamental principle of openness is maintained. They may manufacture and sell the tools or components of them, or they may sell partially assembled kits or merely conduct workshops to teach other farmers to build their tools.

Furthermore, the platform includes a component, called 'Open Shops', envisioned as a space for businesses and organizations sharing Farm Hack's ethics. Ultimately, Open Shops aspires to curate a commercial toolkit that would support different groups and individuals by offering products and services to the broader community. Concurrently, Open Shops connects Farm Hack with other projects working on the same field from all over the world and provides a collaborative space for sharing of skills, knowledge, and designs.

The process of commercialization is challenging for Farm Hack and a significant point of discourse within the community. The creation of sustainable commercial activity is desired and encouraged. It is a means to build economic resilience, by supporting local manufacturing that provides farmers with tools customized to their needs. Hence, commercial activities may be benefiting from the community, but are simultaneously empowering and supporting it.

Interestingly, even though significant improvements have been implemented in the platform over time, most of the coordination and collective development takes place in the physical sphere, for instance at Farm Hack events. The operation of the digital platform as a coordination tool has been not been stressed, while the documentation of processes and technologies are often posing problems within the community. Nevertheless, the platform is continuously updated and improved, based on feedback provided by the community and other sources. Its role concerns both digital interactions, such as the documentation of tools, as well as physical ones, like the provision of templates for the organization of independent events.

In the same direction, several members of the Farm Hack community have developed FarmOS, a web-based open-source software that assists farmers in record keeping, planning, and management of their farm-related work. Similarly to the Farm Hack platform, FarmOS also serves multiple purposes. It can offer different possibilities through the sharing of data and knowledge across the community, but also with third parties, like researchers and expert service providers. Moreover, the open and transparent architecture of FarmOS provides enhanced freedom and control over data sharing by the users in comparison to similar proprietary applications, while the sharing of data is not prerequisite for the use of the software.

2.5. From Contradictions to an Integrated Economic Reality

We do not claim that such nascent ecosystems are sovereign in the current socio-political order. Even more, they all come with their challenges and contradictions. For instance, Enspiral, as a business model, owes a large part of its success to the distinct talent and skills of its members that allows them to be very competitive in their respective fields: skills and competencies that they have acquired from their education and occupation in established institutions,

such as universities, software companies, and financial firms. Its area of expertise is within a niche with a structured market and low capital entry. Therefore, the replicability of its business model is both a matter of some subtlety in application and highly dependent on context.

Similarly, Sensorica and Farm Hack both face significant challenges concerning proper and comprehensive documentation of their processes and outputs, while WikiHouse is still striving to broaden the scope and reliability of its layouts and technologies. Furthermore, all the described projects, especially those entailing any form of localized manufacturing, still substantially rely on cheap mass-produced raw materials and components, which are only affordable mainly because they are produced and distributed under exploitative conditions. Their respective business models are also yet to be defined, and in most cases, it is the case that only a small number of active and highly dedicated contributors that can safely claim sustainable livelihoods.

Nevertheless, we should not underestimate the importance of such cases in providing solutions to very timely and neglected societal challenges. Most importantly, in doing so, they are gradually building a considerable capacity to support their emerging political economy. From Enspiral's co-budget, to Sensorica's Network Resource Planning, and from WikiHouse's parametric design to Farm Hack's on-demand customized manufacturing, each case offers unique techno-social solutions that crystallize a new socially embedded perception of value. They also define new forms of organization and relation to the means of production and offer an alternative representation of economic reality as a whole.

These can empower commoners to counter situations where capitalists co-opt the commons and head towards others in which the commons capture capital and utilize it for the development of the commons. This proposed strategy of reverse co-optation has been called 'transvestment' by Dmytri Kleiner and Baruch Gottlieb (Kleiner, 2010, 2016). Transvestment describes the transfer of value from one modality to another. In our case, this would be from the capitalist market to the commons, using generative market practices wherever and whenever possible. Thus transvestment strategies aim to help commoners become financially sustainable and independent. Transvestment strategies can be identified in all the cases presented above.

Enspiral ventures offer their products and services in the market, like any ordinary enterprise. However, their focus is on the social economy, mobilized in response to societal challenges. Through this process, they create commons (software, infrastructures, knowledge), but also revenue and even profits (some Enspiral ventures are profit-oriented). A significant portion of these finance the operation of the Enspiral Foundation, and the rest is reinvested to new commons-based projects through democratic procedures. When external finance is used, the system of capped returns is applied to redeem control of the projects funded. This ensures that, in the long term, the companies can decide to reinvest their profits in their social mission and new Enspiral projects.

In addition, Sensorica explicitly separates its production processes, which are commons-based, from its market operations, that are held by independent entities, yet entirely controlled by the productive network. Moreover, the network's contribution-based accounting system links every contribution to the people involved in a project, from its initiation to the marketed product. In turn, this allows the network to harness the commercialization of its products under participatory and democratic processes, by fairly distributing all revenue back to the people that have contributed to the production. Through this process, Sensorica emancipates its contributors by providing livelihood opportunities, which enables them to commit more of their creative energy to commons-based production processes.

WikiHouse attempts to create a new market strategy for architecture and related services, by coalescing various stakeholders around the commons. Instead of focusing on large-scale construction projects, which are typically centrally designed and coordinated, a key faction of expert and competent agents can be employed for the parametric design of solutions for every-day problems of the broader society. Through the pooling of designs, knowledge, and technology from all the involved parties in the construction value system, WikiHouse shifts resources from the creation of capital to the creation of commons. Simultaneously, it provides the means to deem a form of community-based design and construction sustainable, which would otherwise be susceptible to enclosure.

Finally, the Farm Hack community encourages its most active constituents to undertake entrepreneurial activities, so long as the community's fundamental values of openness and non-discrimination are safeguarded. On a first level, this enables some of the main contributors to the Farm Hack commons to become more financially sustainable and potentially commit more of their time to the community. On a second, it increases the impact and availability of Farm Hack commons-based technologies. In a vital economic sector like agriculture, this conditions the movement of people, land, and capital to the commons-economy. Because technology is not neutral, opaque technologies with high capital input would force these communities to conform to intensive, large-scale practices. Conversely, the promotion of commons-based technologies emancipates commoners to build a counter-economy.

These commons-oriented practices consciously strive for a transition to a fairer and more sustainable economy and society. There have been many historical opportunities for such a transition, but capitalism has demonstrated high resilience as an economic system, adaptability as a cultural framework, and brutal force as a political apparatus.

The difference on this occasion is found in the profound techno-social transformations that take place on the micro-economic level. P2P constitutes a generic capacity for human beings to contribute to the creation and maintenance of shared resources while benefiting from them. Early CBPP initiatives illustrate the potential of this capacity that allows people to build new vehicles – and

transform old ones – to create and distribute value. Those have been developing along with nascent practices and tools that make certain forms of social relationships visible.

Medieval merchants had too developed their own practices and tools to transform the pre-capitalist societies, guided by the generic capacity of people to exchange and barter in markets. It was not the first time in the history of humanity that trade took place, nor that markets existed. It was, however, the transformational dynamic of their tools that made things visible, rather than the humans behind them. The labour theory of value was one of the first systematic approaches that subsumed human 'toil and trouble', in Smith's (1776) terms, under the sway of commodities to exchange for one another.

The nascent theory of value that is being developed by the CBPP practices can conceivably subsume various qualities of things, such as resources, assets, and commodities, under the capacity of human beings to relate to one another in a non-coercive and permissionless manner. It is a critical process that is transforming the CBPP practices from re-active to pro-active. Such groups are shaping their existence within a dominant system, and through transvestment, they transcend its inherent dynamics. This approach is arguably anti-fetishistic, as it reinstates the relations amongst people that have been hidden by relations between things.

Moreover, this nascent value regime already holds the preconditions to recognize and acknowledge different forms of value. With regards to social relations there is the acknowledgment of contribution, and concerning natural resources, there is the recognition of planetary limits. CBPP thus contributes to a biocapacity-based understanding of value, which establishes foundations for integrating social and environmental externalities.

In the current system, we externalize social and environmental factors to maximize exchange-value. A new form of value is one that integrates social, ecological and economic value. We have to work on our capacity to integrate social and ecological value in our decisions about the use and allocation of resources. CBPP inaugurates a move from a redistribution model, where value is created through the market and then distributed, to a predistribution approach, where economic activities are socially and ecologically embedded, which concerns itself with the recognition of natural limits, as well as the fair distribution of rewards. A crucial task is to re-integrate the different forms of value in a new economy.

Nevertheless, we cannot ignore the close interdependence of CBPP initiatives with capitalism in their struggle to gain autonomy. The success of this struggle necessitates the adoption of practices, tools, and narratives that have been historically been synonymous with capitalism. In order to win in the capitalist game one first needs to abide by its rules, even when trying to bend them. Hence the more successful these initiatives become, the higher the danger of reifying and fetishizing capitalism, which never fails to reward its greatest enemies. The increasing interest in the commons already provides the grounds

for alliances with certain forces that aim to exploit the commons to expand the power of capital and further deepen the divide with class movements (Caffentzis, 2012; De Angelis, 2012).

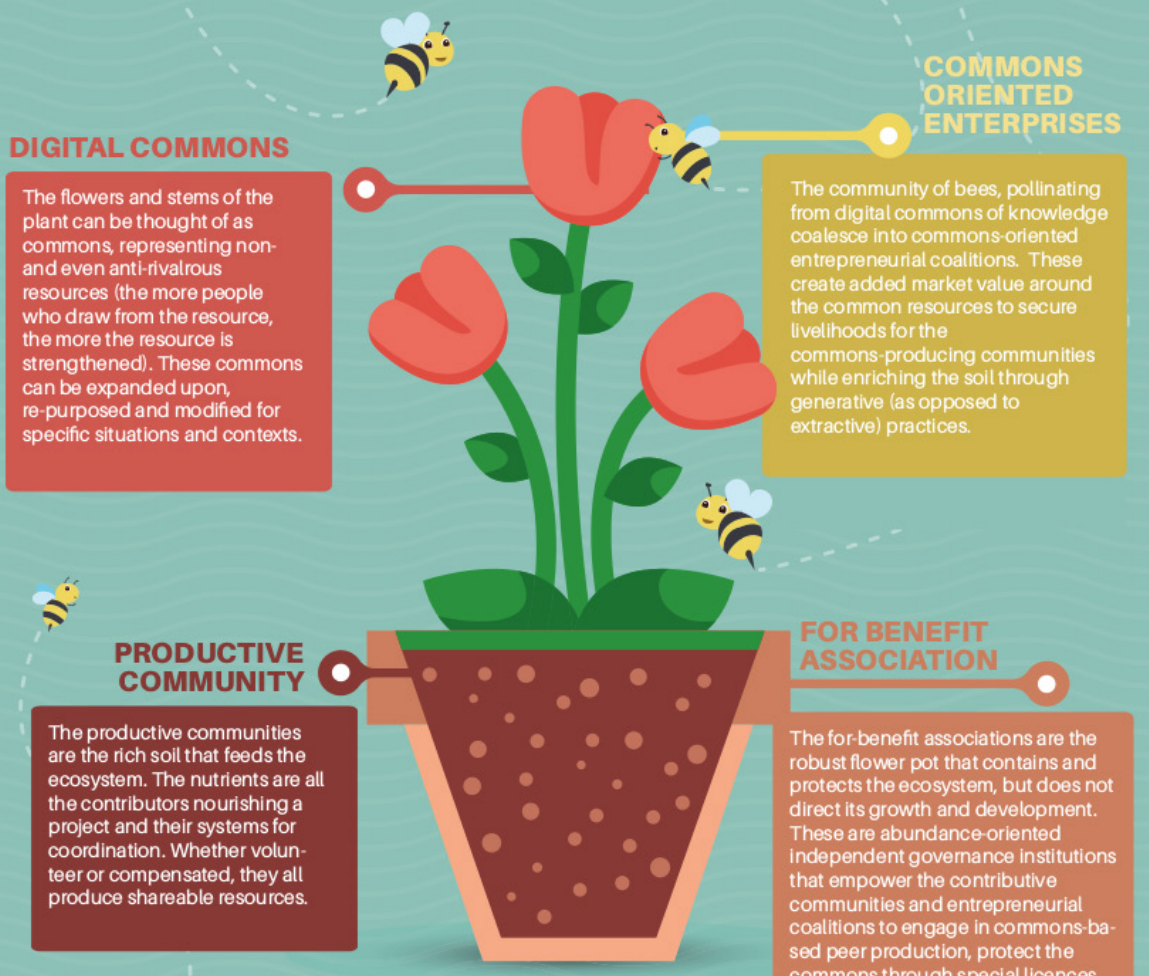
However, we also cannot overlook the fact that those initiatives have been nurtured within capitalism and aspire to overcome it. The same way that the commons can be exploited to rejuvenate capitalism, CBPP can form coalitions and revitalize radical social movements, including class, gender, ecology, and degrowth or post-growth.

From a Gramscian (1971) perspective, CBPP can be viewed as an effort to advance alternatives to dominant ideas of what is considered 'normal' and legitimate. Commons-based entrepreneurship, for instance, transcends those elements of entrepreneurship that are associated with freedom and autonomy and places them in a contributory perspective. Similarly, for-benefit associations transcend elements traditionally associated with the state in its role as the guarantor of the common good, that are reflected in the quality of benefiting from- and contributing to- the commons.

As these solutions mature and as they are taken-up, replicated and improved by other projects, this new economic reality could subsume and transcend today's tumbling political order. Through the support of the commons and the expansion of P2P as the new common sense, in time they shall reshape and sublate the various contradictions and processes upon which they currently rely, into a synthesized, concrete, commons-centric totality.

THE NEW ECOSYSTEM OF VALUE CREATION

Commons-based peer production enables new systems of value creation. Around **shared commons** of knowledge, code and design we find three institutions: **the productive community**, **the commons-oriented entrepreneurial coalition(s)**, and the **for-benefit association**. This ecosystem can be visualized as a plant pollinating a rich environment.



DIGITAL COMMONS

The flowers and stems of the plant can be thought of as commons, representing non- and even anti-rivalrous resources (the more people who draw from the resource, the more the resource is strengthened). These commons can be expanded upon, re-purposed and modified for specific situations and contexts.

COMMONS ORIENTED ENTERPRISES

The community of bees, pollinating from digital commons of knowledge coalesce into commons-oriented entrepreneurial coalitions. These create added market value around the common resources to secure livelihoods for the commons-producing communities while enriching the soil through generative (as opposed to extractive) practices.

PRODUCTIVE COMMUNITY

The productive communities are the rich soil that feeds the ecosystem. The nutrients are all the contributors nourishing a project and their systems for coordination. Whether volunteer or compensated, they all produce shareable resources.

FOR BENEFIT ASSOCIATION

The for-benefit associations are the robust flower pot that contains and protects the ecosystem, but does not direct its growth and development. These are abundance-oriented independent governance institutions that empower the contributive communities and entrepreneurial coalitions to engage in commons-based peer production, protect the commons through special licences and fundraise for their development.

Together, this ecosystem of value creation helps create vibrant free, fair and sustainable economies which are not only based on the Commons, but actively stewards them and protects them for future generations.

Infographic by P2P Foundation.
Plant Concept: Vasilis Kostakis.
Text: Michel Bauwens, Vasilis Kostakis, Stacco Troncoso, Ann Marie Utratel.
Design: Elena Martinez.