cosmo-local reader

José Ramos Michel Bauwens Sharon Ede James Gien Wong

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ISBN: 978-0-9953546-3-0 (Digital Edition)

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Production Editor: Abril Chimal
Cover and Book Design: Abril Chimal

Published by Futures Lab

Acknowledgements

Many people's efforts went into the creation of this book. The work of the P2P Foundation in documenting transformative examples has taken place for many years, and many of their contributions were included here. The contributions of members of the P2P Lab were also substantial, many of their members contributed essays and cases. The production of the book required a production editor, and Abril Chimal rose to the challenge to bring the book into fruition. This book, with over 50 chapters, could not be possible without the creative efforts of all the authors. Finally, financial support came from Action Foresight and Futures Lab.

00 *Introduction to the Cosmolocal Reader* — *13*

José Ramos, Sharon Ede, Michel Bauwens & James Gien Wong

01 *Cosmolocal Framings* — *36*

A Genealogy of Cosmolocalism — *37*
Alexandros Schismenos, Vasilis Niaros and Lucas Lemos

"Do-It-Together": Towards the Factories of the Future — 52
Laurent Dupont, Fedoua Kasmi, Joshua M. Pearce, Roland J. Ortt

Evolving Systems for Generative Justice: Decolonial Approaches to the Cosmolocal — 60
Ron Eglash, Audrey Bennett, Michael Lachney, and William Babbitt

The Pulsation of the Commons: The Temporal Context for the Cosmolocal Transition — 76
Michel Bauwens and José Ramos

02 *Building Cosmolocal Ecosystems* — *95*

Making Room for the Community-Based Circular Economy — *96*
Sharon Ede

Cosmolocal Questions: From Tech Trend to Protocol Commons — 109
José Ramos

Fab Cities and the Urban Transformations of the 21st Century — 121
Tomas Diez

Financing Cosmolocalism 135
Andrew Ward

Cosmolocalism, a Tool for the Social Appropriation of Knowledge and Rural Development 146
Willmar Ricardo Rugeles Joya

03 *Challenging Cosmolocalism* 155

Repositioning Cosmolocal In A 'Beyond' Space-Place 156
Michael McAllum

Cosmolocalization & Localization: Towards a Critical Convergence 169
Helena Norberg-Hodge, Alex Jensen, Steven Gorelick and Henry Coleman

The Australian Bush Mechanic and her Potential in Helping to Save the Planet 184
Paul Wildman with Michel Bauwens

04 *Cosmolocal Stories* 195

Let there be light: IIT Bombay's SoUL Project to Energize Rural India *196*
Raji Ajwani Ramchandani and Snehal Awate

Rural Dynamism in the Digital Age 210
David Li

An Open Source Preemptive Strike in the Coming War Over The Freedom to Make Your Own Products 219
Joshua M. Pearce

Utopia Maker *227*
Chrystèle Bazin

AgOpenGPS and DIY Open Farm Innovation: An Overview *229*
Chris Bennett

Chang’an: 3D Printing Cyberpunk Town on Pearl River Delta *241*
Vicky Xie, David Li, and Kangkang Zhang

05 *Cosmolocal Explorations* ***253***

Wind Empowerment, Pico-hydro and Nea Guinea 254
Vasilis Kostakis, Kostas Latoufis, Minas Liarokapis, Michel Bauwens

Farm Hack: A Farmer-Driven Platform for Knowledge Exchange 264
Chris Giotitsas

L'atelier Paysan: Peasants Building Their Own Tools 269
Chris Giotitsas

Open Bionics 277
Vasilis Kostakis, Kostas Latoufis, Minas Liarokapis, Michel Bauwens

Sensorica 285
Michel Bauwens and Vasilis Niaros

Tzoumakers 294
Alekos Pantazis and Morgan Meyer

MuSIASEM: Accounting for material/energy flows and their limits 301
Michel Bauwens and Alex Pazaitis, with additions from James Gien Wong

FabChain: Linking advanced research to urban metabolisms and mainstream production and manufacturing *306*
Michel Bauwens and Alex Pazaitis

FairCoin and FairCoop: Tools for a Cosmo-local, Open Cooperative Ecosystem *309*
Michel Bauwens and Alex Pazaitis

Envienta *311*
Gabor Kiss

Holochain: An alternative to a global distributed ledger, based on biomimicry *317*
Michel Bauwens and Alex Pazaitis

AbilityMade *320*
José Ramos and Melissa Fuller

06 ***Cosmolocal Q&A*** ***341***

bHive Cooperative 342
Ian McBurney, in response to questions by José Ramos

Open Motors 348
Yuki Liu, in response to questions by José Ramos

Wikifactory 358
Carolina Portugal in response to questions by José Ramos

07 ***Cosmolocal Snapshots*** ***365***

Appropedia *366*
Sharon Ede

Cosmolocalism 368
Vasilis Kostakis

FarmBot 370
Michel Bauwens and José Ramos

Field Ready 372
Sharon Ede

GLIA 375
José Ramos

Hexayurt 377
Christina Priavolou

LEKA Restaurant 381
Sharon Ede

Multifactory 384
Michel Bauwens

Open Source COVID-19 Medical Supplies 387
Sharon Ede

Open Source Ecology 390
José Ramos

OSE Microhouse 392
Christina Priavolou

Open Desk 396
Sharon Ede

Open Food Network 398
Sharon Ede

Open Insulin 401
José Ramos

Precious Plastic 404
Abril Chimal

RepRap 409
José Ramos

Wikihouse 411
Christina Priavolou

08 ***Index*** ***415***

Introduction to the Cosmolocal Reader

José Ramos, Sharon Ede, Michel Bauwens & James Gien Wong

Introduction

Humans can do great things when we work together. This is the simple and central idea of this book. Most of us know this through one experience or another, whether through a team sport, a social movement, an innovation project, or just getting the community together to do something good. This anthology adds a new dimension to an ancient idea: the current era is the birth of working together at a planetary scale for the common good of communities everywhere. It is new because the 21st Century holds the possibility for an open digital knowledge revolution; but it is ancient because the experience of communal sharing and collaboration is normative consciousness, it is the way in which humans mostly lived through prehistory.

The social theorist and historian Manuel Castells described the logic of this shift. He wrote that the new information technologies utilised by powerful corporations and states to shape the world will be matched by a counter movement of people, social movements and other actors, who will utilise these same technologies to dream and create alternative futures.[2] We have seen this play out over the past 50 years to varying degrees.

Born from US military strategy to survive a nuclear war, the internet was

2 Castells, M. (1996). The Information Age: Economy, Society and Culture. *Blackwell.* p.156

passed on to the US university system to support collaboration in research. In tandem with neoliberal economic policy, in the 70s and 80s innovations in ICT became the technology architecture that allowed for rapid global financialisation. These innovations also allowed the more nationally bound corporation to become a fully fledged transnational corporation, giving rise to the "global factory".[3]

The counter movement has also taken many forms. In the 1990s solidarity movements formed using the internet as a networked organising tool against neoliberal economic policy and repressive regimes. The 2000s saw the development of open software and creative commons. The World Social Forum and Occupy were manifestations of this network organising logic. But we think the most profound counter movement is yet to come.

Challenges push us to find new ways, new solutions, to overcome them. We've seen this historically in both wartime and peacetime.[4] Today these challenges are multiple and unprecedented, so much so that we can safely say that the solutions of the past will not solve the problems of the future. We do not hold the pretence that cosmolocalism is a silver bullet. It is one of a number of ideas and strategies that exist or are emerging that hold promise in addressing our great challenges.

But this idea that humans can do great things when we work together, if extended to the almost 8 Billion people on Earth, working together to share experiences, knowledge and resources to solve our greatest challenges, we feel is a worthy idea to contemplate and assess. Today our technologies make this possible, and our challenges necessitate that we use all available potential tools and strategies.

With these initial words we welcome you into our anthology, and hope you find the ideas and examples useful and inspiring. For those itching to dive into the work, the first part contains 12 essays that cover a broad range of topics and the second part contains 38 examples and cases from around the world, organised as long explorations, interviews and short vignettes. For others wanting a summary and some reflections, please read on…

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3 Allen, R. E. (2016). *Financial globalization since the 1970s. In Financial Crises and Recession in the Global Economy*, Fourth Edition. Edward Elgar Publishing.
4 Wilkinson, G. (2021). *Mobilising Whole Communities to Restore A Safe Climate.* [Doctoral dissertation, MICAT].

The Journey

It has been a six year journey since the inception of the idea to create this book. It was in a cafe in central Adelaide, during the Adelaide Festival of Ideas in 2016, when three of the four of us (Jose, Sharon, Michel) began to discuss what this anthology could be. That evening was also graced with Mark Pesce's presence, an augur of sorts and certainly our lucky charm. Besides the idea for an anthology, it is hard to remember what we talked about, but we remember the feeling, we were optimistic.

It was a different time, imbued with the possibility, indeed the inevitability of change, and perhaps some naivete. Trump and Brexit were only freshly minted phenomena. Facebook and their ilk were still on their grand ascent capturing billions of souls. The climate crisis felt more future than present.

Some ideas remain ideas, and others manifest in various ways. It took a few years to gather the courage and intentionality to launch the project. But we did a few years later, in mid 2019, about two years from the writing of this introduction. Also, by 2019, it became clear that we were transitioning into a more turbulent and challenging setting. We began to see the various manifestations of reactionary politics around the world, climate change induced disasters became more pronounced, and the emerging oligarchies of platform capitalism became more visible. So the way that we framed the call out also reflected this sense of urgency:

"We are facing a civilizational crisis that intersects issues such as ensuring a safe climate, social equity, and living within planetary ecosystem boundaries. We are also undergoing a transition toward a post-capitalist mode of production that centres around the themes of mutualization (peer production) and the commons. Cosmo-local production has the potential to play a part in this transition and contribute to solutions by:

- *creating planetary contributory systems that can accelerate our ability to respond to the challenges we collectively face,*
- *ensuring that all people have access to new opportunities for livelihood and problem solving through a well established global design commons and a right to design,*
- *supporting the development of localized circular economies that can transform the waste system and waste paradigm,*
- *supporting cities and regions in becoming auto-productive, to form complex cosmo-local value chains for greater resilience,*
- *demonstrating the outlines of a global workers / peer production*

solidarity system that can bypass the nation-versus-nation ethno-nationalist impasse,
- *reducing the transport of goods and associated carbon / ecological footprints, and modeling production within* planetary boundaries."[5]

What we felt was needed was a way to bring together the various ideas, hypotheses, frameworks as well as cases and examples. The elements felt scattered about. What if there was a compilation that brought together some of the best examples we could find, and the best thinkers we could find? Readers could then see and reflect on a new sense of the whole, a new gestalt.

What we knew was that this could be a survey of sorts that gathered together what there is now - ideas and examples. We understood that this was still the early days, and clearer principles and strategies will emerge after we gather the elements, after we look at the whole. We discussed this project with the remarkable folks from the P2P Lab, who had just undertaken the EU funded multi-year cosmolocalism.eu project. If the P2P Lab project was about depth, testing the ideas, building the conceptual and empirical rigor needed for these new approaches to take flight, then this anthology could complement and (hopefully) support their endeavour by providing some breadth.

Then the pandemic hit. People were driven inward. Into their homes. Into the hall of mirrors that is social media. Homeschooling kids. Zoom working. Home-surviving. The pandemic brought death and trauma, disruption and fear to much of the world. We got to see the callousness of certain so-called leaders, whose narcissistic preoccupations cost the lives of millions. We also saw the heroism of the front line defenses, public servants, nurses, doctors, ambulance drivers and scientists. Project timelines also stretched out. Unfinished checklists grew in length. Amid this, somehow we kept this project going,[6] albeit slowly, methodically chipping away.

Almost two years later here we are, and as editors, authors and readers we can look at what we have gathered together. This introduction provides an opportunity to show what we found, and to reflect. As editors we think what is here is significant and exciting, but it is readers and those that find inspiration and usefulness who will ultimately be the arbiters. But if we give ourselves some creative license for this intro, which we hope we have earned, allow us to offer up some thoughts as we review the contributions.

5 https://our-better-selves.medium.com/the-cosmo-local-reader-invitation-to-participate-dbcb6248f54b
6 This "somehow" is based on the considerable efforts of the authors, editors and production editor.

In these last two years our shared challenges have accelerated. We've seen catastrophic fires in many parts of the world (Australia, Russia, California, the Amazon). The absurd accumulation of even more wealth by the ultra rich during the pandemic. Increasing authoritarian and fascist tendencies in polities around the world. And the unbridled rending of public discourse and the public sphere by unaccountable social media empires. The need for dramatic change, what we can call 'transformation', now feels like it belongs in the present rather than the future.

This reader is about a particular kind of transformation. As evidenced from the over 40 cases and examples in this book, it is already happening. Often, so deeply are we subsumed into the world of the present, it can be hard to see. They are novel forms, mutations and variants. They can also be considered "weak signals", signs of things to come. One of the hallmarks of a weak signal is that the interpretation is not stable, there are in fact multiple emerging interpretations.[7] People don't quite know what it is. They argue, it has "these features", and "those behaviours". And then there is the naming. At first people don't know what to call it. There is no agreed upon term. There are different names that refer to different aspects of the phenomena. Consensus, if an aim at all, only emerges with time.

Is a Rose Just a Rose?

"Design Global Manufacture Local", "Open Design Distributed Manufacturing", "Maker Cities", "Fab Cities", "Do-It-Together", "Planetary Bricolage", "Cosmopolitan Localism", there are many names circulating that describe the possibilities and emergences of the present moment and the emerging futures.

We could have gone for the largest umbrella term, a term to unify all terms. But this is a game of both generalisations and nuance. For we understand that capitalist driven externalities are putting our planetary ecosystems in great peril, and driving ecological, social and now cognitive harms. We know that the endless growth paradigm is not viable. We also know that we are all in it together. If we destroy a safe climate and our other commons, all the other goals mean nothing.

What this points to is the other side of the naming spectrum, from generalisation to nuance. It has driven us to be specific about the kind of phenomena we are interested in naming, and the desired (normative) outcome of this social change process. If you were interested in the co-

7 Hiltunen, E. (2008). The future sign and its three dimensions. *Futures*, 40. 247–260.

mingling of ethics, technology, wellbeing, community, production and the planetary commons, what would you have done?

"Cosmolocal" is used for this reason. Like the other terms it plays the role of generaliser but also cuts and distinguishes what we want to organise and develop. We do not seek consensus on a single term and definition, but rather to plant seeds that can grow into alternative futures. We saw how the potential of the sharing economy as a discourse was appropriated by the big Silicon Valley startups (Uber, AirBnB, etc). Unfortunately and sadly, people who cared had to rebadge "sharing economy" into a new term: "the real sharing economy". We know this is coming. Knowing this, only the most naive would believe that the liberatory phenomena that we describe will not be subject to the forces of capitalist appropriation.

Platform capitalism today has already become a game of peasants and lords, renters and rentiers. These seeds are the new ideas, terminology, imaginaries and visions, examples and emerging practices, which hold a potential that we know can be unlocked in the 21st century. Our intention in this anthology is that these can become the basis for a new system that makes the present one obsolete, but we also know fundamental change happens through the *longue durée*, the long game.

The Cosmo and the Local

"Cosmo" is the classic Greek word for universe or world (κόσμος). For us Cosmo is about the universalisation of care. As the late David Held often wrote, we live in "overlapping communities of fate". All the people of the world (and their future generations) have to deal with the impact of climate change. Human beings, cultural creatures that we are, like to compartmentalise issues, so that we can say, 'that is happening over there, in that other place or system'. But the revolution over the past half century has been a shift into systems thinking, and more so, *systemic experience*.

From the COVID-19 pandemic, to climate, to K-pop, we experience ourselves as deeply interconnected. This means we are involved in shared concerns that require action for the planetary good - the health of our planetary ecosystems, species and the wellbeing of ALL people of the Earth - our shared commons.

The other half of the term, "Local", is a well recognised word, but is too often relegated as secondary. In our conception it is equally important, indeed an integral part of the dynamic synergy we see as necessary for transformation.

Local first of all is our embodiment in a place, denoting that we are always in interaction, and interdependent, with the living and nonliving in our direct proximity. Indeed we first cognise and know the world through this embodiment, and as people and communities we first experience and understand our needs most pointedly through this mode of relationality, whether we live in cities, towns, rural settings or places predominantly comprised of non-humans.

A maker space or fab lab is a place, by definition local. So is a biome or bioregion. How value is realised in this movement for others and ourselves is always somehow embodied, through visceral interaction making or exchanging, and even those relationally abstracted through digits and blockchains. The seeds of the transformation we see are all "localisations", they express themselves in these particular places and times. These are the seeds in our peer-to-peer world that become translocal manifestations that make a cosmolocal world possible.[8]

But even more so the local in cosmolocal is a rupture from a presumed universal development strategy, the flawed assumption that there is a standard and best way to "develop". It signals a movement toward a pluriversal autonomy and creativity. While maintaining a commitment to open knowledge and design, localities can take the pathways that its people and beings know and feel to work for them. This creates the conditions for dynamic synergy between the diversity of creativities that emerge across our planetary geographies.

Diverse Framings and Genealogies

So let this be a moment. Not an aspiration for the universal, but an invitation to the endless regenerative iterations that is life and evolution. Let this be a crossroads that leads to other fruitful paths, ideas and framings. Cosmolocal is a momentary choice among many possible framings that exist and others that will emerge. In the opening section 1 of this anthology, **Cosmolocal Framings**, a number of chapters discuss these different ways of defining and understanding the phenomena and their potentials.

Laurent Dupont, Fedoua Kasmi, Joshua M. Pearce, and Roland J. Ortt, in their chapter **"Do-It-Together": Towards the Factories of the Future",**

8 Under adequate sociological scrutiny the idea of an essential local and global both tend to break down, and appear as particular social constructions. But these ontological and epistemological questions are best dealt with in some of the chapters and in other discussions. See also Latour, B. (2005). *Reassembling the Social: An Introduction to Actor Network Theory*. Oxford University Press; and, Santos, B. (2006). *The Rise of the Global Left: The World Social Forum and Beyond*. Zed Books.

describe the "Do-It-Together" (DIT) approach, a social manufacturing vision and strategy, which employs participatory design and collaborative production. They show how DIT can:

> *[integrate]… consumers in all the processes of customized product development, such as ideation, design and production, engaging them moreactively in local production in a commons-based peer production context, inspired by the agile and distributed functioning of the DIY.*[9]

In their chapter **"Evolving Systems for Generative Justice: Decolonial Approaches to the Cosmolocal"** Ron Eglash, Audrey Bennett, Michael Lachney, and William Babbitt are concerned with "Generative Justice", a "set of design principles, analytic tools, and development strategies for evolving towards a generative economy … which combine unalienated ecological value, labor value, and expressive value." This contribution helps us to understand the connection between production, design and human rights, indeed articulating a kind of "right to design":

> *The universal right to generate unalienated value and directly participate in its benefits; the rights of value generators to create their own conditions of production; and the rights of communities of value generation to nurture self-sustaining paths for its circulation.*[10]

Framings and genealogies are by nature entangled. Cosmolocal has nascent genealogies, but with ancient echoes. It has been used by others in a few different variations, but providing different perspectives that enrich the overall discourse. Genealogy provides foundations, ways of tracing the thinking, to go back, step forward, go back, step forward again. It strengthens the overall project. Not through closing down, but by opening up. Not by consensus but by debate and divergence. Genealogy is not about the single origins, but about the diverse conceptions and ideas that exist or were lost, marginalised, disowned or forgotten, which if rediscovered and re-engaged, can open up new thinking and alternative futures.[11] As any good emerging discourse should, we need a wide variety of perspectives that act like rich soil, a microbiome of complexity and regeneration.

In **"A Genealogy of Cosmolocalism"** authors Alexandros Schismenos, Vasilis Niaros and Lucas Lemos, provide a strong opening discussion. This chapter reviews the early articulation of Wolfgang Sachs' and more

9 Dupont, L., Kasmi, F., Pearce, J.M., and Ortt, R.J. (2021). "Do-It-Together": Towards the Factories of the Future. *Cosmolocal Reader*. Futures Lab

10 Eglash, R., Bennett, A. Lachney, M. and Babbitt, W. (2021). Evolving Systems for Generative Justice: Decolonial Approaches to the Cosmolocal. *Cosmolocal Reader*. Futures Lab

11 Inayatullah, S. (1998). Causal Layered Analysis: Post-Structuralism as Method. *Futures*, 30(8), 815-829.

recently Ezio Manzini's cosmopolitan localism, the broader discourse on cosmopolitanism, localisation, the more recent focus on P2P and the commons, and post-capitalist questions. The discourse is a confluence of emerging synergies, which attempts to create space for divergent post-capitalist imaginaries and strategies for the majority world. They write:

> *More than a mode of design and a manner of communication, cosmolocalism reinvents the communal and creates a different mode of sociality based on commonality, innovation, equipotentiality and freedom. To the degree that cosmolocalism creates community, it consequently creates an ethos and a pathos. These open up new horizons for the project of social transformation and inspire new, more horizontal and equal forms of societal institutions.*[12]

Alternative Globalisations

Even within this diversity of framings and genealogy, cosmolocalism sets an alternative trajectory beyond the neo-liberal globalisation agenda that is too often slanted toward the benefit of multinational corporations, the extremely wealthy and organised transnational crime syndicates. The search and articulation of alternatives has been long and widespread, with work over many decades and across many disciplines, languages and visions. Cosmolocalism can therefore also be seen as a mix between a number of alternative globalization discourses.[13]

Alluded to earlier, Escobar's work on "pluriversalism" and earlier post-development work put forward the need to rupture from universalist, neo-colonial and top-town developmentalism and articulate an autonomous and endogenous "design" approach.[14] Parallel to this, through the 1990s and 2000s the International Forum on Globalization (IFG) brought together global south and north advocates in an alliance dialectically opposed to the mega-scale economic globalization project. They argued for a (re) localization of the economy and sociality as a counterbalance to the stripping away of local power and autonomy.[15] Relocalization articulates the need to reaffirm subsidiarity as a critical principle of economic, social and political life.[16]

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12 Schismenos, A., Niaros, V. and Lemos, L. (2021). A Genealogy of Cosmolocalism. *Cosmolocal Reader.* Futures Lab

13 Ramos, J. (2010). *Alternative Futures of Globalisation: A socio-ecological study of the World Social Forum Process.* [Doctoral dissertation, Queensland University of Technology].

14 Escobar, A. (1995). *Encountering development.* Princeton University Press.

15 Mander, J., Goldsmith, E. (Ed.) (1996). *The Case Against the Global Economy.* Sierra Club Books.

16 Hines, C. (2002). *Localization: A Global Manifesto.* Earthscan.

Alternatively, cosmopolitan theory with its Kantian inspired origins puts emphasis on universal human rights and the critical importance of a planetary community.[17] In the search and articulation of alternatives to globalisation Santos has made foundational contributions. Notable is his concept of insurgent cosmopolitanism, which mobilises a spatial imaginary:

> *insurgent cosmopolitanism... consists of the transnationally organized resistance against the unequal exchanges produced or intensified by globalized localisms and localized globalisms. This resistance is organized through local/global linkages between social organizations and movements representing those classes and social groups victimized by hegemonic globalization and united in concrete struggles against exclusion, subordinate inclusion, destruction of livelihoods and ecological destruction, political oppression, or cultural suppression, etc.*[18]

At the same time, any notion of change must grapple with the power dynamics of global capitalism.[19] In **"The Pulsation of the Commons: The Temporal Context of Cosmolocal Transition,"** Michel Bauwens and José Ramos are concerned with the wax and wane between extractive political economies (e.g. modern day capitalism) and commons based transformations over historical, macro-historical, evolutionary and pre-historical frames. This provides an opportunity to speculate on what a post-capitalist form and transition dynamic may be. They write:

> *we are going through both a meta-historical event, the loss of our balance with nature at a global level, and at the same time a change within the cycles of capitalism. Both these temporal events, which both lead to a re-strengthening of the commons, are converging in one single global process, which brings the necessity of a re-emergence of the commons to the fore.*[20]

Overall this anthology stands for a diversity of framings and genealogies, thought and practice, which we believe can foment debate and creative cross-fertilisations. We believe it is through a rich ecosystem of ideas and conversations that a planetary cosmolocal ecosystem will be born.

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17 Held, D., McGrew, A. (Ed.) (2000). *The Global Transformations Reader: An Introduction to the Globalization Debate.* Polity Press; Baker, G., & Chandler, D. (2004). *Global civil society: contested futures.* Routledge.
18 Santos, B. (2006). Globalizations. *Theory, Culture & Society*, 23(2-3), p.397.
19 Robinson, W. (2004). *A Theory of Global Capitalism*. John Hopkins University Press.
20 Bauwens, M. and Ramos, J. (2021). The Pulsation of the Commons: The Temporal Context of Cosmolocal Transition. *Cosmolocal Reader*. Futures Lab.

Ecosystems for Planetary Mutualisation

One of the critical challenges we face is in discovering how to find synergies and 'symbioses' between diverse but complementary agents of change. Life thrives through these complex networks of relationships that generate far more than the sum of their parts. From the exchanges of the bee and the flower to the estimated five million trillion trillions of microbes that make our soils living and healthy, we know robust systems require dynamic exchanges of value between entities that are fundamentally different.[21] How we create a cosmolocal ecosystem of generative value is one of the critical questions we are facing.

Cosmolocalism in broad terms represents a planetary / translocal mutualisation strategy - the mutualization of planetary knowledge for use in localised production, solutions and development, to support positive social and ecological goals. We imagine that as communities around the world create ideas, innovations, designs, experiments and solutions (IIDEAS), document them and keep them open, these open and globally distributed pools and platforms can increase, getting bigger, replicating, and reciprocally supporting localised solutions and production — a virtuous and regenerative cycle.

The "IIDEAS" mnemonic is a basket to denote how a global knowledge commons includes a number of types and categories of cultural artefacts and processes, as part of an ecosystem. It is a simple way to expand and hold a more complex notion of a global knowledge commons which can include many categories:[22]

- **Ideas** - these can be concepts, ideas for change, and the realm of knowledge. Open knowledge empowers communities with deeper understanding and capabilities;
- **Innovations** - these are any artefacts from an innovation process, and can be reproduced or re-iterated;
- **Designs** - these are the often ready to use ways of manufacturing products, or can be the detailed specifications for a product or shared service;
- **Experiments** - these are processes to try something new with a community. It is possible to do open experimentation, where a planetary community can learn from one community's experiment;

21 https://www.sciencedaily.com/releases/1998/08/980825080732.htm
22 Ramos, J. (2021). The Power of IIDEAS: Cosmolocalism and the Transformation of the Production of Everyday Life. (Report). The Seoul Institute.

- **Actions** - specific practices people use to create change that can be examples for others;
- **Solutions** - ways that a problem is definitively solved in a place, and which can be shared and adapted.

The second section of this anthology **Building Cosmolocal Ecosystems** addresses these questions. In the chapter by José Ramos, **"Cosmolocal Questions: From Tech Trend to Protocol Commons"** he argues that the challenge we face within a global neo-liberal political economy is to sustain smaller scale "pop-up" cosmolocal political economies. These will often have anchor institutions that establish and give support to these ecosystems. Drawing on a number of examples and ideas on the urban commons and the work of Christian Iaione and LabGov colleagues, he shows how cosmolocal ecosystems may be composed. The fundamental challenge he feels is developing a "protocol commons", a shared meta-language of commoning:

> *…in order to create these pop up political economies we need to see ourselves as part of potential ecosystems. We need to begin to create a system of shared language and messaging that allows one commoning activity to leverage or find synergies with another. This 'protocol commons' would allow for collaboration and synergy even when these activities and projects are fundamentally different.*[23]

Sharon Ede's chapter **"Making Room for the Community-Based Circular Economy,"** extends the vision of what it means to generate ecosystems, making the connection between cosmolocal strategies and enabling circular economies. Widely accepted definitions of the circular economy are primarily concerned with designing out waste, keeping products and materials in use and regenerating natural systems. Under this definition, the circular economy also aims to redefine growth and decouple economic activity from the consumption of finite resources. It is often taken for granted that the circulation of materials can happen within a growing economy. However, the demand for materials and energy needs to be considered in the context of the limits of a finite planet.

Materials can keep circulating through being designed for disassembly and remanufacturing, or kept in use longer through being designed for durability, but if the 'circle' or total demand for materials and energy keeps expanding, we have not solved our civilisation's growth problem. Sharon Ede's therefore argues that:

23 Ramos, J. (2021). Cosmolocal Questions: From Tech Trend to Protocol Commons. *Cosmolocal Reader*. Futures Lab.

A circular economy requires a local production capacity, else it remains a bury, burn or bale-and-export linear economy. One approach to relocalising production is 'design global, manufacture local' (or 'produce local'). The economy of bits – the designs, plans, information, which is light, travels. The economy of atoms – the materials, the production, which is heavy, stays as local as possible.[24]

Her implicit vision for cosmolocalism is therefore not just more "manufacturing", "design", and "production" (even if leveraging open IIDEAS), but is a context based notion of convivial economic sustainment that sits within a framework of planetary ecological boundaries and an intelligent metabolism of resource flows that sustain the local.

In the chapter **"Fab Cities and the Urban Transformations of the 21st Century"** Tomas Diez provides a robust vision and emerging practice for transforming cities, ecosystem generation par excellence. In his chapter he argues that:

[Fab Cities bring] the impact of digital technology available in Fab Labs to cities. It connects distributed networks of hyper-local and productive ecosystems. By adopting the Fab City challenge, cities can radically transform the way production and consumption happens within their metropolitan regions, by replacing standardization with smart customization, focusing on interconnected processes instead of isolated products, and more importantly: empowering citizens and communities while reducing the environmental impact of urbanization.[25]

In the over 40 cases and examples in the reader a number of ecosystem generating initiatives are documented. bHive is an open software sharing framework for economic relocalization. The Open Food Network supports the creation of food distribution ecosystems, linking farmers with wholesalers and buyers. Solar Urja uses a university as an anchor institution (IIT Bombay) to appropriate open hardware to design and scale solar lamps for rural Indian villagers. Multi Factory is a federation of autonomous manufacturing centres that practice collaboration and co-production. Ecosystem generation is in the very DNA of cosmolocalism.

As Andrew Ward discusses in his chapter **"Financing Cosmo-Localism"**, to move from just small scale entrepreneurial prototypes to larger scale

24 Ede, S. (2021). Making Room for the Community-Based Circular Economy. *Cosmolocal Reader*. Futures Lab.
25 Diez, T. (2021). Fab Cities and the Urban Transformations of the 21st Century. *Cosmolocal Reader*. Futures Lab.

impact, cosmolocal enterprises need to be able to discover an appropriate investment logic. But far from just succumbing to venture capital, Ward argues that the emerging and value aligned Community Wealth Building model can provide this missing link:

> *When combined, 'Cosmo' and 'Localism' becomes a new set of Cosmo-Local business models. This will provide opportunities that sit well alongside a more sensible investors thesis based on fair returns and less risk. It will suit investors that want to use the services and products locally. This might apply to things like Food, Energy, Water, Waste, Education, Social Services and more. These sectors whilst not "sexy" like Apps and Software have significant asset-backing, market durability and near constant demand.*[26]

To round out the conversation on ecosystem building, Willmar Ricardo Rugeles Joya's chapter **"Cosmolocalism, a Tool for the Social Appropriation of Knowledge and Rural Development"** shows what this ecosystem looks like in a rural setting. He argues that four elements are needed for projects to generate value: 1) Knowledge transfer and exchange, 2) Citizen participation, 3) Knowledge management for the appropriation and 4) Communication of science, technology and innovation. He explains the framework through three case examples, showing how these four elements work together and the centrality of participatory practice:

> *…meaningful participation in finding solutions to [community] problems keeps the work aligned to the real goals, expedites the implementation and improves efficacy. In recent years, many changes have also been observed in the quantity and quality of these processes, both in the number of people involved and in the type of relationships that are generated between grassroots associations and their involvement in these projects.*[27]

Challenging Cosmolocalism

If we are serious that this articulation represents a moment and not a claim to the universal, then we also need substantive critique. As Ashis Nandy argued, in articulating and promoting a vision of the future, we cannot stop "overzealous ideologues" from declaring it the only possible or best future, or locking down lines of debate to certain terms or boundaries. But ideologies need "escape clauses" and we can build in self doubt, openness and dialog

26 Ward, A. (2021). Financing Cosmo-Localism. *Cosmolocal Reader*. Futures Lab.
27 Rugeles, W.R. (2021). Cosmolocalism, a Tool for the Social Appropriation of Knowledge and Rural Development. *Cosmolocal Reader*. Futures Lab.

such that honest reflection and learning is possible, and the thinking can evolve. The third section of the Reader **Challenging Cosmolocalism** takes this up.[28]

In the chapter **"Cosmo-localization & Localization: Towards a Critical Convergence",** Helena Norberg-Hodge, Alex Jensen, Henry Coleman and Steven Gorelick review the earlier relocalization and more recent cosmo-localization literatures. They view the construct of the global with a skeptical and critical eye:

> *When tied into a big-picture, systemic analysis, stories from the other side of the world can help us recognize that the many ecological, social and psychological crises we all experience actually stem from the same source – an out-of-control economic system that is, first and foremost, a global system. From this vantage point, epidemics of depression, unemployment, a growing gap between rich and poor, toxic pollution and climate change are all symptoms of an underlying systemic disease that knows no borders – a disease that is closely tied to the spread of a profit-hungry techno-economic Juggernaut.*

They also argue that characterizations of relocalization as an inward looking movement are false; relocalization has historically been internationalist as a movement of change and invested in transnational solidarities. And they critique cosmolocal literature as being overly "techno-solutionist" and uncritically accepting urbanisation as an inevitability. Presenting a critique of technological and industrial alienation, they write:

> *Distributed digital fabrication may have positive qualities of decentralization and autonomy from the tyranny of corporate commodities, but does not – compared to the older appropriate technology movement – constitute a sufficiently radical break with the alienation of industrial production itself. Thus even the example of a 3D-printed earthen house, while admirably resolving the problem of toxic plastic feedstocks, still presents an alienated form of production where the human element (and thus, potentially meaningful employment) is largely replaced.*[29]

Their chapter reminds us that underneath particular discourses are foundational assumptions that need to be examined and questioned, lest we fall into "used futures".[30] Michael Mcallum in his chapter **"Repositioning**

28 Nandy, A. (1992). *Traditions, Tyranny and Utopias*. Oxford University Press. p.7.
29 Norberg-Hodge, H., Jensen, A., Coleman, H. and Gorelick, S. (2021).
Cosmo-localization & Localization: Towards a Critical Convergence. *Cosmolocal Reader.* Futures Lab.
30 Inayatullah, S. (2008). Six pillars: futures thinking for transforming. *Foresight,* 10(1).

Cosmo-Local in a ´Beyond´ Space Place" takes this one step further. His critique argues that current cosmolocal discourse is too locked into the modernist dualism of socialism versus capitalism, both mechanistic and imbued with subtle meanings and influences that exert hidden force. He argues cosmolocal needs to be freed from these unconscious entanglements and become an opening to a world with many possible worlds. He writes:

> *Pluriversalism or the 'making of many worlds' begins to reconceive [and] redefine localism in ways that are neither necessarily entirely modernist nor constrained by the unrealizable backward nostalgia ... It emphasizes community, commons and conviviality rather than consumerism, contract based relational arrangements (like franchises) and the effects of wealth inequality. It conceives of spaces of reflection and action that are "diverse, ethically negotiated practices that support the livelihoods of humans and non-humans to build flourishing habitats". Clearly this conception of localization is vastly different from [the] urbanized (cosmopolitan) city model that the majority of the world's population inhabit. It portends a completely different way of living; one that restructures value transfer and wealth creation through arrangements which largely contain and distribute benefit within local communities in contrast to the current models which look to extract as much as possible from communities, leaving only sufficient residue to generate future demand.*[31]

Finally, in **"The Australian Bush Mechanic and her Potential in Helping to Save the Planet",** Paul Wildman provides a fascinating genealogy from which to locate hands-on and ground-up cosmolocal inspiration. He writes:

> *[Planetary Bricoleur] Peer with Peer (PwP) is a survival meme, burning man, essentialist yet also a peak achievement for our, and other, species. Yet hardly thrival…. That is up to our souls. Yet now I fear a bridge too far. We will crash and burn and after that what???? We need a social technology that works alongside a technocratic one… we need PwP and P2P that allows us in community to obviate the need for the centre in the first place, without the nation state for extractive neo-liberal system that we have now dominating our mother Gaia. That is where P2P work together best: that interstice, that luminous space; as Leonard Cohen says the crack between the worlds where the light gets in.*[32]

31 Mcallum, M. (2021). Repositioning Cosmo-Local in a ´Beyond´ Space Place. *Cosmolocal Reader*. Futures Lab.
32 Wildman, P. and Bauwens, M. (2021). The Australian Bush Mechanic and her Potential in Helping to Save the Planet. *Cosmolocal Reader*. Futures Lab.

An Overview of the Cases and Examples

The second part of the Reader has 38 stories, examples or cases (sections 4-7). We wanted to build a compelling body of examples and stories, to address healthy scepticism and natural incredulity, but also to provide a large enough body of work to allow readers to draw their own patterns and conclusions. We considered many possible examples but landed on those that we thought fit our implicit understanding of what cosmolocalism is, and where there was sufficient credible information (someone willing to answer questions, news media, previous research). The formats of the stories and examples also differ. Some are more narrative, others more analytic, others are interview responses and others are only short summaries.

In the fourth section of the Reader we look at **Cosmolocal Stories,** which are journalistic and narrative in style. This highlights the amazing achievements of the SoUL / Solar Urja project, carefully documented by Raji Ajwani Ramchandani and Snehal Awate in their chapter **"Let there be light: IIT Bombay's SoUL Project to Energize Rural India."**[33] David Li in **"Rural Dynamism in the Digital Age"** shows how rural villagers have embraced digital fabrication techniques in Jiangsu province in China.[34] Joshua M. Pearce chronicles the battle between patent trolls and the open source movement, and the development of an algorithmic defense of digital fabrication, in his chapter "**An Open Source Preemptive Strike in the Coming War Over The Freedom to Make Your Own Products."**[35] Chrystèle Bazin writes about **"Utopia Maker"** a project to provide open source prosthetics to those in need in Colombia, France, Vietnam and the Central African Republic.[36]

In his chapter **"AgOpenGPS and DIY Open Farm Innovation: An Overview",** Chris Bennett chronicles how farmers in the US are reappropriating technology and using DIY innovation.[37] Finally in **"Chang'an: 3D Printing Cyberpunk Town on Pearl River Delta"** Huiqi (Vicky) Xie, David Li, and Kangkang Zhang, tell the remarkable story of how Chang'an (Pearl River Delta region of Southern China) emerged as the 3D printing capital of China.[38]

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33 Ajwani-Ramchandani, R. and Awate, S. (2021). Let there be light: IIT Bombay's SoUL Project to Energize Rural India. *Cosmolocal Reader*. Futures Lab.
34 Li, D. (2021). Rural Dynamism in the Digital Age. *Cosmolocal Reader.* Futures Lab.
35 Pearce, J.M. (2021). An Open Source Preemptive Strike in the Coming War Over The Freedom to Make Your Own Products. *Cosmolocal Reader*. Futures Lab.
36 Bazin, C. (2021). Utopia Maker. *Cosmolocal Reader.* Futures Lab.
37 Bennett, C. (2021). AgOpenGPS and DIY Open Farm Innovation: An Overview. *Cosmolocal Reader.* Futures Lab.
38 Xie, H., Li, D., and Zhang, K. (2021). Chang'an: 3D Printing Cyberpunk Town on Pearl River Delta. *Cosmolocal Reader*. Futures Lab.

The fifth section, **Cosmolocal Explorations**, provides documented cases more analytic in style. In **"Wind Empowerment, Pico-hydro and Nea Guinea"** authors Vasilis Kostakis, Kostas Latoufis, Minas Liarokapis, and Michel Bauwens provide an overview of the remarkable community windpower and hydropower movement.[39] Chris Giotitsas provides two cases of agricultural communities developing auto-productive capacity, in **"Farm Hack: A Farmer-Driven Platform for Knowledge Exchange"**[40] and **"L'atelier Paysan: Peasants Building Their Own Tools."**[41]

Vasilis Kostakis, Kostas Latoufis, Minas Liarokapis, and Michel Bauwens, analyze **"Open Bionics",** an open source prosthetics community.[42] Michel Bauwens and Vasilis Niaros offer the remarkable example of **"Sensorica"**.[43] Alekos Pantazis and Morgan Meyer provide an in-depth overview of **"Tzoumakers"**, a rural tool development community in Greece.[44] Michel Bauwens, Alex Pazaitis and Gien Wong provide an explanation of ***"MuSIASEM",*** an accounting system for regional societal and ecosystem metabolisms.[45] **"FabChain"** as documented by Michel Bauwens and Alex Pazaitis, links advanced research to urban metabolisms and mainstream production and manufacturing.[46] In a similar fashion Bauwens and Pazaitis discuss **"FairCoin and FairCoop",** tools for creating cosmo-local, open cooperative ecosystems.[47]

Finally, Gabor Kiss describes **"Envienta"**[48], an "open-source project for inventors and product developers to collaborate and openly share their ideas." Michel Bauwens and Alex Pazaitis provide an overview of **"Holochain"**, an alternative to a global distributed ledger that maintains autonomy with local networks.[49] Finally José Ramos and co-founder Melissa Fuller provide an overview of **"AbilityMade: Producing Open Assistive Devices for People with Disabilities."**[50]

The sixth section, **Cosmolocal Q&A**, has three interviews. The first is with

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39 Kostakis, V. Latoufis, K., Liarokapis, M. and Bauwens, M. (2021). Wind Empowerment, Pico-hydro and Nea Guinea. *Cosmolocal Reader*. Futures Lab.
40 Giotitsas, C. (2021). Farm Hack: A Farmer-Driven Platform for Knowledge Exchange. *Cosmolocal Reader*. Futures Lab.
41 Giotitsas, C. (2021). L'atelier Paysan: Peasants Building Their Own Tools. *Cosmolocal Reader*. Futures Lab.
42 Kostakis, V., Latoufis, K., Liarokapis, M. and Bauwens, M. (2021). Open Bionics. *Cosmolocal Reader.* Futures Lab.
43 Bauwens, M. and Niaros, M. (2021). Sensorica. *Cosmolocal Reader*. Futures Lab.
44 Pantazis, A. and Meyer, M. (2021). Tzoumakers. *Cosmolocal Reader.* Futures Lab.
45 Bauwens, M., Pazaitis, A. and Wong, G. (2021). MuSIASEM. *Cosmolocal Reader.* Futures Lab.
46 Bauwens, A. and Pazaitis, A. (2021). FabChain. *Cosmolocal Reader.* Futures Lab.
47 Bauwens, A. and Pazaitis, A. (2021). FairCoin and FairCoop. *Cosmolocal Reader*. Futures Lab.
48 Kiss, G. (2021). Envienta. Cosmolocal Reader. Futures Lab.
49 Bauwens, M. and Pazaitis, A. (2021). Holochain. *Cosmolocal Reader*. Futures Lab.
50 Ramos, J. and Fuller, M. (2021). AbilityMade: Producing Open Assistive Devices for People with Disabilities. *Cosmolocal Reader.* Futures Lab.

the founder of **bHive Cooperative** Ian McBurney, a digital platform that allows people to create, own and run their own sharing enterprises, and to generate local goods and services.[51] Yuki Liu discusses **Open Motors**, an enterprise creating an open ecosystem for electric vehicles.[52] Finally, Carolina Portugal gives an overview of **Wikifactory**, a social platform for collaborative product development.[53]

The seventh section, **Cosmolocal Snapshots**, provides short summaries and vignettes. Various authors contributed to this: **Appropedia** (Sharon Ede), **Cosmolocalism** (Vasilis Kostakis), **FarmBot** (Michel Bauwens and José Ramos), **Field Ready** (Sharon Ede), **GLIA** (José Ramos), **Hexayurt** (Christina Priavolou), **LEKA Restaurant** (Sharon Ede), **Multi Factory** (Michel Bauwens), **Open Source COVID-19 Medical Supplies** (Sharon Ede), **Open Source Ecology** (José Ramos), **OSE Microhouse** (Christina Priavolou), **Open Desk** (Sharon Ede), **Open Food Network** (Sharon Ede), **Open Insulin** (José Ramos), **Precious Plastic** (Abril Chimal), **RepRap** (José Ramos), and **Wikihouse** (Christina Priavolou).[54]

We also understand that there are hundreds, maybe thousands, of other examples around the world that have not been documented and shared, and we encourage anyone who wants to add to the pool by visiting https://clreader.net and submitting their examples.

Concluding Thoughts

Both the ideas and examples in this Reader provide ample resources to draw useful lessons from. Our hope is that by gathering these resources together, by providing a sense of a greater whole, we can all take the work to the next level. Our challenges are great and if cosmolocalism and this Reader play a role in addressing them, then we have made a useful contribution.

We know that cosmolocalism sits within a broader ecology of social change, and it cannot work without a number of other interlocking commons based strategies. To the extent that access to land continues to be enclosed through the global mobility of capital, and the price gains are captured by speculators rather than communities, we'll continue to see people working more and more to hand over their earnings to pay bank mortgages and rents, rather than having resources for auto-productive creativity. If cosmolocalism stands for equipotentiality, the ability of all people to create livelihoods, then land and land rights are fundamental.

51 McBurney, I. (2021). bHive Cooperative. *Cosmolocal Reader*. Futures Lab.
52 Liu, Y. (2021). Open Motors. *Cosmolocal Reader*. Futures Lab.
53 Portugal, C. (2021). Wikifactory. *Cosmolocal Reader*. Futures Lab.
54 See references.

We also inherit a world of deep inequalities and discrimination based on gender, class, caste, culture, skin color and appearance, ability, sexuality and other factors. Many of these inequalities have been generated by capitalist industrialisation, but many more are the legacy of colonialism, and still others the legacy of patriarchy. If cosmolocalism stands for equipotentiality, then it needs to link arms with the movements and voices to end all forms of inequality and discrimination.

As well, we'll need accountable public policy and innovative governance to support this shift. To scale the potentials for cosmolocalism will require new political contracts such as polycentric governance of urban commons, partner cities and states and other forms that build the structures and foundations for this equipotentiality. We'll also need to create a new planetary culture of sharing and solidarity, even while division and fear is stoked by lesser selves.

As you will see in this reader, the idea that we can address our greatest challenges when we work together is a simple idea that belies the complexity and enormity in making this a reality. But every example in the reader shows how it is possible. Fortunately, there are many of us and every human being on the planet can play a part in bringing forth this transformation. Clearly this is the beginning of our journey as each of us discover the part we want to play in these Epic Times.

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01
Cosmolocal Framings

A Genealogy of Cosmolocalism

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Introduction

Over the last decades, the proliferation of ICTs and capitalist markets has created a new social-historical reality for communication, production and societal organisation, while social inequality has deepened. In this context, alternative forms of organisation based on the commons have emerged, challenging the core values of capitalism. Within this new form of egalitarian and transnational collaborative networks, a new concept of social coexistence has been proposed: cosmolocalism. This article presents the genealogy of cosmolocalism and compares it to previous conceptual universalist reconfigurations, namely cosmopolitanism and internationalism.

Cosmolocalism, or cosmopolitan localism, is a concept that has appeared in the last decades in the field of communications, design and peer production, following the creation and expansion of digital communication networks. It is a way to globally link local communities in networks of shared exchange concerning both production and consumption.[2] Cosmolocalism creates a new appreciation of place and reinvents the communal in an open and resilient manner.[3] Thus, it transfigures the relation between locality and

2 Manzini, E. (2015). *Design, When Everybody Designs: An Introduction to Design for Social Innovation.* Cambridge, MA: MIT Press.
3 Escobar, A. (2018). *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds.* Durham: Duke University Press.

universality, respecting and promoting local communities across a global network of equal co-existence.[4]

Cosmolocalism provides an alternative framework for collaborative production. It aims to create resilience locally by sharing resources globally as 'digital commons'. As Ramos notes: "In very basic terms cosmo-localism describes the dynamic potentials of our emerging globally distributed knowledge and design commons in conjunction with the emerging (high and low tech) capacity for localised production of value".[5]

More than a mode of design and a manner of communication, cosmolocalism reinvents the communal and creates a different mode of sociality based on commonality, innovation, equipotentiality and freedom. To the degree that cosmolocalism creates community, it consequently creates an ethos and a pathos.[6] These open up new horizons for the project of social transformation and inspire new, more horizontal and equal forms of societal institution.[7]

This article attempts to analyse the historical and political connotations of the concept of cosmolocalism and examine it in the context of the commons. We examine the configuration of the local/universal polarity within three concepts of universalism that were developed in different historical contexts: cosmopolitanism, internationalism and cosmolocalism. We argue that cosmolocalism provides an alternative conceptual configuration of the relations between locality and universality that underlines issues of social identity and political authority.

Three Concepts of Universalism

Cosmopolitanism

Cosmopolitanism is the first theoretical expression of universalism. It originates in the social-historical context of the late Athenian democracy (ca. 404 to 322 BC), and especially the Macedonian (ca. 335 to 168 BC) and Roman (ca. 27 BC to 476 AD) empires. Diogenes of Sinope, a student of Socrates and the founder of the Cynic philosophical movement, is alleged to have self-identified as a kosmopolites: a citizen of the world. This view

4 Sachs, W. (1992). *The Development Dictionary: A Guide to Knowledge as Power*. London: Zed Books.
5 Ramos, J. (2017). Cosmo-Localization and Leadership for the Future. *Journal of Futures Studies* 21(4): 65-84.
6 Kioupkiolis, A. (2019). *The Common and Counter-Hegemonic Politics*. Edinburgh: Edinburgh University Press.
7 Schismenos, A. (2019). *Direct Democracy, Social Ecology and Public Time. In Social Ecology and the Right to the City*, edited by Federico Venturini, Emet Değirmenci and Ines Morales, 128-141. Montreal: Black Rose Books.

marked a significant widening of the concept of citizenship, far beyond its political limits within the locality of a specific city. Diogenes identified virtue as personal independence from all attachments, material or political. However, his aspiration to cosmopolitanism denoted a deeper sense of belonging than the level of locality, which was universal.[8]

This notion of cosmopolitanism was further explored and theorised by the Stoics. In the context of Stoic philosophy, every human individual "dwells [...] in two communities – the local community of our birth, and the community of human argument and aspiration".[9] The Stoics' description of human existence adopted a concentric model, with each individual at the centre surrounded by circles of degrees of affiliation.

Cosmopolitanism arose in the social-historical context of the polis, a political model based on independent and fairly autonomous cities across the Aegean Sea. However, it grew more fully in the social-historical context of the empire. As a multicultural centralised political formation, an empire could lay claim to territorial universality.

The notion of cosmopolitanism was reinvented in Western Europe during the age of the Enlightenment (between the 17th and the 19th centuries), most notably in the work of Immanuel Kant. Following Kleingeld,[10] cosmopolitanism in Germany differentiated several areas of expertise, including morality, culture, legality and economy, wrapped up into a romantic idealisation. Kant envisioned a perpetual peace that would be founded on the universal features of humankind and, even more broadly, on the universality of reason itself. He argued for a law of 'world citizenship' (ius cosmopoliticum) based on the commonality of human beings as citizens that supersedes local legal codes (ius civitatis) and national legislations (ius gentium) in their external mutual relationships.[11]

According to Kant, this cosmopolitan law exists in terms of mutual hospitality that is founded on the commonality of land-dwelling. Kant stresses our responsibility towards each other, points out that every human being is an end in itself and not a means for other causes, and provides the conceptual basis for universal humanity. Universality is the transcendental condition of human autonomy and dignity. Further, Kant expressed in theoretical and analytical terms the emancipation of Western societies

8 Nussbaum, M.C. (1997). Kant and Stoic Cosmopolitanism. *The Journal of Political Philosophy* 5(1): 1-25.
9 Nussbaum, M.C. (1997). Kant and Stoic Cosmopolitanism. *The Journal of Political Philosophy* 5(1): 3.
10 Kleingeld, P. (1999). Six Varieties of Cosmopolitanism in Late Eighteenth-Century Germany. *Journal of the History of Ideas* 60(3): 505-524.
11 Kant, I. (1795/1991). *Perpetual Peace: A Philosophical Sketch. In Kant's Political Writings,* edited by Hans Reiss, 93-131. Cambridge: Cambridge University Press.

from religious heteronomy, which had already inspired the American and French revolutions. The consequent declarations of universal human rights were a decisive institutional self-acknowledgement of humanity beyond local delimitations.

In recent years, cosmopolitanism has emerged in the context of post-colonial and anti-colonial studies to showcase the importance of non-European cultures, but also as a response to globalisation at the dawn of the 21st century.[12] Regarding the latter, one of the most vocal proponents of cosmopolitanism on a global scale is the German sociologist Ulrich Beck. In his works, Beck introduces a temporal element conceived as "reflexive modernisation". This element is manifested in the emergence of unanticipated global events during the process of globalisation, towards which societies must react simultaneously.[13] A revived cosmopolitanism is, according to Beck, necessary to recognise the Other and eliminate cultural biases.

Beck argues that "only the cosmopolitan outlook adequately fits with reality and provides an adequate basis for action".[14] In this context, cosmopolitanism is utilised as a methodological tool to describe a globalised world emerging in phenomena that highlight the interconnectedness between societies.[15]

Beck refers to events like the terrorist attacks of 9/11, climate change, and social insurrections like the Arab Spring, calling for a critique of the national paradigm that he deems inadequate to analyse these phenomena.[16]

Still, Beck's theory of cosmopolitanism bears the traits of a Eurocentric tradition and, as such, is a modernised version of Kantian cosmopolitanism.[17] His conception of Us and the Other seems fixed in preconceived geographical and cultural divisions. He also tends to downplay other fields of social struggle and inequality, like class divisions, the division between global North and South, and the primacy of capitalist centres over the global periphery. Thus, his cosmopolitan outlook does not transcend the hierarchy of global westernised culture over local indigenous cultures. Beck's advocating for tolerance and recognition of the Other fails to integrate cultural diversity in a culturally equitable level of global interconnectivity.

12 Mignolo, W.D. (2011). Cosmopolitan Localism: A Decolonial Shifting of the Kantian's Legacies. *Localities 1*(1): 11-45.
13 Beck, U. (1999). *World Risk Society*. Cambridge: Polity Press.
14 Beck, U. (2005). *Power in the Global Age*. Cambridge: Polity Press, p. 111
15 Beck, U. (2002). *The Cosmopolitan Society & Its Enemies*. Theory, Culture & Society 19(1-2): 17-44.
16 Beck, U. (2012). Redefining the Sociological Project: The Cosmopolitan Challenge. *Sociology 46*(1): 7-12.
17 Bhambra, G. K. (2010). Sociology after Postcolonialism: Provincialized Cosmopolitanisms and Connected Sociologies. In *Decolonizing European Sociology: Transdisciplinary Approaches,* edited by Encarnación Gutiérrez Rodriguez, Manuela Boatcă, and Sérgio Costa, 33-48. Farnham: Ashgate.

Instead, he follows a traditional centre/periphery model that complies with the dominant capitalist imaginary.

Gerard Delanty stresses the reflexive and internalised dimensions of Beck's re-evaluation of cosmopolitanism. He calls for a new cosmopolitan imagination that focuses on a variety of possible combinations between locality and globality, instead of reasserting the dominance between the centre and the periphery.[18] According to Delanty, "the notion of critical cosmopolitanism sees the category of the world in terms of openness rather than in terms of a universal system. It is this that defines the cosmopolitan imagination".[19] However, Delanty's critical approach seems to obscure the conceptual foundations of cosmopolitanism, since the notions of centre and periphery are presupposed and thus cannot be transcended in this context.

Internationalism

The revolutions of the 18t century gave birth to modernity, which inspired the impending dominant form of societal and political organisation: nationality. Nationality is directly linked to territory and politicises social features of locality, such as indigeneity, nativity, custom and language. It is correlated to a sense of common past, while nations are historical constructs not of universal necessity; rather, they are limited and sovereign imagined political communities.[20] As a fabricated intermediate between locality and universality, nationality is neither existential nor immanently transcendental. In principle, nationality is opposed to universality. Its dependence on territory and homogeneity negate any appeal to the universal. On the contrary, each nation-state is considered as an independent entity that is at war with other self-consistent, independent entities.[21]

The national fragmentation of universality does not favour locality either. The transition of political decision-making from the community to the state has deprived locality of any power. A base level of representation is of course left to local communities, which are the foundations of state legitimacy. Therefore, nationality disrupts the conjunction between locality and universality by substituting for their political and social dimensions.

18 Delanty, G. (2006). The Cosmopolitan Imagination: Critical Cosmopolitanism and Social Theory. *The British Journal of Sociology* 57 (1): 25-47.
19 Delanty, G. (2006). The Cosmopolitan Imagination: Critical Cosmopolitanism and Social Theory. *The British Journal of Sociology* 57 (1): 38.
20 Renan, E. (1996). What is a Nation? In *Becoming National: A Reader*, edited by Geoff Eley and Ronald G. Suny, 41-55. Oxford: Oxford University Press; Gellner, E. (1983). *Nations and Nationalism.* Ithaca: Cornell University Press; Anderson, B. (1991). *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. London: Verso.
21 Schmitt, C. (2007). *The Concept of the Political.* Translated by George Schwab. Chicago: University of Chicago Press.

Nationality is a measure of determination and an arbitrary formation of identity. Communities can become part of different nations, while nations can never become universal. Balibar and Wallerstein point out that "the concept of 'nation' is related to the political superstructure of this historical system [capitalist world-economy], the sovereign states that form and derive from the interstate system".[22]

Internationalism arose as an attempt to address this issue by transfiguring and recapturing universality in the context of national politics. This was the form that universalism took in the age of nation-states. Internationalism acknowledges the dominance of the nation-state paradigm and proposes equality and solidarity among nations, appealing to a sense of human universality.[23]

This type of internationalism emerged emphatically on the historical scene after the formation of the International Workers' Association in 1864, which united the whole spectrum of the revolutionary movement, from Marxists to anarchists. Internationalism has been an essential feature of emancipatory social movements that, at times, have managed to overcome national limitations and question the boundaries of nationality.

Another form of internationalism, related to markets and not to peoples' rights, has been promoted by the expansion of capitalism. In 1843, while the British Empire was expanding, advocates of Free Trade like Richard Cobden[24] argued for a Smithian version of internationalism that could be realised by connecting world markets. After the collapse of the Soviet 'Iron Curtain' in 1991, financial capitalist networks have expanded across the globe, a process that has been labelled "globalisation".[25] However, this internationalist agenda did not reduce, but rather intensified the contradictions of nation-state capitalism: the division between directors and executants; the division between native and foreigner; social inequalities and divisions of race and gender; and the dichotomy between internal space, i.e. the space of state jurisdiction, and external space, i.e. the space of international relations.

The invention of the telegraph, the radio and later digital communication technologies made universality tangible in the form of globality. Globality is the sense of a common world, restricted to our planet. It fills universality

22 Balibar, É. and Wallerstein, I., (1991). *Race, Nation, Class, Ambiguous Identities*. London: Verso, 78.
23 Nordlinger, J. (2013). *Peace They Say: A History of the Nobel Peace Prize, the Most Famous and Controversial Prize in the World*. New York: Encounter Books
24 Cobden, R. (1908). *Speeches on Questions of Public Policy*. London: T. Fisher Unwin.
25 Bresser-Pereira, L.C. (2008). Globalization, Nation-state and Catching Up. *Brazilian Journal of Political Economy* 28(4): 557-576.

with concrete experience, creating global infrastructures that provide an empirical foundation. Globality provides locality with a global length to project its activities, and renders universality an actualised potential, above the level of local individuation. It is over the international communication infrastructure of globality, known in the digital age as Information and Communication Technologies (ICT), that globalisation's private profit-driven network of corporations can constitute a global market.

An alternative to globalisation was offered by Roland Robertson, who first proposed the term "glocalisation" in the late 1980s.[26] This notion describes products or services that are distributed globally and take into consideration the needs of local users.[27] In its business sense, glocalisation is connected with micro-marketing and the construction of differentiated "consumer traditions".[28] However, Robertson broadens the meaning of glocalisation to offer a new articulation of the relation between the global and the local in terms of simultaneity and interpenetration. For Robertson, "glocalisation means the simultaneity – the co-presence – of both universalising and particularising tendencies".[29] He tries to transcend the tension between globalisation and localisation by emphasising the production of heterogeneity over the surface of homogeneity that globalisation projects. Robertson invites us to embrace heterogeneity, albeit in the homogenous acceptance of a top-down approach, since capitalistic processes of globalisation and glocalisation are driven by international directories and corporations.

In our view, glocalisation is a concept that proceeds from the universal to the local, thus obscuring local diversities and resistances that may be found in the tensions between globalised mechanisms and local authorities. In that manner, glocalisation remains rooted in its business origins and tied to micro-marketing and diverse advertising practices and thoughts, without putting into question the core capitalist motives behind globalisation/glocalisation. As a top-bottom theory it provides a methodological tool to describe the potential of capitalist expansion in a diverse world, but misses the potential for a post-capitalist transition.

As the ICT era matures, a new form of universality called cosmopolitan localism or cosmolocalism is emerging. Building on the criticism of corporate capitalism and global value chains, this new form transfigures

26 Robertson, R. (1997). Comments on the 'Global Triad' and Glocalisation. In *Globalisation and Indigenous Culture,* edited by Nobutake Inoue, 217-225. Tokyo: Institute for Japanese Cultural Classics.
27 Mendis, P. (2007). *Glocalization: the Human Side of Globalization.* Morrisville: Lulu Press.
28 Robertson, R. (1995). Glocalization: Time-Space and Homogeneity-Heterogeneity. In *Global Modernities*, edited by Mike Featherstone, Scott Lash and Roland Robertson, 25-44. London: Sage, 29.
29 Robertson, R. (1997). Comments on the 'Global Triad' and Glocalisation. In *Globalisation and Indigenous Culture*, edited by Nobutake Inoue, 217-225. Tokyo: Institute for Japanese Cultural Classics, 220.

the existential, the social and the political across the axis of locality and universality.

Cosmolocalism

The concept of cosmopolitan localism or cosmolocalism was pioneered by Wolfgang Sachs, a scholar in the field of environment, development, and globalisation. Sachs is known as one of the many followers of Ivan Illich and his work has influenced the green and ecological movements. In 1992, he edited the Development Dictionary: A Guide to Knowledge as Power, a 'classic' in (post-) development studies. Sachs asserts that cosmolocalism "seeks to amplify the richness of a place while keeping in mind the rights of a multifaceted world. It cherishes a particular place, yet at the same time knows about the relativity of all places".[30] Cosmolocalism retains 'placedness' linked with locality, while at the same time projecting it globally, without risking its particularity. Hence, cultural and communal diversity flourishes in a context of universal networking. Further, the local remains independent within the interdependent network that constitutes the global, thus promoting autonomy within complementarity on both levels. Contrary to glocalisation, cosmolocalism moves from locality to universality, acknowledging the local as the locus of social co-existence and emphasising the potential of global networking beyond capitalist market rules.

Ezio Manzini, a leading thinker in design for sustainability, has also envisioned workable alternatives for a sustainable society. As a professor in Design for Social Innovation, Manzini focuses on innovative processes and strategies related to production and consumption in the perspective of sustainable development. His recent work, Design, When Everybody Designs: An Introduction to Design for Social Innovation, discusses creative communities and emerging forms of collaboration.[31] Manzini describes cosmopolitan localism as a way to globally link local communities in distributed networks of shared exchange, bringing production and consumption closer together. This form of cosmolocalism is rooted in an emerging productive model that is based on the concept of the 'digital commons'.[32] While it can be argued that organisational structures resembling cosmolocalism yet rooted in the commons may exist, in the context of this article we embrace solely the aforementioned form.

30 Sachs, W. (1992). *The Development Dictionary: A Guide to Knowledge as Power.* London: Zed Books, 124.
31 Manzini, E. (2015). *Design, When Everybody Designs: An Introduction to Design for Social Innovation.* Cambridge, MA: MIT Press.
32 Bauwens, M., Kostakis, V. and Pazaitis, A.. (2019). *Peer to Peer: The Commons Manifesto.* London: University of Westminster Press.

The basic structure of the commons involves three parts in equal and reciprocal interrelation: common resources, which can be technical, cultural, social, or natural; institutions that set the rules of commoning, like open-source licenses or decision-making processes; and the communities involved in the (re)production of the commons.[33]

The process of digital commoning was first exemplified by open knowledge projects such as the free encyclopedia Wikipedia and other open-source software projects.[34] The second wave is related to open design and manufacturing.[35] In this setting, the design is developed and shared as a global digital commons, while manufacturing takes place locally.[36] Several technology initiatives that are small-scale and oriented towards resilience have been applying cosmolocal practices. Such initiatives include WikiHouse (buildings), RepRap (3D printers), OpenMotors (vehicles), OpenBionics (robotic and prosthetic hands) and L'Atelier Paysan (agricultural tools). Practically speaking, the latter initiative utilises a global pool of knowledge to produce farming tools locally but also expands this pool with its own contributions (in terms of designs, know-how and practices). Such a form of cosmolocalism has the potential to address the dependence of local communities on global value chains for its subsistence and the global corporate extractive model that spurs global warming.

Cosmolocalism relies on the same means of information production that support capitalist globalisation, i.e. communications, computation, sensors, and electronic storage.[37] What distinguishes cosmolocalism from capitalist globalisation is mostly its set of values and principles: reciprocity and self-organisation that respect individual autonomy, local particularity and cultural diversity; sharing that acknowledges commonality and mutual responsibility; collaboration that allows for public deliberation and reflection; and for-benefit orientation that offers a sense of social common good. In this sense, the commons are a necessary condition for cosmolocalism.

Cosmolocalism is not characterised by the external/internal dichotomy

33 Bollier, D. and Helfrich, S. (2015). *Patterns of Commoning*. Amherst: Levellers Press.
34 Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom.* New Haven: Yale University Press.
35 Kostakis, V., Latoufis, K., Liarokapis, M., and Bauwens, M. (2018). The Convergence of Digital Commons with Local Manufacturing from a Degrowth Perspective: Two Illustrative Cases. *Journal of Cleaner Production* 197(2):1684-1693.
36 Bauwens, M., Kostakis, V. and Pazaitis, A.. (2019). *Peer to Peer: The Commons Manifesto*. London: University of Westminster Press; Kostakis, V., Niaros, V., Dafermos, G. and Bauwens, M. (2015). Design Global, Manufacture Local: Exploring the Contours of an Emerging Productive Model. *Futures* 73: 126-135; Ramos, J. (2017). Cosmo-Localization and Leadership for the Future. *Journal of Futures Studies* 21(4): 65-84.
37 Kostakis, V. and Giotitsas, C. (2020). Small and Local Are Not Only Beautiful; They Can Be Powerful. *Antipode Online.*

that was imposed on internationalism by the dominant nation-state paradigm; instead it is characterised by modes of association that unify local communities without reducing their locality. Locality, being detached from territoriality, becomes purely cultural, correlated to language and custom; the common pool of resources created by the shared practices of commoners across their association preserves every local particularity in a plural, multivocal context where every commoner can equally and freely contribute. This collective, open and equal value production and distribution runs contrary to capitalism's profit-motivated economy. Whereas the latter establishes an exploitative and extractive method of using valuable resources in favour of profit, commons-based peer production establishes a contrary, generative method of sustaining and creating valuable resources in favour of mutual social benefit.[38]

Is cosmolocalism inherently anti-capitalist? As we have mentioned, it has been argued that cosmolocalism may be reduced to a tech trend.[39] However, we argue that this danger is the result of a failure to fully realise the potentials of cosmolocalism. In content, context and principle, cosmolocalism challenges the core values of capitalism. In reality, it puts into question the primal drive and motivation of the capitalist imaginary, the primacy of profit and "the central imaginary signification of capitalist development."[40]

Sachs has argued that the development discourse mobilises key concepts that crystallise "a set of tacit assumptions which reinforce the Occidental world-view".[41] The same critique can also be applied to Beck's cosmopolitanism. Sachs recognises that the significations of capitalist development have both shaped our worldview in a westernised mould and inspired devastating exploitative policies that "evidently failed as a socioeconomic endeavour".[42] Sachs invites us to test the developmental model of reality by realising cosmolocalism. In that sense, cosmolocalism challenges not only capitalist practices, but also the dominant perception of social-historical reality as defined by basic capitalist imaginary significations. In our view, the potential of a cosmolocalist worldview encompasses an anti-capitalist set of values, a non-capitalist mode of co-operation and a post-capitalist horizon of expectations.

Through open contributory practices and the equal distribution of resources, cosmolocalism establishes a new mode of community that is not based in

38 Bauwens, M., Kostakis, V. and Pazaitis, A.. (2019). *Peer to Peer: The Commons Manifesto*. London: University of Westminster Press.
39 Ramos, J. (2019). Cosmo Localism: Tech Trend, Post Capitalist Commons Transition or Something Else? *Medium*.
40 Arnason, J.P. (1989). Pour une Philosophie Militante de la Démocratie. *Revue Européenne des Sciences Socials,* 27(86): 328.
41 Sachs, W. (1992). *The Development Dictionary: A Guide to Knowledge as Power*. London: Zed Books, 4.
42 Sachs, W. (1992). *The Development Dictionary: A Guide to Knowledge as Power.* London: Zed Books, 5.

territoriality but in equal participation.[43] This is made possible through its resilient infrastructures, which provide open communication channels and ways of sharing knowledge, techniques and practices.

The decisive novel element that cosmolocalism brings is a radical reconfiguration of existing modalities.[44] This creates alternative forms of social relations based on the direct connection of locality and globality in a horizontal and reciprocal manner. For Manzini, this kind of cosmopolitan localism is capable of creating a new sense of place that forms the ground for instituting a community. Escobar argues that this new sense of place, i.e., a new set of relations between individuals and their spatial surroundings, implies a dynamic reinvention of the communal.[45]

Understanding the Transition Dynamics of Cosmolocalism

Cosmolocalism appears to be a promising form of universalism. It appropriates the emancipatory elements of cosmopolitanism while averting most limitations of internationalism. Cosmolocalism transcends national restrictions towards globality, while at the same time acknowledging and empowering locality. It takes full advantage of the liberatory aspects of ICT, allowing for global collaborative production in an equipotential way. Moreover, it reinvents the sense of community and commonality in an open, egalitarian and plural manner.

As seen in existing 'digital commons' communities, cosmolocalism promotes different forms of co-existing,and inspires alternative modes of production based on the commons. As a mode of collaborative production it provides for more resilient and functioning networks that can revive local economies and promote a commons-based form of collaboration. In this setting, the profit-incentive is downgraded in favour of communal values. Thus, cosmolocalism permits a different transfiguration of locality and universality that allows us to envision new ways towards social equality and justice, without sacrificing diversity and plurality.

Nevertheless, several aspects of cosmolocalism, such as its socio-environmental implications, require further exploration. For instance, cosmolocalism is highly dependent on ICT, whose proliferation is linked

43 Bauwens, M., Kostakis, V. and Pazaitis, A.. (2019). *Peer to Peer: The Commons Manifesto.* London: University of Westminster Press.
44 Bauwens, M., Kostakis, V. and Pazaitis, A.. (2019). *Peer to Peer: The Commons Manifesto*. London: University of Westminster Press.
45 Escobar, A. (2018). *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds. Durham:* Duke University Press.

to complex production relations and the new division of digital labour.[46] Thus, a thorough investigation of cosmolocalism from a political ecology perspective seems essential. Also of paramount importance is the research and support of the emerging institutions that navigate the practicalities of such a configuration.

In all, cosmolocalism advances alternatives that could potentially undermine dominant capitalist imaginary significations, attitudes and modalities. It can lead the way for a transition towards a post-capitalist, commons-centric economy and society where value is collectively created and accessible to all. In order for cosmolocalism to become more than a blueprint for a mode of production, the autonomy of local communities and individuals is essential. Cosmolocalism could provide resilient communicational and productive infrastructures that would enable social autonomy on a global scale. Its political potential is yet to unfold, but it is worth reflecting upon both in theory and in practice.

46 Fuchs, C. (2014). *Digital Labour and Karl Marx.* New York: Routledge; Fuchs, C. (2013). Theorising and Analysing Digital Labour: From Global Value Chains to Modes of Production. *The Political Economy of Communication* 1 (2): 3-27.

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"Do-It-Together": Towards the Factories of the Future[1]

Laurent Dupont, Fedoua Kasmi, Joshua M. Pearce, Roland J. Ortt

1 Adapted from the Call for papers – Special Issue Innovations. *Journal of Innovation Economics & Management.*

Faced with the environmental and socio-economic limitations of the current production model, that has persisted for decades, the accelerated development of information and communication technologies has made it possible to explore new innovative fields in the productive sectors. New reflections are emerging on the transition towards more sustainable and innovative production models. In this context, the emerging "Design Global, Manufacture Local" model (DGML), aims at transforming the global manufacturing industry so that the vast majority of products can be manufactured locally by globally exchanging the information flows on how to manufacture the product (information, knowledge, design, codes, models, drawings, etc.) over the physical flows.[2] This model is based on the principles of commons-based peer production[3] in which resources are shared with equal interest for all the involved stakeholder.[4] It represents a form of democratization of the industrialization through processes in which the design is developed as a global commons, while the manufacture of products takes place locally, considering the specificities of local ecosystems.

The mode of commons-based peer production, particularly digital

2 Kostakis, V., Latoufis, K., Liarokapis, M., & Bauwens, M. (2018). The Convergence of Digital Commons with Local Manufacturing from A Degrowth Perspective: Two Illustrative Cases. *Journal of Cleaner Production,* 197, 1684-1693. https://doi.org/10.1016/j.jclepro.2016.09.077
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3 Bauwens, M. (2005). The Political Economy of Peer Production. *Post Autistic Economics Review* 37; Kostakis, V., Niaros, V., Dafermos, G., & Bauwens, M. (2015). Design Global, Manufacture Local: Exploring The Contours of an Emerging Productive Model. *Futures,* 73, 126-135.

4 Ostrom, E. (1990). G*overning the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press. 298.

commons, has mainly developed within the so-called Makers' movement, also known as the Do-It-Yourself (DIY) movement. The emergence and multiplication of spaces and networks of makers, hackerspaces, micro-factories, fab labs or other spaces equipped with digital manufacturing tools and technologies (e.g. 3-D printers led by the open source RepRap project, laser cutters, and sensors...) has favored the development of a more agile, democratized and distributed production.[5] In the most distributed form of production, individuals download open source designs on their own digital tools like 3-D printers and make their own products.[6] Such environments are conducive to distributed collective creativity, which plays an important role in the emergence of new forms of innovation and entrepreneurial activities.[7] Based on the customization, integration and involvement of users in the production processes and local production in small series, the DIY practices represent a source of the development of:

"prosumption (local production with local materials by local people), innovation, and entrepreneurship by local populations in regions without industrial manufacturing infrastructure."[8]

The confluence of ideas and technologies and the interconnection between digital and physical environments offer the potential for a transition to a new form of hybrid production that combines the scale and efficiency of

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5 Dupont, L. (2019). Agile Innovation: Creating Value in Uncertain Environments. *Journal of Innovation Economics Management*, n° 28(1), 1-5. https://doi.org/10.3917/jie.028.0001
Kohtala, C., & Hyysalo, S. (2015). Anticipated Environmental Sustainability of Personal Fabrication. *Journal of Cleaner Production*, 99, 333-344. https://doi.org/10.1016/j.jclepro.2015.02.093
Pearce, J. M. (2014). *Open-Source Lab How to Build Your Own Hardware and Reduce Research Costs*. Elsevier.
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6 DeVor, R.E., Kapoor, S.G., Cao, J. and Ehmann, K.F. (2012). Transforming the landscape of manufacturing: distributed manufacturing based on desktop manufacturing (DM) 2. *Journal of manufacturing science and engineering*, 134(4).
Wittbrodt, B.T., Glover, A.G., Laureto, J., Anzalone, G.C., Oppliger, D., Irwin, J.L. and Pearce, J.M. (2013). Life-cycle economic analysis of distributed manufacturing with open-source 3-D printers. *Mechatronics*, 23(6), pp.713-726. https://doi.org/10.1016/j.mechatronics.2013.06.002
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7 Boutillier, S., Capdevila, I., Dupont, L., & Morel, L. (2020). Collaborative Spaces Promoting Creativity and Innovation. *Journal of Innovation Economics Management*, n° 31(1), 1-9. https://doi.org/10.3917/jie.031.0001
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Capdevila, I. (2015). Les différentes approches entrepreneuriales dans les espaces ouverts d'innovation. *Innovations*, n° 48(3), 87-105. https://doi.org/10.3917/inno.048.0087

8 Fox, S. (2014). Third Wave Do-It-Yourself (DIY): Potential for Prosumption, Innovation, and Entrepreneurship by Local Populations in Regions without Industrial Manufacturing Infrastructure. *Technology in Society*, 39, 18-30. https://doi.org/10.1016/j.techsoc.2014.07.001

high-volume manufacturing with the benefits that small local producers (SMEs and SMIs) bring to local economies.[9] Nevertheless, supporting this hybrid production approach and disseminating the free and open source and DIY principles among local producers requires the development of new production modes and strategies in a context where processes:

"are less open, less distributed and less minimal than the new Do-It-Yourself processes."[10]

As a result, many actors, especially small producers, miss the opportunities of development and innovation offered by the DIY.

The new "Do-It-Together" (DIT) approach attempts to address these limitations. It is a participatory design and collaborative production strategy that allows "global design and local manufacturing" involving "prosumers" (consumers/producers)[11] in the manufacturing process. It has recently been developed in the context of social manufacturing, which is a more open and democratic approach to traditional manufacturing, involving different levels of user participation in the production process.[12] The social manufacturing approach aims to:

"seamlessly link the social manufacturing network consisting of the Internet, the Internet of Things, and the 3D printer, thus enabling social people to participate fully in the entire manufacturing process through outsourcing, facilitating personalized, real-time, and socialized modes of production and consumption".[13]

It integrates consumers in all the processes of customized product development, such as ideation, design and production, engaging them more

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9 Waldman Brown, A. (2016). *Exploring The Maker-Industrial Revolution: Will The Future Of Production Be Local?* Berkeley Roundtable on the International Economy.
Fox, S. (2014). Third Wave Do-It-Yourself (DIY): Potential for Prosumption, Innovation, and Entrepreneurship by Local Populations in Regions without Industrial Manufacturing Infrastructure. *Technology in Society*, 39, 18-30. https://doi.org/10.1016/j.techsoc.2014.07.001

10 Fox, S. (2013). Paradigm Shift: Do-it-yourself (DIY) Invention and Production of Physical Goods for Use or Sale. *Journal of Manufacturing Technology Management*, 24(2), 218-234. https://doi.org/10.1108/17410381311292313

11 Toffler, A. (1980). *The Third Wave*. Bantam Books.

12 Hirscher, A.-L., Niinimäki, K., & Joyner Armstrong, C. M. (2018). Social Manufacturing in the Fashion Sector: New Value Creation through Alternative Design Strategies? *Journal of Cleaner Production*, 172, 4544-4554. https://doi.org/10.1016/j.jclepro.2017.11.020
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13 Mohajeri, B., Nyberg, T., Karjalainen, J., Tukiainen, T., Nelson, M., Shang, X., & Xiong, G. (2014). The Impact of Social Manufacturing on The Value Chain Model in The Apparel Industry. *Proceedings of 2014 IEEE International Conference on Service Operations and Logistics, and Informatics,* 378-381. https://doi.org/10.1109/SOLI.2014.6960754

actively in local production in a commons-based peer production context, inspired by the agile and distributed functioning of the DIY.[14]

The first studies on the collaborative creativity practices of the Do-It-Together have examined its impact on the creation of value in the fashion industry. Social, economic, environmental, knowledge, emotional and experiential values associated with the DIT were identified, generating positive externalities for all the involved stakeholders (customers, professionals and local producers).[15] The DIT strategies are indeed adapted to small-scale production on local sites offering significant potential for new business opportunities and new innovative activities especially for SMEs that face many challenges to engage open innovation processes and drive the circular economy.[16] The potential for open creativity generated by the DIT can provide competitive advantages for companies while limiting the costs and risks associated with the development of innovative products.[17]

Building on social manufacturing paradigms such as cyber-physical-social space that:

"involves human intelligences and social organizations (e.g. communities) to enable social interactions and organic connections between prosumers and socialized resources (e.g. machine tools, design software, measurement equipment and sensors) to co-create individualized products and services"[18]

The DIT strategies would enable the development of connected open innovation networks coordinated by multi-sided digital platforms. These platforms support co-creative communities in the form of distributed value networks in a collaborative economy context.[19] The DIT networks link consumers, makers, micro-factories and small local producers, making

14 Hirscher, A.-L., Niinimäki, K., & Joyner Armstrong, C. M. (2018). Social Manufacturing in the Fashion Sector: New Value Creation through Alternative Design Strategies? *Journal of Cleaner Production*, 172, 4544-4554. https://doi.org/10.1016/j.jclepro.2017.11.020

15 Hirscher, A.-L., Niinimäki, K., & Joyner Armstrong, C. M. (2018). Social Manufacturing in the Fashion Sector: New Value Creation through Alternative Design Strategies? *Journal of Cleaner Production*, 172, 4544-4554. https://doi.org/10.1016/j.jclepro.2017.11.020

16 Laplume, A., Anzalone, G.C. and Pearce, J.M. (2016). Open-source, self-replicating 3-D printer factory for small-business manufacturing. *The International Journal of Advanced Manufacturing Technology*, 85(1-4), pp.633-642. https://link.springer.com/article/10.1007/s00170-015-7970-9

Zhong, S., & Pearce, J. M. (2018). Tightening the loop on the circular economy: Coupled distributed recycling and manufacturing with recyclebot and RepRap 3-D printing. *Resources, Conservation and Recycling*, 128, 48-58. https://doi.org/10.1016/j.resconrec.2017.09.023

17 Cullmann, S., Guittard, C., & Schenk, E. (2015). Participative Creativity Serving Product Design in SMEs: A case study. *Journal of Innovation Economics Management*, n°18(3), 79-98. https://doi.org/10.3917/jie.018.0079

18 Jiang, P., Leng, J., & Ding, K. (2016). Social Manufacturing: A Survey of the State-Of-The-Art and Future Challenges. *2016 IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI)*, 12-17. https://doi.org/10.1109/SOLI.2016.7551654

19 Gandia, R., & Parmentier, G. (2020). Managing Open Innovation through Digital Boundary Control: The Case of Multi-Sided Platforms in the Collaborative Economy. *Journal of Innovation Economics Management*, n° 32(2), 159-180. https://doi.org/10.3917/jie.032.0159

their production capacities available to the local ecosystem and forming regional poles of industrial innovation that could disrupt the functioning of the current production systems.

The emergence of the Do-It-Together approach could be integrated within the EU's Factories of the Future (FoF) strategy that aims at a transition of the European manufacturing industry towards a more flexible, digital and demand-oriented industry. It is in this context that the INEDIT[20] H2020 research project seeks to set the conceptual and experimental basis for the understanding of the DIT concept and to explore its potential for the transition of the industrial systems towards a disruptive change inducing radical innovations.[21] To this purpose, a special issue of the Journal of Innovation Economics & Management calls for interdisciplinary research to deepen the analysis of this novel approach and will be published at the end of 2021.

20 open INnovation Ecosystems for Do It Together process, European Union's H2020 research program - Agreement N 869952, http://www.inedit-project.eu/

21 Dedehayir, O., Ortt, J. R., & Seppanen, M. (2014). Reconfiguring the Innovation Ecosystem: An Explorative Study of Disruptive Change. *2014 International Conference on Engineering, Technology and Innovation* (ICE), 1-9. https://doi.org/10.1109/ICE.2014.6871553

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Evolving Systems for Generative Justice: Decolonial Approaches to the Cosmolocal

Ron Eglash, Audrey Bennett, Michael Lachney, William Babbitt

Abstract

Examples of the cosmolocal tempt us to make a wish list: we want solar over fossil fuels, civic engagement instead of mass media, worker ownership replacing corporations, and so on. But wish lists are vulnerable to appropriation: you can hear words like "sustainable" and "empowerment" throughout corporate propaganda. Wish lists are also poor at adaptation: what does it mean to ask for civic engagement once Facebook has captured the social network? As an alternative to the wish list, generative justice offers a set of design principles, analytic tools, and development strategies for evolving towards a generative economy. The term "evolving" recognizes that the cosmolocal is not just concerned with a paradox of space--the relation of local and global--but also the paradox of time. Before and after the pandemic seems like two different worlds. White supremacist movements against immigrants, middle eastern theocratic destruction of civil rights, and African struggles against neocolonialism are all contradictions between an imagined past and increasingly brutal present. Combining unalienated ecological value, labor value, and expressive value, generative frameworks can nurture the emergence of Indigenous futurity and other bridges between past and future, old and young, colonizer and colonized. The utilization of heritage algorithms, artisanal AI, and other new forms of techno-cultural

syncretism are explored as evolutionary paths towards a society grounded in generative justice.

Introduction

One challenge of the cosmolocal is the broad variety of examples. India's solar project in Maharashtra is one example; Cleveland's Greater University Circle Initiative is another; farmbot's open source sharing for agricultural technology is a third. The right side of our brain cheers for each one; the left side struggles to name exactly what they have in common. So we are tempted to make a wish list: we want solar over fossil fuels, civic engagement instead of mass media, worker ownership replacing corporations, and so on. But wish lists are vulnerable to appropriation: you can hear words like "sustainable" and "empowerment" throughout corporate propaganda. Wish lists are also poor at adaptation: what does it mean to ask for civic engagement once Facebook has captured the social network?

As an alternative to the wish list, generative justice offers a set of design principles, analytic tools, and development strategies for evolving towards a generative economy. The term "evolving" recognizes that the cosmolocal is not just concerned with a paradox of space--reconciling the contradiction of local and global--but also the paradox of time. Before and after the pandemic seems like two different worlds. White supremacist movements against immigrants, middle eastern theocratic destruction of civil rights, and African struggles against neocolonialism all involve contradictions between an imagined past and increasingly brutal present. Combining unalienated ecological value, labor value, and expressive value, generative frameworks can nurture the emergence of Indigenous futurity and other bridges between past and future, old and young, colonizer and colonized. The utilization of heritage algorithms, artisanal AI, and other new forms of techno-cultural syncretism are explored as potential evolutionary paths towards a society grounded in generative justice.

Restorative justice: circulating expressive value

The term "restorative justice" (or "creative restitution" as it was first named) was introduced by psychologist Albert Eglash in a series of papers from 1957-1959[2]. At the time he was working with convicted youth in Detroit,

2 Father of first author Ron Eglash. For details about the elder Eglash's concept see Maruna, S. (2014). The role of wounded healing in restorative justice: an appreciation of Albert Eglash. *Restorative Justice,* 2(1), 9-23.

and rehabilitation programs focused on individual counseling. Using the model of AA, he began a group called "youth anonymous" and later, for citizens returned from incarceration, "adults anonymous". This use of peer-to-peer support to empower returned citizens was unheard of at the time, and was reported in the journal Federal Probation in 1955. Today these support groups are in nearly every rehab program across the US. But Eglash recognized that localized in-group rehabilitation was not sufficient; the relation of the offender to the criminal system as a whole needed transformation.

He began with the perspectives of the incarcerated and returned citizens: many of them had expressed a desire to make amends. The legal system had defined financial restitution for certain criminal cases, but these faceless bank account deductions lacked any human connection or agency. Drawing on older Indigenous, Quaker and other traditions,[3] he contrasted these cold calculations with the creative, thoughtful efforts that traditional societies used to "bring back balance" through groups mediating victim and perpetrator.

As a consequence of this restorative practice, he noted that these older traditions addressed the contemporary paradox of free will versus determinism, which troubles disciplines from philosophy to neurobiology, and is especially worrisome when prosecuting crimes by those who were themselves abused or somehow set on their path by external forces.

> *A restorative approach of creative restitution accepts both free will and psychological determinism. It redefines past responsibility in terms of damage or harm done, and can therefore accept psychological determinism for our past behaviour without destroying the concept of our being responsible for what we have done. Similarly, it redefines present responsibility in terms of our ability or capacity for constructive remedial action and can therefore accept free will for our present.*[4]

This is why, when South Africa ended apartheid and began the Truth and Reconciliation Commission, restorative justice was fundamental. White citizens throughout the system had played a role in apartheid's moral crimes and physical destruction. But tossing thousands in prison would have only furthered racial conflict. Restorative justice allowed the separation between blame, recognition of the harm done, and taking responsibility for carrying out restitution in the present. The fact that Desmond Tutu and others stressed the Indigenous roots of restorative justice--that African traditional

3 Some scholars have disputed the Indigenous influence on his work. He had an amazing repertoire of Native American and African traditional stories, and used them in participatory storytelling. He also volunteered at the Redwind Native community throughout the 1970s, as both he and Chumash founder Semu Huaute were counselors at the California state prison in San Luis Obispo.

knowledge and practices would now guide them--was in itself of strong significance.
Today's supremacist movements are everywhere: white nationalists supporting Donald Trump; Hindu nationalists supporting the BJP in India; the right wing "beef, bullets, and Bible" caucus that is now ruling Brazil. This political force has abandoned US carbon goals, promoted India's fossil fuel consumption and increased deforestation in the Amazon. What holds us back from a transition to a circular economy is not a lack of global warming data or sustainable energy innovations. It is a failure to engage a restorative process that can resolve conflicts between past and present. Middle class social justice advocates in the US spent the last 4 decades telling white working class youth "you need to carry the shame from your privilege of whiteness". Is it any wonder that so many rejected shame, and instead joined a supremacist movement called "Proud Boys"?

To recap the fundamentals of restorative justice:

1. The fundamental flaw in the standard approach is reducing restitution to a silent, faceless banking transaction. The alternative form of value exchange is creative, requiring mutual agency and connective understanding. It is an unalienated form of expressive value.[4]
2. The circulation of this expressive value can only happen through a peer to peer network, from the bottom-up. But institutional support is critical; there is a kind of dialectic between bottom-up and top down in that regard.
3. Through this circulation, recognition of past harm can be separated from blame, and agreement on future reparations returns unalienated value. Just as improvements in the built environment can move us toward better spatial relations, well structured restorative practices can move us toward better temporal relations.

One limitation of this framework is that it is focused on expressive value. It's true that without psychological and social expressions of support, our reforms, no matter how clever, cannot stop wealth inequality and environmental destruction. However the reverse is also true. Unless we have a framework that can bring together all three forms--expressive value, labor value, and ecological value--we cannot have a systems-level transformation. We refer to that trinary framework as generative justice.

4 To clarify: he was not asking for an end to the financial component; indeed he referred to that as "the first step" of a fuller process.

Generative Justice: the circulation of unalienated ecological, labor, and expressive value

Eglash's[5] and our other prior works[6] define generative justice as having a focus on three forms: expressive value, labor value, and ecological value, circulating according to:

> *The universal right to generate unalienated value and directly participate in its benefits; the rights of value generators to create their own conditions of production; and the rights of communities of value generation to nurture self-sustaining paths for its circulation.*

We have briefly examined the concept of *unalienated expressive value* as it was described in restorative justice. Other examples of unalienated expressive value would be censor-free expressions of arts that best flourish in a liberated society; the free exchange of ideas that underlie the US constitution's first amendment; and other communicative liberties by which our social networks offer creative emancipation for our curiosity, sexuality, spirituality, innovation and so on. As noted by Bauwens, Ramos and others, this is complicated by the fact that ideas freely circulated by the poor can be used to the advantage of extractive economies for the rich. To tackle that paradox, we need to move on to the second category for unalienated value, that of labor.

The category of *unalienated labor value* is best known in its formulation by Karl Marx: "In handicrafts and [hand] manufacture, the workman makes use of a tool, in the factory, the machine makes use of him".[7] For unalienated workers, such as a pre-capitalist artisan or food production in an Indigenous tradition, emancipated labor allows the refashioning not only of the external world, but of the self. Here too the recursion of generative creativity is central. "By thus acting on the external world and changing it, he at the same time changes his own nature. He develops his slumbering powers and compels them to act in obedience to his sway." The switch from artisan to factory labor meant that labor value was essentially stolen by capital. Communism would centralize, organize, and optimize this extraction, retaining its advantages in efficiency while redistributing it to serve social betterment.

In the Soviet Union, Eastern Bloc states, China, and other economies with

5 Eglash, R. (2016). An introduction to generative justice. *Teknokultura*, 13(2), 369-404.
6 For further publications see https://generativejustice.org/publications/.
7 Marx, K. (1867/1887). Capital: A Critique of Political Economy. Vol. 1, *The Process of Production of Capital*. The Marx-Engels Reader. New York: WW Norton.

state ownership of production, Marx's dream of what it would mean to have a communist state completely in control of labor was put to the test. The results were disastrous: continued wealth inequality; greater amounts of environmental destruction than that of the US, and human rights records as brutal as any fascist dictatorship. Where did this go wrong? Marx saw capitalism as a necessary stage in cultural evolution: without its ruthless march toward efficiency, we would be left at the whims of nature. Once it had created mechanisms for mega-scale value extraction--mass production factories, mass production agriculture, massive energy plants, and so on--those could be left intact, and the alienated value redistributed by the state. In other words, Marx's plan was similar to court-ordered financial restitution, allowing the value to be alienated before it is returned. If we want restitution for the theft of labor value--for its extraction by capitalist corporations or communist states--*we need a labor form of restorative justice*, such that value remains in unalienated form, and is returned to those who generated it. Hence, generative justice.[8]

One classic way to keep labor value in unalienated form is the role of the artisan. A search on Google scholar will reveal that a large percentage of contemporary citations are for "artisanal gold mining", the attention due to the massive mercury poisoning it creates. To tackle that paradox, we need the third category, *unalienated ecological value*. Again, extractive production under either capitalist or communist economies will create disastrous effects. Attempting to return value in the alienated form of pesticides, artificial fertilizers and so on kills soils just as mineral contamination does from mining. Traditional agroecology maintained value in unalienated form, returning agricultural waste back to the soil, where composting completes the circuit, thanks to microbial minions. Peer to peer collaboration was the key to restorative justice's unalienated circulation of expressive value; in similar ways the collaborations in a network of humans and nonhumans is key to unalienated ecological value. That is to say, some of our peers are not humans. Just as creativity played a crucial role for expressive value and labor value, nature's creativity can be seen in the explosion of soil biodiversity that composting engenders.

Ecological value, labor value, expressive value: how did we come to have these categories, and why is creativity so fundamental to each one? A generative system is one that self-generates value. Physicist Erwin Schrodinger attempted to explain how living systems work by calling it negentropy:

8 Hanson and Umbreit suggest using the term "regenerative justice" for similar reasons. Toran Hansen & Mark Umbreit (2018) Regenerative justice, beyond restoring, Contemporary Justice Review, 21:2, 185-207. "Regenerative economy" has also become popular, but we have stayed with the term "generative" to keep the emphasis on all three unalienated value forms. "Regenerative" is often reduced to simply meaning "circular economy", "industrial symbiosis" or other synonyms for environmental sustainability without regard for maintaining just and unalienated social experiences.

taking in energy and producing order.[9] But he failed to encompass what later versions of complexity theory revealed: the creative role of disorder. Mutations, adaptations, genetic drift, hybridity, and other mechanisms allow life to explore the landscape of possibilities. Life folds back on itself in an evolution of evolution: the first cells replicated by fission; but eventually developed sexual reproduction, which vastly accelerated evolutions' landscape exploration. Human physical labor similarly folds nature back on itself, as Marx pointed out.[10] Expressive (i.e. semiotic; informational) value is the means by which culture can pass on adaptations without waiting for genetics: language, writing, and technology. And in its most recent recursive turn, machine intelligence folds human culture back on itself. The idea that it too contains a fundamental creativity--that AI will explore its own space of possibilities--means that it is all the more urgent to map out evolutionary trajectories for generative justice, and ensure they are deeply embedded in these new algorithmic regimes from the start.

Trajectories for generative development: the braiding of unalienated value

Our research group has attempted to develop alternatives to the extractive economy by what might be called a restorative evolutionary process, gradually intertwining all three forms of unalienated value in ways that connect past and present. It is currently trendy to use the term "entanglement" and invoke quantum physics in social analysis, and elsewhere we have used the concept of a recursive intertwining.[11] But the more humble concept of braiding will do nicely here. Expressive, ecological, and labor value can be braided together in myriad forms. Like the fantastic Black hair algorithms we describe below, they can merge nature and artifice; mundane and spiritual; and concrete and abstract across an infinity of hybrids, mutations and innovations.

A typical process for us begins with a collaborative investigation of unalienated value. Usually the group we are working with--an Indigenous society, low-income urban group, or other underserved community--has some prior tradition or practice that includes unalienated value, but it has yet to be framed in ways that allow it to enter other kinds of circulation. An important class of these attributes are "heritage algorithms" -- the repertoire of pattern generation systems underlying Navajo weaving; African carving,

9 Schrodinger, E. (1944). *What is life*. Cambridge: University Press.
10 "He opposes himself to Nature as one of her own forces, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants. By thus acting on the external world and changing it, he at the same time changes his own nature." Chapter 7, section 1 of Capital: A Critique of Political Economy (1867).
11 Lachney, M., Bennett, A., Appiah, J., & Eglash, R. (2016). Modeling in ethnocomputing: replacing bi-directional flows with recursive emergence. *RIPEM*, 6(1), 219-243.

Latinx drumming, urban graffiti, Amazonian body art, and so on. Working with elders, artisans, and others, we co-develop open source software, called "Culturally Situated Design Tools" (CSDTs).[12] These allow users to simulate the designs, and develop new versions that build on the older traditions. The co-development is needed in part for permission: we only simulate artifacts that are approved for this use by cultural representatives. But equally important is the role of elders, artisans and others in helping to ensure that the simulation is a *translation* from Indigenous knowledge to its western equivalent, not imposing external knowledge.

The translation is itself a part of the restorative process in that we can often show sophisticated mathematical and computational concepts and practices in supposedly "simple" cultures, as we describe below. But a truly restorative approach has to also be transformational for the colonizer as well. For that reason our website includes CSDTs for Celtic design.[13] Students learn how Celtic tribes once spanned Europe from Ireland to Turkey, and how their brutal colonization by the Roman empire and others has parallels to that suffered by other Indigenous groups, except here Europe was colonizing itself. Other approaches to whiteness include a section on the abolitionist movement in the Appalachian region,[14] seen in their quilting patterns, and multicultural hybrids in which students collaborate across ethic lines.[15] That describes a restorative approach for the dominant group in the case of White/Nonwhite conflict in the US. A similar restorative approach could be carried out for the dominant group in other kinds of conflicts: Hindu/ Islamic in India; Straight/Queer in sexual orientation; and so on.

In the case of African knowledge translation, our most successful work has been that of African Fractals. Fractal geometry was first introduced by Benoit Mandelbrot in 1977. Yet a clear case for fractal structures in African traditional design[16] showed that this profound system for recursive composition of form was deeply embedded in their Indigenous knowledge systems.[17] This attempt to decolonize mathematics--to oppose the racialized knowledge hierarchy that colonialism had imposed--has met with some cases of extreme opposition (including a white supremacist effort to have the first author fired from his job). But the impact has been worth it (figure 1). We have been able to show statistically significant improvement for underrepresented students using these simulations in controlled studies.[18]

12 Applications. (n.d.). Retrieved from https://csdt.org/.
13 Celtic Culture. (n.d.). Retrieved from https://csdt.org/culture/tooledleather/celtic.html.
14 Appalachian Quilts. (n.d.). Retrieved from https://csdt.org/culture/quilting/appalachian.html.
15 Eglash, R., Bennett, A., Lachney, M., & Babbitt, W. (2020, April). Race-positive design: A generative approach to decolonizing computing. In *Human factors in computing systems*.
16 African Fractals. (n.d.). Retrieved from https://csdt.org/culture/africanfractals/index.html.
17 Eglash, R. (1999). African fractals: Modern computing and indigenous design. Rutgers University Press.
18 Eglash, R., Krishnamoorthy, M., Sanchez, J., and Woodbridge, A. (2011). Fractal simulations of African Design in Pre-College Computing Education. *ACM Transactions on Computing Education*, v11 n3 Article

Figure 1: The impact of African fractals in arts, architecture, and AfroFuturism.[7]

Mathematicians have used it to advance technical theory.[19] Thanks to this work fractals have now appeared as a theme in AfroFuturist science fiction, African postmodern dance; African American arts, African diasporic design innovation, and a wealth of other contexts.[20] [21]

Its most important use may be applications to contemporary African architecture. Xavier Vilalta, looking to use fractals for a building in Addis Ababa (Ethiopia),22 found that the Indigenous patterns applied to a building's exterior created a breathable skin, eliminating the need for air conditioning. This lowered the space cost in the building, allowing small scale local entrepreneurship in a downtown overwhelmed with expensive

17 Oct.
19 Bruhn, H. (2008). Periodical states and marching groups in a closed owari. *Discrete mathematics*, 308(16), 3694-3698.
20 For examples in dance, design and arts see:
https://www.nytimes.com/2013/12/06/arts/dance/moses-es-comes-to-brooklyn-academy-of-music.html
https://blackfractals.wordpress.com/
https://www.reneecox.org/soul-culture
21 Okorafor, N. (2015). *Binti* (Vol. 1). New York: Tor Books.
22 May, K. (2013). Architecture infused with fractals: how TED speaker Ron Eglash inspired architect Xavier Vilalta. Retrieved from https://blog.ted.com/architecture-infused-with-fractals-ron-eglash-and-xavier-vilalta/

foreign stores. In 2017 the building won the UNESCO's Prix Versailles for best exterior in the world. Note here the braiding of value: ecological (lower carbon footprint); labor (increased financial opportunity for small scale entrepreneurs); and expressive (de-primitivising African knowledge as an algorithmic source).

As encouraging as it is to see African fractals taken up as a tool of anti-primitivist, anti-racist activism in education, design and arts, it is also fair to say that these instances are to some extent swallowed up by surrounding extractive economies. Therefore, translation to heritage algorithms--making the cultural capital more "fungible"[23] into other forms--is only a first step. In a recent series of articles we have mapped out some potential strategies for transition to a generative economy utilizing AI and other automation technologies.[24] We have deliberately avoided the kinds of transition that are upheavals; the tear-down-and-build-from-scratch. "A utopian future awaits if everyone follows our orders" has never been followed by utopia. Rather we seek evolutionary trajectories that embody the concept of "prefigurative politics". As Yates[25] and others have pointed out this goes beyond the moral exhortation for consistency in ends and means (i.e. opposition to a Machiavellian hypocrisy). In our case the main focus is to offer "proof of concept" in working examples along the evolutionary path, rather than asking people to take a leap of faith based on ideological allegiance.

For that reason we typically begin with a currently existing unalienated value form. Heritage algorithms are just one of many possible categories, and even within that category, there are complex dimensions. From a western view the Navajo weaving algorithm[26] is simply an abstract pattern, but from the Indigenous view the pattern is only the tip of the iceberg: the algorithm is just as much about carding wool, raising sheep, making dye from plants; a braiding of all three forms of value. For disenfranchised members of an inner city community, love for the local neighborhood can be a powerful form of unalienated expressive value; but we tend to focus on the tip of the iceberg: understandably, as some graffiti algorithms have produced masterworks of art.[27]

Recognizing the full range of unalienated value in a particular community, especially in its hidden potential (for computing, engineering, biodesign

23 Used here in the sense that something can be modified without losing value (like fusion cuisine).
24 Eglash, R., Robert, L., Bennett, A., Robinson, K. P., Lachney, M., & Babbitt, W. (2020). Automation for the artisanal economy: Enhancing the economic and environmental sustainability of crafting professions with human–machine collaboration. *AI & SOCIETY,* 35(3), 595-609.
25 Yates, L. (2015). Rethinking prefiguration: Alternatives, micropolitics and goals in social movements. *Social Movement Studies*, 14(1), 1-21.
26 Navajo Rug Weaver. (n.d.). Retrieved from https://csdt.org/culture/navajorugweaver/index.html.
27 Graffiti Grapher. (n.d.). Retrieved from https://csdt.org/culture/graffiti/index.html.

etc.) is a non-trivial challenge. In many university programs for engineering students in development, they not only lack training but are not even directed towards collaboration in value discovery. Rather, they are told (understandably) to be solving problems, and so they end up addressing issues that were created by the corporations themselves. We already know deforestation is rampant; adding GIS, AI etc. to monitor it ignores how such tech is used to create the problem in the first place. The generative strategies presented here are in opposition to this kind of "technosolutionism".[28] While still experimental, we hope to proceed in the following stages:

4. Co-discover (with local collaborators) heritage algorithms and other translations of the unalienated value.
5. Enhancement of the value without alienation: facilitating circulations already present, increasing fungibility of the value forms
6. Development of the interface with the current extractive economy: if it remains isolated, there is little potential for transformation. If simply plunged into extraction, we lose the unalienated character.
7. Shrinking the extractive component, and/or expanding the generative component.

28 Lindtner, S., Bardzell, S., & Bardzell, J. (2016, May). Reconstituting the utopian vision of making: HCI after technosolutionism. In Proceedings of the *2016 CHI Conference on Human Factors in Computing Systems* (pp.1390-1402).

Illustrative example: a generative economy for adinkra

The first step is co-discovery with local cultural representatives. Figure 2 shows an example of traditional value circulation for the case of adinkra, a stamped cloth tradition from Ghana.

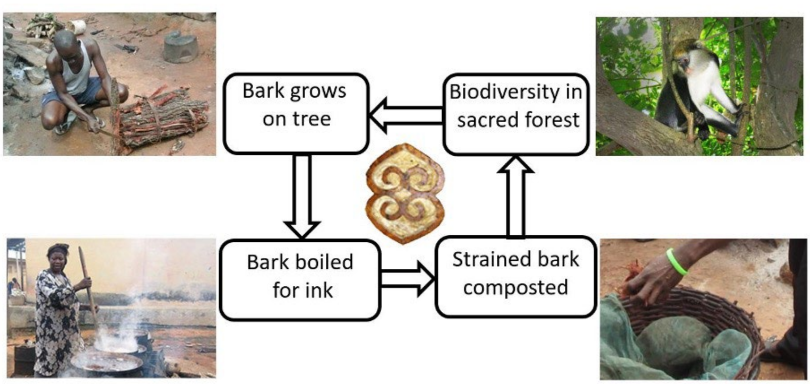

Figure 2: Traditional value circulation for adinkra ink in Ghana

They begin with the bark of the badie tree, which is boiled, and the colorants further reduced to ink for stamping. The remaining bark is strained, and returned to the soil. This is part of a larger set of practices that return ecological value to nature: for example, in the areas where traditional animist religion remains, there are stands of sacred forest where taking organic material is not allowed. These are biodiversity hotspots which spread the value elsewhere (for example monkeys and birds dispersing seeds from their droppings), including areas where the badie tree grows. Thus the cycle is completed. The local artisans reported that the bark is harvested such that the tree is not killed--it can regrow--and that the badie tree forests are protected by the bark harvesters, preventing deforestation.

At the center we have placed the adinkra symbol *Asase Ye Duru* which translates to "earth in balance". The bilateral symmetry suggests humans on one side and nature on the other (balance scales are ancient in Ghana due to its gold trade). Like many adinkra symbols, logarithmic curves are used to represent the animist energy or life force. The fact that biological morphogenesis often results in log curves (shells, pinecones, ferns, horns, tails, ears, are just some of the more obvious examples) is a keen geometric insight into what mathematicians would call an "invariant property". These geometric aspects of adinkra constitute an important heritage algorithm that we have incorporated into the CSDT suite (https://csdt.org/culture/adinkra/index.html).

In the second step, we utilize technology to facilitate the fungibility of this cultural capital. In the case of adinkra this so far includes the following:

- Solar heating to replace wood fires: this shrinks the carbon footprint even more. It is safer and healthier (no smoke inhalation).[29] It lowers the cost (no buying firewood), and allows more protection of forests (since decreasing costs can increase throughput, more areas of badie tree forest are under the protection of bark gatherers).
- Application of adinkra math and computing to schools: in a controlled study, we found that children learning about programming adinkra simulations scored higher in skills and interest than a control group learning the same topics without cultural context.[30]
- Application of adinkra symbolism to HIV prevention led to the development of DIY condom vending machines in

29 Solar dye in Ghana. (n.d.). Retrieved from https://generativejustice.org/solar-dye-in-ghana/.
30 Babbitt, W., Lachney, M., Bulley, E., & Eglash, R. (2015). Adinkra mathematics: A study of ethnocomputing in Ghana. *Multidisciplinary Journal of Educational Research*, 5(2), 110-135.

Ghana.[31]

- Tracking the use of adinkra symbols in applique cloth led to the use of digital fabrication (ranging from laser cutters and digital embroidery to a custom-built BatikBot).[32] See figure 3. For these “artisanal cyborgs” there is still creativity and agency in designing on the screen, and learning to code creates value for their skill development. This also creates a larger repertoire of shapes as screen modification allows them to apply the heritage algorithm to new forms.

Figure 3: “Artisanal Cyborgs”, combining hand crafting and computational modeling. At top, growing biodegradable mycofoam in 3D molds replaces latex stamps. Center, a BatikBot. Bottom row: Creativity Group at Kumasi Hive laser cutting adinkra simulations for matching covid masks and shirts.

This Darwinian approach to design diversification is a kind of creative restitution for the industrial economy, allowing circulation of unalienated value to mutate into experimental forms that local communities can then apply to further modifications and combinations under their own control

31 DIY Condom vending machine: Open source, locally manufactured vending machine for reproductive health products. (n.d.). Retrieved from https://generativejustice.org/diy-condom-vending-machine/.

32 Artisanal Cyborgs. (n.d.). Retrieved from https://generativejustice.org/artisanal-cyborgs/.

and preferences. As noted earlier, there needs to be a dialectic between this sort of bottom-up creativity, and the design of top-down institutional forms that can facilitate and nurture its survival. Thus our future steps include a more deliberate set of system-level technologies.[33] For example, we hope to soon begin experiments with AI applications to a database of feedstocks, services, products, and other elements of the artisanal value chain that create an artisanal ecosystem, maintaining value in unalienated form even for sourcing beyond the scope of any single business. Equally important is developing sustainable approaches to consumption. In an upcoming experiment we will be using an AI-enabled cell phone app to identify the difference between real and fake (factory made) cloths, and (in the case of the authentic) connecting consumers to a video clip of their fabric as it is made.

Coda

At the time of Darwin, slave owners had colluded with racist scientists such as Louis Agassiz to create the polygenesis theory: separate "acts of creation" gave us different types of humans, frozen into levels of superior and inferior states. Darwin, born into a household of abolitionist activists, understood that the anti-racist theory of monogenesis--a singular origin for "the family of man"--would require explanation for why we see differences in skin color, height, etc. He developed his theory of nature's creativity--adaptation from life's self-varying, ever-mutating forms--directly in relation to his abolitionist views.[34] An understanding of the self-generative complexity of nature was instrumental to freeing humanity from authoritarian myths about nature's fixed hierarchy of separate origins.

Famed abolitionist Frederick Douglass, while never meeting Darwin directly, traveled to his alma mater, Edinburgh, met with others in the same bio-abolitionist network, and also promoted this connection between life as a creative, self-organizing system, and its implications for human freedom.[35] In his 1854 address to Case Western University he extends the concept to the creative power of multicultural societies. It is always the liminal places--cross roads, trading zones, and other cultural mixing--that give us explosions of innovation: the fertile crescent in the ancient middle east, the renaissance in the Mediterranean, and his vision for a post-slavery multicultural America.

33 Eglash, R., Robert, L., Bennett, A., Robinson, K. P., Lachney, M., & Babbitt, W. (2020). Automation for the artisanal economy: Enhancing the economic and environmental sustainability of crafting professions with human–machine collaboration. *AI & SOCIETY*, 35(3), 595-609.
34 Desmond, A., & Moore, J. (2014). *Darwin's sacred cause: How a hatred of slavery shaped Darwin's views on human evolution*. HMH.
35 Eglash, R. (2019). *Anti-Racist Technoscience: A Generative Tradition. Captivating Technology: Race, Carceral Technoscience, and Liberatory Imagination in Everyday Life*, 227-51.

We need to relearn what these bio-abolitionists already understood: nature's creative biodiversity and human social diversity are essentially the same self-generative phenomenon; a wellspring for those thirsty for generative justice.

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The Pulsation of the Commons: The Temporal Context of Cosmolocal Transition

Michel Bauwens and José Ramos

Overview

We believe that cosmolocal strategies are critical as a new form for the next global system. As a reminder, this is what we mean by the term cosmolocal and cosmolocal production, which is not merely about combining the local and the global:

1. Cosmolocal production requires global and collaborative knowledge production, based on free association; it is a guarantee that ecological and social problems can be solved both locally and globally, without endangering local specificity, adaptations and differences; it recognizes the true abundance of knowledge and cultural resources that should not be endangered by artificial scarcities,
2. Cosmolocal production is based on the subsidiarity principle in material production, i.e. intelligent localization, which dramatically reduces the footprint of material transport; local communities can choose wisely within their concrete resource boundaries,
3. The local production units are based on solidarity and mutualization.

We believe that cosmolocalization, understood in this specific way, ‘transcends and includes’ the best of the previous socio-economic systems, while also ‘negating’ its degenerative aspects. Indeed, it negates:

- Artificial scarcity regarding knowledge, which excludes those without means from using the best solutions for ecological and societal problem solving,
- It fully recognizes the material limitations of our planet and the need of other beings as well as our mutual interdependence, by radically reducing the human footprint,
- It fully recognizes that a successful ecological shift cannot happen without sufficient social justice.

Indeed, in this book of readings we are presenting a very bold hypothesis that a quite fundamental reversal of the logic of production and value creation is starting to occur, and that the model we are proposing has strong claims to be a big part of the emerging post-capitalist logics.

In this preliminary essay, we’d like to give the readers a sense of ‘timing’, and offer an explanation of the context in which a transformation to the new mode of how material production and value creation occurs.

Introducing Pogany: The Time for the Chaotic Transition has Begun

The first temporal framework we’d like to present is that of Peter Pogany. Pogany is a very original but rather unknown Hungarian-American thinker who published two books.[1] Rethinking the World is an arduous but rewarding new view of the world system and its structures. He’s one of the very few thinkers who links the thermodynamic basis of our world (i.e. how much matter and energy is at our disposal in the medium and long term, given the second law of thermodynamics, which states that the quality of matter degrades in a ‘isolated’ system like planet Earth (we get energy from the universe, but hardly any new matter), to the socio-economic system. More importantly, he links both these levels to a third one, the ‘mode of apprehension’, i.e. how human cultures see the world, what they can ‘see’, but more importantly, what they ‘can’t see’. This is important, since for example the typical left of center analysis usually focuses on material structures, but often ignores a systematic vision of human agency, while right of center analysis usually focuses on human agency and responsibility, but often ignores the structural constraints on human and natural systems. Here we

1 Pogany, P. (2006). *Rethinking the world*. iUniverse; Pogany, P. (2015). *Havoc, Thy Name is Twenty-First Century! Thermodynamic Isolation and the New World Order*, iUniverse.

have a type of integral theory which holds the three levels of reality in an organic and holistic embrace.

Based on the huge literature and findings of biophysical economics and books on the self-organizing of the universe and humanity (complexity theory), Pogany concludes that our world, i.e. human society embedded in nature, is a 'complex adaptive system' and reminds us that such systems change through 'punctuated equilibrium', 'chaotic transitions' and 'bifurcations'. This is a huge statement as it means that humanity doesn't adapt to radically new situations through reasoned debate, but through shocks in the system. First, the old system disintegrates and the old institutions lose legitimacy, then, a cambrian explosion of alternatives emerge, carrying the seed forms of the next system, but these alternatives need to fight it out before a new stable system emerges. It is important to note that work on complex adaptive systems and bifurcation dynamics is widespread and Pogany's work was preceded and ran parallel to many others.[2]

This also means that societal transitions are also about the installment of new logics, not just a re-arrangement of the old system. For example, the christian feudal society that replaced the imploded Roman Empire, believed that work was positive and sacred, which was fundamentally opposed to the Greco-Roman vision of work as a degrading activity for slaves. So, in our expectation of a new mode of organizing productive life more in harmony with the limitations of the material planet and its living beings, we should not expect a mere 'business as usual' adaptation. The new system must 'transcend and include' some of the achievements of the previous system, while solving its problem at a higher level of complexity and integration, or alternatively, it will disintegrate to a lower level of complexity.

Pogany sees our current context based on his analysis of three succeeding 'global' stable systems. What he calls Global System 0, a proto-global society, was the mercantile system that dominated Europe under the absolute kings of the 17-18th centuries. This stable system, for a while, was interrupted by a 'chaotic transition': the French Revolution and the Napoleonic Wars (1789-1815).

The second stable system which emerged after that chaotic transition period was the first truly global system, i.e. Global System 1 (GS1), the so-called 'Smithian' capitalist system, based on the full dominion of Capital over Labor. That system and its institutions stopped functioning and was interrupted by the chaotic transition of WWI to WWII. During this transition, two other

2 Homer-Dixon, T. (2010). *The upside of down: catastrophe, creativity, and the renewal of civilization.* Island Press.; Gunderson, L. Hollings, B. (2001). *Panarchy: understanding transformations in human and natural systems.* Island press.

systems competed with 'democratic capitalism', i.e. fascism and the Soviet 'communist' system.

The third stable system, Global System 2 (GS2) emerged after 1945 and created a system of 'weak multilateralism' (GS0 had no multilateral institutions), and was based, at least in the Western countries, on a compact between capital and labor (the welfare system and the 'fordist' system of capitalism). This was also of course based on a hyper-exploitation of natural resources and on a neocolonial relation with the countries of the Global South. Though they largely obtained political independence for the new nation-states, they also were locked in unfavourable terms of trade, and had little or no power in the new institutions which were dominated by the victors of WWII (the Bretton Woods institutions, World Bank, International Monetary Fund and the World Trade Organization). Pogany writes after the onset of the Global Systemic Crisis of 2008.

> *"It is hardly a mere coincidence that the collapse of the global financial casino coincided with the divorce between cheap oil and the full utilization of the rest of productive resources. We will never see the two of them together again — a situation loaded with the awesome implication that the world will be knocked back and forth between recession and aborted recovery as the oil price roller coaster alternatively encourages and discourages profligacy with our body economic's vis vitalis. This emergent cyclicality reveals that the collision between humanity's material ambitions and the planet's physical constraints is not a single dramatic event as symbolized by the more than three decades-old "overshoot and collapse" meme. Rather, it is an extended, macrohistorically recognizable temporal process."*[3]

So, we think it is fair to say that GS2 started unraveling in 2008. It's not just the deep economic crisis which was caused and affected the financialized system, but also the *weakening of the multilateral system based on US dominance; social unrest eventually resulting in right-populist victories, but also the rapid realization of the physical unsustainability of our current systems of production.* Thus, we have entered, at the very least the beginning stages of a new chaotic transition.

The social compact between capital and labor has slowly unraveled due to neoliberalism after the 80s, but isn't entirely destroyed. But, it has been weakened, and so has the multilateral system. Pogany it is quite clear where we have to go: the next system, Global System 3 (GS3), must be based on 1) a compact with nature, i.e we must learn to produce for human needs within planetary boundaries, and, in order to do this successfully with social stabilization, this must also be accompanied by a degree of social equity, i.e. the social compact can not be abandoned as it is the condition for a successful ecological compact. Finally, in order to do this, we will need strong and two-level multilateralism. A form of global governance will be needed which can embed human production into relatively coercive planning frameworks as to the availability of resources for the long term survival of humanity. This view is expressed for example in the proposal by the R30 project for a 'Global Thresholds and Allocations Council'.[3]

This view of Pogany, of world history as a 'pulsation', between stable systems and chaotic transitions, is very much in line with other understandings of long term human and natural history. But note that for Pogany, there is no certainty that humanity will succeed in this coming transition. It is not just that regression can happen, to a lower level of complexity that is no longer able to sustain that many human beings, but even a much deeper collapse is within the realm of possibility, a point paralleled by another writer on historical complexity, Dixon.[4] But it does give us a clear meta-historic vision of the priorities we need to pursue in this chaotic transition.

The HANDY Project and Mark Whitaker's Ecological Revolutions

It is our hypothesis, that in the current conjuncture, we are again moving towards an emergence and eventual 'centrality' of the commons format. There is also a 'cyclical' argument to be made for this shift in the current conjuncture.

Alan Page Fiske has established a relational grammar for the allocation of resources in society, which Kojin Karatani,[5] in his Structures of World History (which examines the evolution of modes of exchange, and not, like Marx, the modes of production), has 'historicized':

- the original modality of humankind is commoning, which is when everyone contributes and partakes in a common pool; it is a prime mode in hunter-gathering bands
- the gift economy, in which the gift creates social obligations for a counter-gift becomes the dominant modality in more complex tribal societies;
- authority ranking, when in a class-based polity, the rulers

3 For details on the GTAC proposal, see https://reporting3.org/gtac/: "to establish an authoritative approach to reporting economic, environmental and social performance in relation to generally accepted boundaries and limits".
4 Homer-Dixon, T. (2010). *The upside of down: catastrophe, creativity, and the renewal of civilization.* Island Press.
5 Karatani, K. (2014). *The Structure of World History: From Modes of Production to Modes of Exchange.* Duke University Press.

must legitimize their domination through the redistribution of resources,

- and finally, market pricing, where prices allow for the exchange of resources deemed of equal value.

As indicated just above, these four modes have nearly always co-existed (states and markets appear later in human evolution), but their relation has evolved over time. Original nomadic and horticultural peoples mainly practiced commoning and the gift economy. State-based societies, i.e. more or less every society with more than 200,000 people, has had state-like management, practicing redistribution through taxation.[6] Today, the capitalist market rules supreme, with the state at its service.[7] The commons has always had a subservient role in class societies, until capitalism made extraordinary efforts to marginalize it.

But there is also strong historical evidence of a pulsation of the role of the commons, vis a vis the extractive economic systems in whose context they co-exist. In fact, the HANDY report,[8] on human and nature dynamics, takes a predator-prey hypothesis to look at human societies since the neolithic. Their conclusion is that all class-based peer polities, which are locked in a competition which each other, routinely end up over-using their resource base. At this point, the extractive logic stutters and there is a strong pressure to return to the commons, i.e. to give it a more important role in the overall mix. At such moments of crisis, reducing carrying capacity through mutualization is one of the most efficient ways to avoid or soften societal collapse, or to recover from it. The pooling of resources is a key way to reduce matter-energy footprints. The HANDY authors insist and show that equality is a key factor in the depth and severity of these crises. More authoritarian and extractive societies insulate the ruling class from the environmental problems that are piling up, therefore, their fall is deeper and it takes them longer to recover; while in societies with a stronger egalitarian bent, there is more sensitivity to the signs of coming collapse: these societies have a smoother transition with reduced time spans for the recovery period. But it is clear that in this vision, there is a period of return to commoning.

The conclusions of the HANDY research project seem very congruent with the research into ‘secular cycles’ by Peter Turchin et al.,[9] and combines two factors. One is the evolution of the population numbers (demographics),

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6 Turchin, P., Whitehouse, H., Korotayev, A., Francois, P., Hoyer, D., Peregrine, P., & Currie, T. E. (2018). Evolutionary pathways to statehood: old theories and new data. *SocArXiv*.

7 Bobbitt, P. (2002). *The Shield of Achilles: War, Peace and the Course of History*. Knopf.

8 Motesharrei, S, Rivas, J, Kalnay E. (2014). Human and nature dynamics (HANDY): Modeling inequality and use of resources in the collapse or sustainability of Societies. *Ecological Economics*. Volume 101, May.

9 Turchin, P., Nefedov, S. (2009). *Secular Cycles*, Princeton University Press.

the other is the evolution of the extractive mechanisms by the state and the elite. Turchin and the cliodynamical school (i.e. the study of the temporal dynamics of large societies in history) using a vast set of databases[10] about the historical record (wars, conflicts, famines, political and social revolutions, etc.) also concludes that there are long-term oscillations that are related to how population numbers tend to exceed the local carrying capacity of the societies in question, and how ruling class extraction aggravates those conditions. So far, these scholars feel confident to assert that these secular cycles do occur systematically in agrarian societies.[11] Hence, even though we are not aware of the studies of this school on the subject of the commons, we can posit that within those oscillations, and at the time when the local overshoot occurs as a crisis, there should be efforts to mutualize so as to stay within the local carrying capacity boundaries. Testing this hypothesis is exactly what Mark Whitaker has done through a number of historical examples.[12]

Indeed, according to Whitaker, in his 3,000 year review of ecological crises in Europe, Japan and China, and how societies/civilisations overcome these types of crises, the commons repeatedly plays a crucial role. This expresses itself in political and social movements, which in the past took a religious expression, but Whitaker also looks at the role of the contemporary Green movement in Germany to confirm his thesis. The productive classes would follow the lead of religious reformers and/or revolutionaries, who insisted on a new balance between people amongst themselves, and on a more balanced relationship with nature. Citing Whitaker:

> *"Most argue environmental movements are a novel feature of world politics. I argue that they are a durable feature of a degradative political economy. Past or present, environmental politics became expressed in religious change movements as oppositions to state environmental degradation using discourses available. Ecological Revolution describes characteristics why our historical states collapse and because of these characteristics are opposed predictably by religio-ecological movements. As a result, origins of our large scale humanocentric axial religions are connected to anti-systemic environmental movements. Many major religious movements of the past were environmentalist by being health, ecological, and economic movements, rolled into one. Since ecological revolutions are endemic to a degradation-based political economy, they continue today."*[14]

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10 See the Seshat: Global History Databank , which "was founded in 2011 to bring together the most current and comprehensive body of knowledge about human history in one place", http://seshatdatabank.info/

11 Abel, T. (2007). Pulsing and Cultural Evolution in China. Proceedings from the 4th Biennial Emergy Research Conference, 2007. Emergy Synthesis 4, December 2007 https://www.academia.edu/3052637/Pulsing_and_Cultural_Evolution_in_China?

12 Whitaker, M. (2008). *Ecological Revolution: The Political Origins of Environmental Degradation and Environmental Amelioration: Patterns, Processes, Outcomes: A Comparative Study of Japan, China, and Europe.* [Doctoral dissertation, University of Wisconsin-Madison].

One example will be familiar with Western readers. Indeed, we can consider the mutualization of knowledge by the Catholic monastic communities, as an answer to the crisis of the western Roman Empire, as a paradigmatic case study.

These monks were also the engineers of their time and according to Jean Gimpel in his book about the first medieval industrial revolution, were responsible for nearly all technical innovations of that era.[13] It effectively functioned as a knowledge commons; secondly, the monasteries themselves, seen as a mutualization of shelter and common productive units, provided shelter, culture and spirituality, at a dramatically lower footprint than the cost of the Roman elite; finally, the relocalization of production, through the feudal 'manor', was a third factor. The resemblance with our own conjuncture today is uncanny. Faced with ecological and social challenges, we see a re-emergence of knowledge commons, under the form of free software and open design communities; we see a drive towards mutualization of productive infrastructure, for example the emergence of fablabs, makerspaces and coworking spaces, and the emerging multifactory model.[14] Developments such as the capitalist 'sharing economy', which is focused on creating platforms for underutilized resources, partake in this trend; finally, new technologies around distributed manufacturing, which are prototyped in makerspaces and fablabs, point to a re-organization of production under a 'cosmolocal' model.[15]

Today we see an exponential rise in knowledge commons; infrastructural commoning is also emerging rapidly, and not just in the southern European countries where state and market failure is the most obvious. A recent study on urban commons in the Flemish city of Ghent, showed the existence of nearly 500 urban commons, active in all areas of human provisioning,16 a jump from the 50 existing ten years earlier.

The difference with earlier cyclical re-emergences of commons in times of crisis is that the current exhaustion of resources and dangers to our ecosystem are global in nature, requiring transnational and globally coordinated responses (while being local at the same time, hence: cosmolocal).

13 Gimpel, J. (1977). *The Medieval Machine: The Industrial Revolution of the Middle Ages.* New York: Penguin Books.
14 Salati, L, Focardi, G. (2018). *The rise of community economy : from coworking spaces to the multifactory model.* Sarajevo : Udruženje Akcija.
https://www.academia.edu/41043179/THE_RISE_OF_COMMUNITY_ECONOMY_From_Coworking_Spaces_to_the_Multifactory_Mode
15 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studie*s, 21(4), pp 65-83.
16 Bauwens, M., & Onzia, Y. (2017). *A Commons Transition Plan for the City of Gent.* Commons Transition.

There is ample evidence that the commonification response to societal and civilizational crises due through over-extraction of resources, was not just a restorative strategy, but also in itself created the conditions for prosperity.

Adam Arvidsson,[17] relates the remarkable integration of commons and markets after the 11th cy. The 'First European Revolution' that started in 970,[18] the so-called 'Peace of God' movement, was a social revolution that united monks and peasants in France and neighbouring countries. It established a social contract (the Peace of God charters were signed in several hundred cities and regions) that allowed for a productivity rise in the countryside, creating an exodus to the re-emerging cities which had shrunk in the preceding period (5 to 10th cy.). There, the city workers created guilds, i.e. productive commons, while free farmers created agricultural commons through contracts,[19] creating a new ethical economy that had strong elements of redistribution and solidarity. The European population doubled in 3 centuries and tripled in Western Europe. Another example is the Tokugawan period[20] in Japan (between 1600 and 1868), which started after the emperor retook control of a largely deforested Japan, and protected the land as imperial commons. This period was known not only for its prosperity but also because it succeeded in creating a long term stable ecological society, with a stable population level.

Other authors have made similar observations. William Irwin Thompson earlier identified the civilizational tendency for overshoot across Babylonian, Greek, Roman and European civilizations, here a civilization's core growth comes at the expense of its peripheries, and where the overshoot ultimately undermines the viability of the core civilization itself.[21] Homer-Dixon's detailed analysis of energy use within the Roman civilization also came to a convergent view: growth dynamics were early on based on large "energy returns on investment" (the amount of energy needed to exploit new energy sources), but diminished over time as social and ecological externalities mounted up.[22] And of course analysis of core-periphery dynamics in the 20th century adds another inter-state political dimension to our understanding of what a degradative political economy looks like.[23]

17 Arvidsson, A. (2019). *Changemakers: The industrious future of the digital economy*. John Wiley & Sons.
18 Moore, R. I. (2000). *The First European Revolution*, c. 970-1215. Oxford and New York: Blackwell Publishers.
19 De Moor, T. (2008). The silent revolution: A new perspective on the emergence of commons, guilds, and other forms of corporate collective action in Western Europe. *International review of social history*, 53(S16), pp 179-212.
20 For some details, see https://wiki.p2pfoundation.net/Tokugawan_Period_in_Japan
21 Thompson, W. I. (1985). *Pacific shift*. Random House (NY).
22 Homer-Dixon, T. (2010). *The upside of down: catastrophe, creativity, and the renewal of civilization.* Island Press.
23 Galtung, J. (1971). A structural theory of imperialism. *Journal of Peace Research*, 8(2), 81-117.

Of course, we don't just live in an abstract world with a general world history, but we do now live very specifically in a capitalist system, which is unlikely to be overthrown or transcended in the very short term. It therefore also matters that we look at cycles and rhythms that are specific to the capitalist system. The two authors that can help us here are Karl Polanyi and Carlota Perez.

Karl Polanyi's double movement vs Carlota Perez's adaptation of the Kondratieff Cycles

Karl Polanyi's classic history of the emergence and evolution of capitalism,[24] stresses the pulsation of history which he calls 'the double movement', which periodically challenged the balance between market and state, but was also accompanied by the ebb and flow of commons. As also shown by Carlota Perez in her book on 'Technological Revolutions and Financial Capital',[25] capitalism is marked by waves of economic progress and stagnation, ending in crisis, which last 50-60 years on average. At some point on the economic arc, a particular combination of energy use, geopolitical domination, land use and managerial practice, accompanied by specific forms of technological infrastructures, will set in motion a high growth phase. In this phase, capital needs a lot of labor, which strengthens it, so it is accompanied by pro-labor reforms and the market is more strongly embedded in societal needs and demands. It is to be noted that the welfare advancements of this period are most often not top-down inventions and innovations, but generalizations of the mutualized seed forms that had been created in the crisis phase of the previous descendent wave. Thus, both the Atlee and Roosevelt New Deal reforms were inspired by the forms developed as commons, but were then bureaucratized through state-driven generalization to the whole society.

When this cycle ends, there is a supply crisis, as capital makes less profit. The political form of this cycle is a conservative revolution in favour of capital, which 'frees' the market from societal constraints and which sets in motion a lower growth period, accompanied by financialization, which is less favourable for labor. Social movements weaken, and it usually ends in a crisis of demand, as citizens/workers/consumers are suffering from stagnant incomes and high debt levels. This demand crisis will reset in motion social unrest and pressure to re-embed the market in society but also, as the situation of the working and middle classes deteriorate, set in motion a renewal of commoning among civil society actors.

24 Polanyi, K. (1944). *The great transformation.* Boston: Beacon press.
25 Perez, C. (2003). *Technological revolutions and financial capital.* Edward Elgar Publishing.

This is the double movement, also called the lib-lab pendulum (referring to the British case study of Polanyi), lib meaning the phases of deregulation/privatisation/marketisation, lab referring to the re-regulation. Liib periods are marked by demutualization from the top down and through market pressures in the early deployment, but as the welfare systems degrade, and after the systemic crises that mark their end, remutualization occurs. We have remarked above that this dynamic should also be seen in the context of the general hostility of capitalism towards the commons. The growth of capitalism and its coming into dominance is linked to the destruction of the landed commons of the peasantry, the so-called enclosures. The peasants who lost this land, and also the access to independent livelihoods, were forced to migrate to the cities. Just as their ancestors did in 11th cy., in order to survive, they created social commons, i.e. they pooled their risks. Thus were born the seed forms of what would become the new welfare state.

So where are we now: we can now also see the convergence of more long term trends, with the shorter term dynamics within capitalism. The longer term trend towards exaggerated extraction by the capitalist system, which has created the conditions for the Anthropocene (see below), merges with the more short term ending of a capitalist Kondratieff cycle.

Kondratieff cycles, cycles that are related to 50-year patterns in commodity prices, were first remarked upon by the Russian agricultural economist Kondratieff. Although they remain controversial amongst economists, they remain a constantly discussed cyclic pattern in capitalism, that was taken up by the economist Schumpeter and neo-Schumpeterian economist Carlota Perez. These analytical schools link these waves to technological innovations that create new techno-social systems. Polanyi's classic work on the history of capitalism since the end of the 18th century, The Great Transformation, sees these cycles at work in the social and political history of the system, and he coined the term 'the double movement'. While Polanyi stresses the social and political impacts, Perez focuses on technological and financial infrastructures.

If a radical transformation of capitalism is not in the cards 'in the short term', this could mean that before me move to a more fuller commons-centric form of civilization, we will go through attempts by capital to integrate these commons features, into a next Kondratieff cycle, without of course, a guarantee of success. But it will mean that elements of social commons (which today often take on a P2P form and of natural commons (climate change and energy scarcity reforms), are definitely on the agenda and that a new Perezian cycle must include P2P and green elements.

Our preliminary conclusion: we are going through both a meta-historical event, the loss of our balance with nature at a global level, and at the same time a change within the cycles of capitalism. Both these temporal events, which both lead to a re-strengthening of the commons, are converging in one single global process, which brings the necessity of a re-emergence of the commons to the fore.

Revolution and Phase Transition - the Notion of Seed Forms

Following the iconic examples of the French and Russian revolution, some of the radical left traditions, in particular Marxist-Leninism, has been focused on how to strategize the final assault on the bourgeois state. Other left traditions (anarchism / autonomism) emphasize an exodus from the state. And there are still other left traditions which take a gradualist approach. But an examination of the phase transition towards industrial capitalist structures rather shows a greater variety of moments of change, with many different kinds of actors, as when Bismarck introduces the welfare state in Prussia/Germany, or when the Russian Tsar liberates the serfs, or the constitutional civil wars in England and the US. Moreover, if one looks at the earlier phase transition, say from the Roman system to the 'feudal' system, one sees a very long transition based on seed forms that slowly emerge, start interacting with each other, and create the conditions for a phase change that can take on multiple forms. So, essentially, we see the socialist tradition, in its main remaining forms, reiterating a debate from within the capitalist mode of exchange, either about the right share of the fruits of labor (social-democracy), or to re-orient the functioning society with the state as the agent of capital, but still within largely the same organizational frameworks based on salaried labor.

Similarly, the constituent factors of the capitalist system emerged as early as the 11th century AD. For the development of capitalism we saw such early seed forms with the Italian city-states, mercantilism as the consolidation of this logic and the current era through forms of both predatory capitalism and green capitalism. Thus, the *longue dureé* of the phase transition we are part of is dependent on the creation of seed forms that ultimately 'burst' into the organizational logic of the societies from which they had been planted.

For the emergence of a post-capitalist commons political economy the seed forms are much more recent, from the 20th century, and the *longue dureé* can be seen through the distributed experiments (involving commons and commoning) that indicate and bring forth a new organizational logic. This is not to say that there will be no 'revolutions', but that they are the result of more long-term changes in the productive systems and structures, and the social forces they create. If we have capitalism, it's because we had capitalists; if we have a post-capitalist commons transition, it will be because we have commoners. So what then is the nature of these seed forms for a post-capitalist commons transition?

To recap, from Pogany we have learned that societies change through chaotic phase transitions, in which the old binding elements start disintegrating and new seed forms, preconfiguring potential futures, start emerging and proliferating in various contexts and niches. We can therefore not necessarily predict which seed forms will ultimately be the seeds of the successor system. Nevertheless, given the crucial role of the limits of carrying capacity to the growth of human societies, and the equally important role of mutualization in lowering humanity's ecological footprint, we feel fairly confident that the current emerging P2P and commons-oriented seed forms will play a crucial role in the current transition. This brings us to the last perspective on long term change, through the notion of the Anthropocene.

Mutualization for the Anthropocene

Much is now written about the so-called "Anthropocene," a new epoch that signifies humanity as more than just a passive traveller on planet Earth. The Anthropocene signals humanity as a transformer, or a terraformer, of our planet—producing effects comparable to grand geological shifts. For the purpose of this discussion we can distinguish three "movements" of the Anthropocene.

The first movement is the significance of humans as a species with planetary impacts. This is the popular definition of the Anthropocene—humanity has become such a powerful aggregate force that we can assign a geological era to ourselves! If this were the only dimension of the Anthropocene, however, then we would be no different than the species that generated the first planetary crisis approximately 2.5 billion years ago, anaerobic cyanobacteria, which led to the Great Oxygenation Event where the planet was literally poisoned by excess oxygen, a waste product of cyanobacteria.

Fortunately, the Anthropocene also signifies an awareness of ourselves as a planetary species with planetary impacts. We are not just blindly having planetary impacts, we are increasingly aware of our powerful and precarious effects. We have the power to reflect on who we are, to evaluate what it means to be human. While the first movement of the Anthropocene—human instrumental power —is far more advanced than the second movement—

reflective planetary awareness—this second movement is catching up with the first, for obvious reasons.

Finally, a third movement of the Anthropocene closes the loop on the first two: reflexive planetary responses. Reflexive planetary responses signifies the capacity for humanity to leverage the second aspect, reflective planetary awareness, toward coordinated, intelligent responses to the challenges we collectively face. This third movement of the Anthropocene is by far the most embryonic, and yet ultimately the most crucial, without which we have little hope of any real long term viability. These three aspects play out a classic action learning cycle, act—reflect—change, but at a grand scale that we have only begun to experience today.

This apparent action learning cycle is arguably of a much longer time frame. Our experience and language is often the foundation for our identities and consciousness.[26] Emerging as we did millions of years ago as primates in small bands, group / tribal identity is a primary feature of being human. Over time we added other layers of experience and identity, e.g. clans, states and national identities, or even newer corporate / organizational identities. Today we still struggle with ethnocentrism. The Blue Marble image of the Earth was only taken in 1972 - it cannot be understated how recent it is that we begin to engage or assume a planetary identity.[27]

While we have discussed research and historical perspectives on degradative political economies, much of the literature has been at the scale of nations or civilizations, not a planetary unit of analysis. The same year the Blue Marble image was taken the Club of Rome published the landmark report Limits to Growth,[28] which took this planetary unit of analysis, and extrapolated it out to 2100. Unsurprisingly, they projected major degradation, even collapse, in the middle to latter half of the 21st Century if the growth/consumption/population trajectory was not altered. Throughout the 70s, 80s and 90s many follow up studies were done,[29] but the turn toward neoliberal globalization only intensified growth, consumption and extraction; as William Robinson argues,[30] capitalism went globally *extensive* (in geographic reach) and *intensive* (commodifying subjectivities / relationships).
Today this planetary unit of analysis on the subject of degradation is

26 Lakoff, G., & Johnson, M. (2008). *Metaphors we live by*. University of Chicago press; Maturana, H. R., & Varela, F. J. (1987). *The tree of knowledge: The biological roots of human understanding*. New Science Library/Shambhala Publications.
27 See: https://en.wikipedia.org/wiki/The_Blue_Marble
28 Meadows, D. H., Meadows, D. L., Randers, J. (1972). *The Limits to Growth*. Yale University Press.
29 Henderson, H. (1996). *Building a win-win world: Life beyond global economic warfare*. Berrett-Koehler Publishers; Daly, H. E. (1973). *Toward a steady-state economy. San Francisco*: WH Freeman; Thompson, W. I. (1985). *Pacific shift*. Random House (NY).
30 Robinson, W. I. (2004). *A theory of global capitalism: Production, class, and state in a transnational world*. JHU Press.

common, including research on planetary boundaries,[31] "donut economics", and others.[32] Thus first of all, we like many others cannot see how a runaway global growth machine will lead to anything but unimaginable ecological disruption, even collapse, with dramatic consequences for humanity, especially those most vulnerable. But further, even with "course correction" (as discussed earlier a kind of regulated capitalism), there will still be major disruptions, loss of habitats and livelihoods, and unimaginable inequalities. Following our thesis, what this points to is mutualization, the commons format, but this time at the planetary scale, what we term cosmolocalism.

As mentioned earlier, cosmolocalism describes a planetary mutualization of knowledge and resources in service to the myriad communities that compose humanity. We believe, with access to the legacy of human knowledge, designs, innovations, technology, we can accelerate our response to the climate emergency, address myriad sustainability challenges, and enable local livelihoods. Thus, as we experience at a planetary scale a degradative global political economy, and the local effects / disruptions are increasingly felt, we will likewise need to have a planetary scale mode of mutualization and commoning to respond.

To put this back into a temporal context, we need to acknowledge that this planetary shift in human identity and the emergence of cosmolocal commoning exists within both geological and anthropological frames of reference. Geologically we are moving out of the Holocene, an approximately 10,000 year period of relatively stable climate that was conducive to the emergence of civilizations. Most of the Earth's geological record does not necessarily conform to these conditions. Anthropologically speaking, the bulk of the evolutionary experience of humans was as small bands and tribes. The development of civilizations let alone a planetary unit of civilization is very recent, less than a minute on the cosmic clock.[33] It should come as no surprise that today people experience cognitive dissonance and future shock, an inability to confront the complexity of our contemporary planetary existence and grapple with the post normal futures and challenges we are facing, which are unprecedented. At the same time, our evolutionary experience also gives us two resources: we practiced tribal and inter-tribal mutualization (commoning) for perhaps millions of years, and over that period we experienced dramatic climate variations - we've been through this before, but it is distant in the collective memory. A cosmolocal transition in this context, commoning at a planetary scale, may entail much longer time

31 Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., & Foley, J. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecology and society*, 14(2).
32 Raworth, K. (2017). *Doughnut economics: seven ways to think like a 21st-century economist.* Chelsea Green Publishing.
33 See: https://en.wikipedia.org/wiki/Cosmic_Calendar

frames, and this will require remembering, engaging this new experience and an intensive social learning process.

To put this back in the language of the commons, the second and third movements of the Athropocene are how the commons shifts from a noun to a verb. The second movement of the Anthropocene is our capacity to interpret and understand ourselves in the current era. It entails our capacity to see ourselves as interdependent with other people and other species for our wellbeing and common futures—the web of life and family of humanity. From this the third movement of the Anthropocene can be brought forth, our reflexive planetary responses, what Bollier and Helfrich refer to as "commoning".[34]

This subjective transformation is a movement of "implication," whereby through our relational awareness of our interdependence with the web of life and human family are "plied into" understanding that we are part of a planetary commons. We become aware that we share with others common interest. This explication of a planetary commons, a domain of shared care and concern, is simultaneously the invocation of an Earth community who together must steward the good of the common good for the planet—commoning, in verb form the third movement of the Anthropocene.

The third movement of the Anthropocene depends on both an emerging awareness of our shared commons and an emergent subjectivity that responds to this awareness through commoning as a relationally charged form of action. Commoning as an act of governance is integrated through this movement of self awareness—those who share this commons for their mutual well being and survival must make a shift toward becoming active protectors, shapers, and extenders of that commons. This is the movement from a *commons-in-itself to a commons-for-itself,* and implies a radical democratization of planetary governance.

The transformation of subjectivity in the 21st century, of the experience and the definition of self and community, is the reawakening of our embodied relationality in respect to multiple categories of the commons, and its expression through our emergent practices of commoning. This can be from our connection to our local community or the resources that the local community manages for its well-being, but can also be in connection to what we experience in relation to the future of Earth's atmosphere and its suitability for human life, through which the community which is enacted is a global one in which all of us, and our children and/or grandchildren, are all critical stakeholders.

34 Bollier, D., & Helfrich, S. (Eds.). (2015). *Patterns of commoning*. Commons Strategy Group and Off the Common Press.

Conclusion

The merit of this comparative review is in providing an understanding of the non-exceptionality, or even regularity, of civilizational overshoot. For example, Whitaker's thesis and documentation argues that every class-based system based on competition between elites creates a "degradative political economy" and an overuse of both internal and external resources. Against this, in predictable fashion, eco-religious movements arise that stress the balance between the human and the human, the human and the totality (the divine), and the human and the environment. These ideas, led by religious reformers but followed by people who directly face the challenges of production and survival, lead to temporary re-organizations of society. It is these commons-based transformations that allow overshooting systems to find new ways to work within the biocapacity of their own regions. It is this dynamic—which until now has played out on local, regionally limited scales—that is now necessary on a planetary scale.

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02

Building Cosmolocal Ecosystems

Making Room for the Community-Based Circular Economy

If you are not making locally, you don't have a circular economy

Sharon Ede

A key policy concern for 21st Century civilisation is the circular economy – how to make the best use of resources and keep them circulating in the economy as long as possible.

The circular economy is also closely linked with another major concern - how to rapidly bring down carbon emissions to avoid further destabilising our Earth's climate.

Yet our ways of producing and delivering what people need and want is taking us in the opposite direction of what we must do to achieve these goals.
Estimates at the time of the 1992 Rio Earth Summit[2] found that 75% of the natural resources harvested and mined from the Earth are shipped, trucked, railroaded and flown to the 2.5% of the Earth's surface that is metropolitan, where 80% of those resources are converted into 'waste'.

Materials and carbon are intricately linked, with shipping by sea projected to be responsible for 17% of global emissions by 2050. Aviation is projected to be 22% of global emissions by 2050, meaning ships and planes will account for almost 40% of global emissions[3], if this trend is left unchecked. Our

2 https://ruaf.org/assets/2019/12/Urban-Agriculture-Magazine-no.-1.pdf
3 https://www.europarl.europa.eu/RegData/etudes/STUD/2015/569964/IPOL_STU(2015)569964_EN.pdf

current projections about carbon and climate may be an underestimate, as both shipping and aviation are excluded from international climate change negotiations.[4]

We're moving an awful lot of material around unnecessarily, and wasting a lot of the material that does arrive for us as end-consumers of supply chains that are out of sight, out of mind and usually outside our ability to change or influence.

If we are serious about re-engineering our linear take-make-waste economy into a circular economy, we need to redesign our systems for making and accessing material goods.

A circular economy requires a local production capacity, else it remains a bury, burn or bale-and-export linear economy.

One approach to relocalising production is 'design global, manufacture local' (or 'produce local'). The economy of bits – the designs, plans, information, which is light, travels. The economy of atoms – the materials, the production, which is heavy, stays as local as possible.

Creating a circular economy requires an industrial-scale response, but this can be complemented by a community-based response and associated physical infrastructure that fosters making locally, providing spaces where anyone can learn and maintain relevant skills to effectively participate in such activity.

Sharing and repairing are key contributors to the community based circular economy, however there is huge potential for relocalising production into cities with makerspaces and fabrication laboratories. Instead of overproducing in big factories that need to be separated from where people live for health and safety reasons, manufacturing could return to the city as small scale, clean, on-demand production.

How Community-Based Production Can Support a Circular Economy

The maker/hacker community has some points of confluence with the circular economy and the environment movement more broadly — for example, both are seeking to tackle planned obsolescence — but in general, they have arrived at this point as a result of different motivations:

4 https://www.europarl.europa.eu/RegData/etudes/STUD/2019/642344/IPOL_STU(2019)642344_EN.pdf

• the maker community is challenging planned obsolescence through the ethos of right to repair, expressed in documents like iFixit's Repair Manifesto,[5] which is based on the premise that 'if you can't repair it, you don't own it'. Access to spare parts, availability of repair manuals, the need for nonstandard parts or special tools, materials and design that are not durable are all motivations for the DIY/maker community's pursuit of the right to repair. This push goes far beyond the maker community — in rural USA, farmers are organising for the right to repair their tractors.[6] While environmental concerns are a factor, the primary motivation is challenging the proprietary right of corporations to control the ability to disassemble, repair, and upgrade their products.

• the environment movement is challenging planned obsolescence through a lens of wasteful consumption, and the understanding that capitalism depends on the ongoing use, throughput and waste of material in order to perpetuate economic growth.

In terms of a circular economy, community based shared fabrication spaces have the potential to deliver much more than providing people with the ability to tackle planned obsolescence. They can enable and encourage:

• **reducing resource consumption through sharing** — as shared, open, peer-learning spaces, they enable shared access to equipment, along with the potential for expanding this more widely into the community via initiatives such tool/equipment libraries[7]

• **repair and reuse** — these spaces also provide opportunities for fix-it clinics/repair cafes[8] and other initiatives that promote the circular and collaborative economies — reusing, repairing and fixing things, and transmitting the knowledge of how to do so

• **avoiding consumption** — digital fabrication, which is a technology typically offered in these spaces, enables productive activity with more precision in the use of materials,

5 https://www.ifixit.com/Manifesto
6 https://www.vice.com/en_us/article/kzp7ny/tractor-hacking-right-to-repair
7 https://www.shareadelaide.com/stuff
8 https://www.shareadelaide.com/space-skills

creating less waste that needs to be salvaged in the first place. The ability to design to order, customise, and produce in small batches also avoids the wasteful over-production aspects of existing manufacturing

• **recovery and recycling** — at the other end of the materials life cycle, digital fabrication techniques in workshops enable opportunities such as converting 3D printer and other plastic waste into new filaments[9] for reuse of plastics as 3D printer 'ink'. In their operations, these workshops can also be exemplars of source-separated waste and recycling systems and resource management focused waste contracts, which reward service providers for how much material they recycle, rather than just a fee for emptying bins

• **convening events and activities** — to challenge designers and suppliers of surplus materials into thinking creatively about how their waste resources could be used in projects by others, and develop a platform for discussing and experimenting with local circular economies.

Making the Case: Highlighting Opportunities

Highlighting the range of potential benefits from shared fabrication spaces can help decision makers to see their value and the opportunities they offer.

Such benefits may include:

Employment: governments everywhere are dealing with the vexed issue of how to create jobs in an era where more traditional forms of employment are disappearing, becoming casualised, freelance, moving offshore, or automated. Investing in community development can support economic development, and foster 21st Century industries and livelihoods where people are more empowered than ever to create their own job. This will be critical in a world where more people are not in traditional employment, and are seeking to build a livelihood around their passions and skills.

Health and Wellbeing: open access, community based spaces founded on principles of diversity are welcoming to anyone who wishes to participate.

9 https://www.facebook.com/dc3dprint/posts/1110824555793364

In a community based lab/space, people who cannot access spaces restricted to commercial or enrolled students have the opportunity to have their skills and knowledge valued, with these facilities providing an outlet for creativity, social connection and self-directed activity. For those whose social ties have been lost or are fractured (loss of job, retirement, loss of partner/ family members or friends), becoming part of a community that does things together opens up a range of new personal and working relationship possibilities. Community workshops contribute to what Asset Based Community Development[10] advocates call 'associational life', acting as 'third places' to bring people together in the spirit of exchange and collaboration, which contribute to physical, mental and emotional wellbeing.

Entrepreneurship: providing access to shared fabrication spaces, equipment and communities of practice can enable people to take their idea from the shed or kitchen table to commercialisation and the world. They are the bridge between great, innovative ideas and creating a working prototype — especially for people who might not necessarily identify as an 'entrepreneur' or fit the mould of a typical startup incubator.

Local Economic Development: such spaces can serve as local economy engines as well as the basis of building capacity for distributed manufacturing, on-demand manufacturing and micro-factories. There is an economic value and multiplier effect[11] when production returns to a city. By encouraging learning, experimentation, collaboration and invention, the economic potential of such spaces emerges organically. While pathways to support for commercialisation and entrepreneurship should certainly be apparent and available, if there are expectations placed on such spaces to become production lines of businesses and jobs, their creative force will be more likely to dissipate.

Industry: by providing the physical space to connect and collaborate, makers/creators and pioneers are able to 'cross pollinate' with business and industry leaders, opening up opportunities to transform the way products are conceived and made through collaborative and open source processes. These spaces can help seed the new forms for reindustrialisation and distributed manufacturing at a micro level, to reduce waste associated with over-production and carbon emissions associated with shipping materials and products, and — combined with the right business models — to generate employment opportunities associated with re-localising production.

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10 https://www.nurturedevelopment.org/blog/asset-based-community-development-5-core-principles/
11 https://blog.p2pfoundation.net/pollinating-prosperity-michael-shuman-on-how-to-incubate-generative-economies/2017/09/29

Education & Skills: community technology spaces provide a focus for formal and informal STEAM (Science, Technology, Arts, Engineering, Maths) education and skills, which can continue to be developed throughout life, rather than ceasing once no longer a student or employee.

Environment: the spaces can support initiating the bigger shift needed at the front end of the materials life cycle, in changing the culture of how we make and produce, first micro, then at scale; how we bring industries that 'make' back to the city, how we might provide people with work and income while automation — including in the recycling industry — is rapidly advancing. Spaces can embed sustainability[12] in both their operations (resource efficiency, reuse, recovery and recycling of materials, energy and water efficiency, procurement practices) as well as the focus of their activity. Scaling local production can also support carbon reduction objectives.

Making the Case: Addressing Challenges

There are many ingredients necessary for community based production spaces, including:

- people with relevant knowledge, skills and availability, including technical skills such as training people to use equipment safely; strategic skills to help build the networks of supporters and members, the funding base and communications plan of the space; business and administrative skills, such as ensuring insurances are in place, regulations complied with, and reporting (including financial reporting) to funders/sponsors

- a community of interest to get the dynamo spinning — it will be easier to secure a range of support with a community ready to activate the space, help get the word out, and pull in other resources

- an amenable or receptive 'authorising environment' which is willing to work with the community across a range of areas, from providing or securing funding, in-kind support, and helping navigate the regulatory and legal frameworks (planning, insurance etc) that might not have been formulated with such spaces in mind a variety of equipment and consumables, including recovered materials.

12 www.researchgate.net/publication/298006534_Making_Sustainability_How_Fab_Labs_Address_Environmental_Sustainability

However community based production spaces face barriers in both establishing and sustaining their operations.

Rent

The major common barrier is access to capital, and specifically space. The cost of rent can make or break civic assets such as these. Often, citizens may not have the capital to access suitable space, either through not being able to afford the purchase of a building, or ability to afford commercial rent.

Make Media in the US produced a series on the business case of makerspaces,[13] which undertook extensive investigations into this issue. Artisan Asylum outside Boston cited rent as the largest ongoing expense, initially 75% of their income, and still at 25–30% after years of being established.

Though it will vary from city to city, the issue of rent is central to whether such spaces can survive and thrive. This opens a broader question of who and what the city is for, and whether affordable spaces for uses that cannot compete in a purely commercial sense have a role in the city — if so, there needs to be support which will include paying for space, as unless a suitable space can be donated or purchased, rent will be an ongoing and major cost. Interestingly, ultra-libertarian Silicon Valley titans such as Peter Thiel, Founder of PayPal,[14] have also identified this issue:

> *One thing I've been thinking about as a venture capitalist in Silicon Valley is the vast majority of the capital I give to the companies is just going to landlords. It's going to commercial real estate and even more to urban slumlords of one sort or another.*

Furthermore, grants and funding often preclude the use of funding for the biggest financial barrier — rent.

Community grants tend to be too small to secure a space. Philanthropic funds may tend to favour ameliorating the effects of our current economic and power systems, and be oriented towards tackling their symptoms, such as homelessness, poverty and other forms of disadvantage. Industry development funds are usually targeted at organisations which have a six or seven figure financial turnover and an ability to match government funding.

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13 https://makezine.com/2013/06/04/making-makerspaces-creating-a-business-model/
14 https://finance.yahoo.com/news/peter-thiel-vast-majority-capital-give-companies-just-going-landlords-134709786.html

One approach is to present these spaces as infrastructure,[15] as budgets for infrastructure are often much bigger. The concept of community technology workshops or makerspaces can be framed as a type of 'enabling infrastructure'. If infrastructure is defined as that which enables an activity to occur, then space, and the rent required to access it, is infrastructure. If a municipality or regional authority has budget for waste and recycling infrastructure, make an argument for 'transplanting' some of that funding for projects that activate the upper part of the materials hierarchy.

Revenue

There may be an expectation that such spaces should 'pay for themselves' and not be dependent on government or other large single sources of funding.

In many arenas, non-profits, not for profits and community groups have realised the dangers of dependence on government funding, which is subject to the vagaries of political changes and shifting priorities. Years of work can be destroyed or set back in a very short space of time as a result of a change in personnel (advocates and champions within government) or policy. These organisations have increasingly moved away from models of dependence or charity, and towards as great a level of financial self-sufficiency as possible.

A business model derived from assets, skills and offerings of the organisation can help generate revenue, and this is already a feature of many existing spaces/workshops. Key revenue streams (depending on the space) could include subleasing, storage space, prototyping services, memberships, corporate team building sessions, events and more.

While it is in the interests of these spaces that any ongoing subsidy is sourced from a diverse range of funders to insulate it from the impact of losing one major donor or sponsor - even for spaces which intend to move towards financial self-sufficiency, generated through enterprise as much as possible - this goal may not be achievable in the first years, and ultimately may not be completely achieved.

Yet a makerspace differs from a social enterprise in that it serves many purposes, including as a community asset (a 'common asset', like a library which offers services to the community) and an incubator (ADX Portland has incubated 100+ businesses),[16] where people with expertise provide training, mentorship and space for others to develop and build enterprises. Both common assets and incubators for other purposes are regularly supported with government funds. If there is a need for an ongoing subsidy from a

15 https://gisa0201.worldsecuresystems.com/shared-fabrication-space-infrastructure-grants
16 https://portland.aiga.org/portland-meet-your-makers-adx/

municipality or government or philanthropic entity, perhaps fluctuating from one year to the next to meet any shortfall rather than a fixed amount, this could be set up under a service level agreement, where a for-benefit entity such as a community based makerspace provides a range of programs and services on behalf of the funding body. There are many other options for funding civic infrastructure including Community Land Trusts, where community assets are held in a trust and stewarded by a non-profit entity on behalf of a community, or adapting this concept for an Industrial Land Trust.

Commons value capture, a subset of land value capture,[17] is a concept worth further investigation. Public value is often captured by private interests when development occurs – a rail line is built, water and other utilities are established, a park is created, land is rezoned from farming to residential, and the land value of property for private owners increases, gifting them a financial windfall via public investment or policy. This 'land value uplift' works to extract value from the commons as private gain. Though many mechanisms exist[18] which seek to capture some of the private gain back for the public, community based production or similar initiatives would benefit from a reverse mechanism which directly feeds back to and sustains citizens contributing value to the commons. These people are creating great civic and public value, often working in a voluntary capacity, yet also having to pay rent and being expected to be 'self-sustaining'. Can we adapt land value capture to have an ongoing flow of revenue, a fund hypothecated (ring fenced) for commons initiatives as beneficiaries? If we can find a way to create a circular economy of value creation, to return some of the financial benefit to those creating it, it would be an authentic circular economy of not just materials, but also community and human development.

Regulation

Planning and zoning regulations can help or hinder spaces. Most planning authorities are unlikely to have specific provision for 'makerspaces' in their development plans, and because of some activities undertaken in them (eg. welding), they might not be allowed to establish in certain areas, or fit under existing definitions, such as community centres. Being able to clearly convey what these spaces are, and what the noise, safety, and traffic implications may be, will assist any approval process. Under some planning systems, a change in land use may constitute 'development' and require approval, even if no major works are planned to retrofit the space. Governments can help commoners to navigate the legal and regulatory requirements to become established, to keep operations safe and to prevent any incidents which may jeopardise the ongoing availability of the space to the community.

17 https://www.prosper.org.au/land-value-capture/
18 https://civiccommons.us/2018/11/value-capture-commons/

Communicating the Value Proposition

Authorities and funders may struggle to grasp the value of, and the difference between community based, open access spaces and other facilities that offer 3D printing, or which are only open to employees of a company, or only open to staff and students of an educational institution. Spaces that are inclusive and open access create more possibilities for innovation from a much wider and more diverse base. It is critical to be very clear on the benefits of an open access space, and highlight those which are most likely to be of interest to funders.

In a context of budget cuts or fiscal constraint, it may be harder to convince decision makers and funders to undertake what might seem to them to be a risky experiment in innovation. However shared fabrication spaces are not new — among many prior incarnations around the world, they were successfully established in London19 as community technology workshops in the early-mid 1980s with much the same ethos as contemporary open access makerspaces, though they were eventually undermined by a central conservative government, and seem to have been largely forgotten in a kind of collective cultural amnesia. Studying history can provide some insights into potential pitfalls and how to buffer such spaces from threats.

Crafting A Genuine Circular Economy

Identifying and supporting community based infrastructure projects that encourage local production and economic activity, extend the life of materials and things, and foster innovation and skills development, will contribute to establishing a circular economy.

Community-based shared fabrication spaces offer ways to help people develop materials literacy, reconnecting people to the origin of their material lives, and can serve as sites of cultural transformation, enabling and demonstrating changes to the way we design, make, use and dispose of materials.

They offer people a means of actively participating in provisioning for themselves, rather than being passive recipients of an often impenetrable supply chain and associated invisible environmental and social impacts scattered across the globe.

They offer potential to challenge the primacy of consumption and culture of disposability, and they invite people to remember and (re)discover they

19 http://sro.sussex.ac.uk/id/eprint/53574/2/Smith_2014_Technology_Networks_JPP_final.pdf

are citizens, not just consumers. As such, they are a signal interruption to the prevailing economic operating system. These wider cultural shifts are critical in order to meet the objective of creating a circular economy. However a circular economy of materials is necessary, but not sufficient, for the systemic change we need to get us on track for a secure future.

Any approach which is aligned with or dependent on an economic system based on perpetual growth and the pursuit of more, or one where value is created by many but captured by a few, does not offer the structure that can deliver the changes we need to address our environmental and social challenges. A truly circular economy would mean that the circular ethos is also reflected in our social systems, including our financial and business structures, and the political frameworks and cultural norms that influence human behaviour.

A real circular economy would expand the definition of the circular economy to one where its operating system is regenerative not extractive not only towards nature, but people; one where wealth is equitably circulated and shared.

Making room for community based production and circular economy initiatives is one way of seeding change in the substrate of cities to bring about a circular, regenerative economy and society.

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Cosmolocal Questions: From Tech Trend to Protocol Commons

José Ramos

Cosmolocalization as a tech trend

From the point of view of the study of social change and the future one of the more well-established notions is that the future begins in 'seed form'. This is to say that people create ideas, which turn into prototypes, and experiments, which over time become refined into working models.2 Sometimes these models scale or get replicated, and become dominant features of the social fabric. First Bucky Fuller dreams about solar energy. Then researchers prototype it. Fast-forward 60 years and solar is the fastest growing energy type on the planet. First Julian Assange blogs the idea for WikiLeaks, then with the help of Chaos Computer Club members in Berlin he prototypes it and launches it. Fast forward 15 years and he is in a jail cell in the UK awaiting extradition to the US. As dream or as nightmare, the future begins in a dark alley, hidden from the world.

Cosmolocalization is one such seed form, an emerging issue that has been gaining momentum, but still in its relative infancy. We see the successes of many commercial initiatives, some documented in this reader, which are expressions of the idea. We also see more cooperative and commons based initiatives, also documented here.

2 Molitor, G. (2010). Timeline 22-step model for tracking and forecasting public policy change. *Journal of Futures Studies,* 14(3), 1-12.

As a tech trend many of these developments rest firmly on new technologies such as microcontrollers, such as arduino, raspberry pi and others, which undergird the operation of 3D printers and CNC machines, laser cutters, and other automated and robotics based manufacturing. The technologies seem to point towards the potential for a democratization of production. The dreamers tell us we'll all be able to produce and print everything we need locally. But much of this relies on the accumulated wealth of knowledge that emerged with the internet. With the internet and crowdsourced knowledge a knowledge commons became a reality. Wikipedia showed us what was possible. With distributed production this idea has transformed into the idea of a "global design commons" or an IIDEAS commons (Ideas, Innovations, Designs, Experiments, Actions, Solutions). In this view, an IIDEAS commons allows us to use ideas and designs for everything, from medicine to machines…. Suddenly we have the capacity to use the human legacy of knowledge to solve real problems to support real livelihoods where they are needed most.

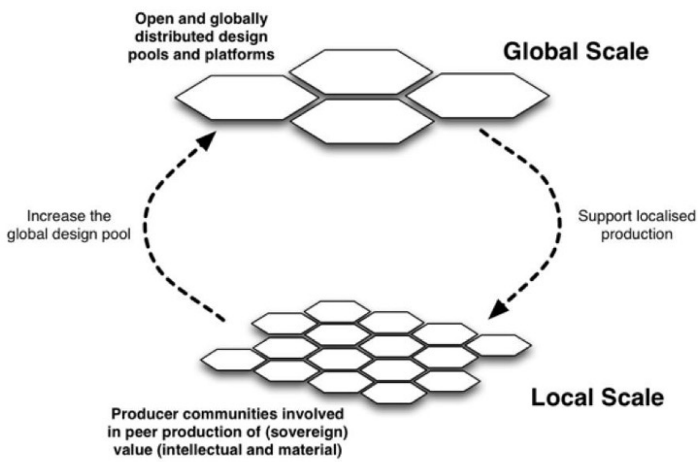

Diagram 1: Idealized Virtuous Cycle for Cosmolocal Value Creation, Source Author

In its idealized dimensions cosmolocalism follows the process in the diagram above. As producer communities around the world create solutions, document them and keep them open, open and globally distributed IIDEAS pools and platforms increase, getting bigger and reciprocally supporting localized production and solutions to challenges — it is a virtuous cycle.

This of course also addresses our need to create solutions to our environmental crisis. Bauwens and Pazaitis write:

> *"The idea of pseudo abundance is based on the mistaken premise of infinite material growth on a finite planet, where natural resources are actually fundamentally limited. Artificial scarcity refers to the strategies that prevent the sharing of technological and scientific progress because of excessively restrictive intellectual property rights. A sensible alternative is, of course, to recognize the limits of what we can use from the world of nature, of which we are an intrinsic part, and to allow for the sharing of all knowledge that can contribute to living within the limits of this 'biocapacity.'*[2]

The contradictions

But there are some fundamental contradictions to grapple with. Some enterprises seemingly on the cusp of cosmolocal production have not been able to go all the way. They want to do open design, full open source, but in these cases there is one central issue. If they want to get investment capital from investors, they cannot make all of their IIDEAS open. Investors want a return on their investment and for them open-source amounts to giving away their investment and losing money. If you are creating designs and making them open source they are allergic to you. If you are using other people's open source knowledge to make money they love you.

Michel Bauwens has repeatedly pointed out this fundamental contradiction in the domain of open source.3 It has usually been the big corporates that have been quicker to adopt open source systems, such as Linux and Android, while those nonprofits committed to open source, create value which is not "generative" — that is, value does not return to sustain them. As with industrial agriculture, and the rest of the economy, the logic is extractive.

So we begin to see some of these contradictions:

- Contradictions number one is, make your IIDEAS free and open and lose your ability to get investment capital,
- Contradiction number two is, make your IIDEAS free and open and support capitalism as usual.

We all work within a historical and political-economic context, which today is global neoliberalism, capitalism on steroids.

- a system designed for the 1/10th of 1% to become even richer,
- about extracting value irregardless of the social or ecological consequences — it is a mindless accumulation machine,
- a political economy, not just an economic system. This is to

3 https://vimeo.com/362939708

say that it structures political relations and policy in its own interests. Therefore we increasingly live in a world of oligarchs who influence political systems for the purpose of defending and expanding their wealth,[4]
- most of us are unwitting accomplices and complicit in the perpetuation of this system.

We can see this in the example of insulin production. Diabetes is a life-threatening illness associated with an inability to produce insulin which affects the body's capacity to distribute glucose. In 1923, Frederick Banting, Charles Best, and James Collip sold the patent for insulin to the University of Toronto for $1 each, because they thought that this discovery was so important, it should be available to everyone. Imagine this. The discoverers of insulin essentially gave away their discovery for next to nothing, so that many others could benefit. This was the spirit of the commons and cosmolocalism in the 1920s! They didn't need a fancy word for it, it was simply what made sense, what was the right thing to do.

Yet fast forward five decades later and it is impossible to get any insulin in the United States without paying exorbitant fees. The cost of insulin tripled from 2002 to 2013 and doubled between 2012 and 2016. In 1996 a vial of Humalog cost $21 — today, it is $324, an increase of 1,400%. Those without insurance, pay thousands of dollars per month. Diabetes has become the most expensive disease in the United States. By wrapping insulin production in a convoluted and labyrinthine system of process patents, pharmaceuticals have been able to create artificial scarcity. So today we have a cosmolocal initiative, the open insulin project in Oakland, which is attempting to bypass the pharmaceuticals by creating their own insulin products. (See account in this reader).

So the dilemma becomes a little clearer. In the current political economy those cosmolocal enterprises and initiatives which are willing to play by the rules of capital may survive and thrive. They will be platforms that allow distributed production or manufacturing, but the IIDEAS they create will never be truly open and the enterprise / platform will likely be owned by a few founders and their investors, rather than the many. Many of these are or will be good solid businesses which create and exchange value. But, we know that it's the "after value" logics of venture capital and shareholder capital that turns an innovative business into a value extraction machine.

The Cosmo local enterprises which refuse to play by the rules of capital will continue to keep their IIDEAS open, but these IIDEAS may simply

4 Winters, J. A. (2011). *Oligarchy*. Cambridge University Press.

be appropriated and used by commercial entities, and commons based enterprises may struggle to be viable.

Pop up political economies

So what do we do then if we are trying to create the new from within the old? We can wait around for the next political economy to come by, but that could take a while and we might not get the one we want.

The Great Depression and World War II ushered in Keynesian economics, social democracy, the Non-aligned Movement and socialism. It took a massive crisis to create a modest social contract that regulated capital and provided for basic needs. But it was bloody and painful and the crisis could have gone either way. Fascism could have prevailed and we could now be living in Philip K Dick's fiction future from The Man in the High Castle. Today's climate is perhaps even more dangerous. With the threat of climate change, water wars, mass migration, and a populist xenophobic backlash against economic and cultural globalization, the next crisis is not guaranteed to go our way.

So how do we NOT wait for the next crisis, but actually begin to bootstrap a new political economy, to create new systems that allow for commons based cosmolocal potentials to thrive? Clues come from here and there, and many in this reader.

The Solar Ujra through Localization for Sustainability project (SoULS) is a project initiated by the Indian Institute of Technology (Bombay) around 2013 / 2014.[5] The project addresses the need for rural Indian villagers to have light at night, which can help kids study and creates more amenable households. Many rural Indian villagers use kerosene lamps to light their homes. However kerosene is dirty and associated with health problems, nor is it cheap, as many villagers are not even able to afford it consistently.

The SoULS project aimed to directly impact the livelihood and well-being of rural villagers by replacing the use of kerosene with solar lamps. The solar lamps were designed based on open hardware, which allowed the project to reduce the cost of the lamps. Importantly, solar lamp repair centers were established to service the villages that received and use the lamps. Locals were trained in the repair of the lamps, and a service model was developed whereby they would earn sufficient income from the ongoing servicing. Solar lamps end up being cheaper overall for villagers than running kerosene

5 http://www.soulsiitb.in/

lamps. A number of new jobs are created in repair centers. The project also adheres to open hardware principles:[6]

> *"With an aim to decentralize the diffusion of the solar technology, IIT Bombay will release the designs of all the solar products in the public domain. The open source hardware will make these products available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. The hardware's source, the design from which it is made, is available in the preferred format. People can make modifications to these designs to cater to the needs of the people in their vicinity. Rightnow, the solar study lamps distributed under the 70 lakh solar study lamp scheme and the Million SoUL Program have been made available in the public domain."*

On top of this, the project established a cooperative for the production of solar panels, which would drive the supply of new panels to service existing and new regions of the scheme, and which benefited from a dedicated market.[7]

> *"Dungarpur Renewable Energy Technologies Pvt. Limited (DURGA Energy) is a one of its own kind module manufacturing plant completely owned and operated by local tribal women of Dungarpur District, Rajasthan. The women from the self-help group formed under the four clusters of Antri, Biladi, Jhonthri and Punali co-jointly own the company. The company is equipped to make all standard as well as custom-designed solar panels raging for 1Wp to 330Wp modules."*

The project has demonstrated strong benefits such as increased health, increased educational performance by children in the villages with the lamps, and this is not to mention the reduction in carbon emissions from the phasing out of kerosene.

This project shows how an anchor institution can form the basis of the development of an ecosystem which is able to recirculate value in virtuous ways.[8] It is what we might call a "pop-up political economy", because for a moment it is able to interrupt the relentless logic of neoliberal capital and create an alternative economy. The example points to the crux of the challenge that we face if we want to create a world in which open IIDEAS potentiate local livelihoods.

The P2P Foundation has been grappling with this problem for a number of years. One of the ideas has been a reciprocation license. If open source gets

6 http://www.soulsiitb.in/open-hardware.php
7 http://www.soulsiitb.in/durga.php
8 See: https://democracycollaborative.org/democracycollaborative/anchorinstitutions/Anchor%20 Institutions

easily appropriated and users do not give back to its source, then some kind of means for mutualization needs to be built into an intellectual property license — a peer production license.[9] If a commercial entity wants to use a design they would pay back to the owner a commercial price. If another commons-based enterprise wants to use the design, it can be done at a lower price or freely. This idea has the benefit of returning value from the capitalist economy into a commons economy.

Yet there has not been any sufficient development or uptake of such a license. This solution relies on the social construction which is our legal system, and the ability to enforce claims, as well as cultural norms. But it has a precedent, the example of Lawrence Lessig's development of the creative commons license.

Other solution ideas have come from within the blockchain space. The reasoning goes that we can create a commons economy within a capitalist economy that uses its own blockchain accounting system. When someone contributes to the pool of knowledge or IIDEAS, and another person uses a design or piece of intellectual property, the transaction would go through the blockchain technology, it is recorded and some value has a way of returning to those that produced it, through its tracking via the distributed ledger. Ostensibly if somebody wants to purchase something within such a system it would ultimately use a blockchain token or currency. The "trustless" nature of the distributed ledger solves the problems that the peer-to-peer licenses has, which is how to track and enforce reciprocation. There are a half dozen or so other prototypes in this space. So in this area we are well past the idea phase and now in the prototype phase, with some systems delivering value.[10]

In another example, Sensorica is one of the enterprises at the forefront of using a form of contributory accounting that allows contributors and producers of R&D to receive reciprocal payment in a granular way, but does not actually use blockchain to do this.[11]

So here we have one institutional solution via use of an anchor institution (e.g. SoULS), legal solution via the peer production license and technological solution via the blockchain and / or contributory accounting, for bootstrapping pop-up commons based political economies from the bottom up.

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9 See: https://wiki.p2pfoundation.net/Peer_Production_License
10 Bauwens, M., & Pazaitis, A. (2019). *P2P accounting for planetary survival. Towards a P2P Infrastructure for a Socially-Just Circular Society*. P2P Foundation, Guerrilla Foundation and Schoepflin Foundation.
11 Bauwens, M., & Niaros, V. (2017). *Value in the commons economy: Developments in open and contributory value accounting.* Heinrich Böll Stiftung, P2P Foundation.

The role of the urban commons

This finally brings us to the role of the urban commons. What has happened in Bologna, Ghent and Seoul with the urban commons is potentially transformational. When we talk about anchor institutions able to bootstrap the development of new value circulating ecosystems, we normally think of organizations like hospitals and universities that have large-scale capacity to do social procurement, such as with the case with the Cleveland's Greater University Circle Initiative.[12] Like the SoULS project in Maharashtra, the Cleveland model was able to jumpstart a number of local cooperative businesses and bring good jobs to the area.

When we consider the ideas of the urban commons we are dealing with an order of magnitude greater than just a few institutions. If we take on board Christian Iaione's vision of the "Five Helix" of the urban commons and polycentric governance, which according to him includes: "(1) social innovators, including active citizens, entrepreneurs, digital innovators, urban regenerators, and urban innovators; (2) public authorities; (3) businesses; (4) civil society organizations; and (5) knowledge institutions, including universities, schools, and cultural academies."[13] In fact, we might say that this idea of the urban commons, working across asymmetrical organizational forms, is an anchor institution force multiplier - on a different order of magnitude. It is more like a meta-anchor institution, with multiple systems and organizations looking for and finding collaborative synergies. It also corresponds to the idea of a 'partner state', or 'partner city', where a new political contract exists between citizens and their governments, which establishes polycentric governance as the foundation for caring for the urban commons.

We know that cities are key in so many crucial areas. It is where most carbon emissions come from and where we need to reduce emissions. It is where most professional expertise is found. It is where most markets and market demand exists. It is where most people will live in the 21st century.

What if cities demanded a circular economy function within its geographical boundary, and between it and the broader value chains it depends on and supports? What if cities emphasized their capacity for auto-productivity, and supported localized production using new cosmo local potentialities? This is what the Fab City Global Initiative has championed for years.[14]

12 See: https://www.clevelandfoundation.org/wp-content/uploads/2014/01/Cleveland-Foundation-Greater-University-Circle-Initiative-Case-Study-2014.pdf

13 Iaione, C. (2016). The CO-city: Sharing, collaborating, cooperating, and commoning in the city. *American Journal of Economics and Sociology*, 75(2), 415-455. p 426

14 See: https://fab.city/

Cities are a greenfield opportunity to jumpstart cosmolocal transformation when we combine the meta-anchor institution-like dimensions of the urban commons.

From the seeds of change (the many stand-alone initiatives) that we see expressing a cosmolocal logic, such as SoULS, we know that such meta-scale anchoring — an urban commons with cosmolocal depth — could and would be a pop-up political economy to be reckon with, within which new rules, incentives, norms and possibilities would exist in supporting generative social and economic activities rather than extractive ones.

We can also see that such generative value circulation at the scale of cities might use new technologies, like a distributed ledger system, to tokenize value exchange. Such sub-political economies would be a new force with real scale. And of course we could see how protocol cooperativism, where cities across the world work together to mutualise resources, would only amplify this further.[15]

The need for a protocol commons

The commons is not a singular phenomenon, there are many different types of commons and commoning activity. Bollier and Helfrich's seminal work makes this abundantly clear.[16] For the commons to grow, we need to find synergies between many different types of commoning activity and scales of activity. Of course we need cooperative, distributive and regenerative forms at the scale of the enterprise. But we need as well urban commons that support a garden garden bed of commoning to thrive — partner cities that grow the commons intentionally. And we need transnational forms of solidarity, such as city to city mutualization and cosmo local production.

The challenge is both an epistemological one and as well related to our maturity as human beings. Our worldviews come from our sense of place, language, experience and embodiment. It is too often too easy to see what we do in isolation from the multiplicity of other activities in the world, we are so deeply embedded in our own struggles, challenges and activities. And then there is the ego. We want to see our creations, our priorities, as primary.

So in order to create these pop up political economies we need to see ourselves as part of potential ecosystems. We need to begin to create a system of shared language and messaging that allows one commoning

15 See: https://wiki.p2pfoundation.net/Protocol_Cooperativism
16 Bollier, D., & Helfrich, S. (Eds.). (2014). *The wealth of the commons: A world beyond market and state.* Levellers Press.

activity to leverage or find synergies with another. This 'protocol commons' would allow for collaboration and synergy even when these activities and projects are fundamentally different. It means that there is a way for one commoning activity to be asymmetrical (different in form) to another commoning activity and yet be able to develop generative synergies. We can think of the metaphor of the bee and the flower. They do not fundamentally know how each other think, but there is a form of signaling that allows each to find a synergy with the other and reciprocate the value that forms the basis for their survival. Regenerative agriculture works on such principles - companion planting and nutrient synergies.

This indicates that commons synergies can comprise ontological and epistemological complexity.[17] This means that we do not have to share the subjectivity of the other in order to collaborate fruitfully. It also means that two entities can be different in form and function, and still form a generative ecosystem of commoning. There can be a kind of metalanguage, a protocol of the commons, which allows for complex and asymmetrical reciprocation, collaboration, value exchange, generativity. Through this we can envision this variety of commoning activity, from the micro cooperative scale (e.g. platform cooperatives), to the scale of the urban commons, and to the transnational scale.

We know, whether intuitively or rationally or perhaps through unconscious anxiety, that we (the web of life and human family) are mutually implicated into our shared survival. How the Amazon goes we go. How the oceans go we go. How our soils go we go. How our climate goes we go. A protocol commons is more than just a technical metalanguage for communication and asymmetrical reciprocation but is underlined by the knowledge that we are interdependent, and the language and practice of this interdependence is fundamental to our collective survival and long term wellbeing.

17 Ramos, J. M. (2010). *Alternative futures of globalisation a socio-ecological study of the world social forum process* (Doctoral dissertation, Queensland University of Technology).

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Fab Cities and the Urban Transformations of the 21st Century

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Introduction

Traditional industry is starting to be disrupted not only because of the climate crisis, but also thanks to an emergent production paradigm supported by advanced manufacturing technologies, new forms of synthetic intelligence, new material science or connected systems, which are opening endless opportunities to re-calibrate the negative effects of the human-centered activities on planet earth. Some of these emergent technologies (digital fabrication, synthetic biology, artificial intelligence, blockchain, to name a few) are already disrupting the established mechanisms under which our productive model operates, and are producing massive cultural transformations in society. If the machine era aimed to shape the human habitat by creating interfaces with natural resources through science and technology, the ubiquitous nature of digital technologies will demand articulation and rapid synchronization of systems at different scales, both biological and synthetic. The emergence of such new tools and technologies is demanding us to create different outputs from the ones we already know, and to design possible futures for life (human and non-human) to prevail on this planet.

One of the characteristics of this period of transition is centred in the fact that most of our challenges are "wicked problems", or problems without solutions, which adds a new level of complexity to this moment of convergence of crises and technologies. These problems need to be addressed from a multidisciplinary and collaborative perspective, with a holistic view to the implementation of possible interventions to address them, and by long term planning and expected results. Small-scale interventions can help us to approach large-scale challenges, in order to dissolve these same wicked problems, and scale up these interventions using the power of digital networks, and the agility for society to adapt to transformation.

Cities, Production, and Digital Revolutions

In order to think about possible futures in our cities, it is necessary to look a little towards the past. During the last couple of centuries, humanity has developed a globalized industrial model that reached its peak in the last few decades with the observed increase in CO2 in our air, pollutants in our water and soil, and the rising temperature of the planet. We have been moving cheap raw materials around the planet, using cheap energy sources, so that they can be transformed into consumer goods (food or products) thanks to cheap labor. We move materials and products around the world because the costs are low, and because the rules of the global economy benefit competitive advantages and economies of scale. There are two tragic factors in this economic model, which is based on infinite growth. The first, is that in reality labor, energy, and raw materials are not cheap and their social and environmental externalities are not calculated inside the real costs of any product or company in the world. Instead, they are taken as credit from the future that will be taken care of by someone else. The second tragedy is that this model is completely linear and assumes that the planet's resources are infinite and that we can dispose of the waste into our land, oceans, and air.

Under this linear economic model, cities have developed infrastructure for the movement of atoms: airports, ports, roads, together with technologies such as cars, trucks, trains, or airplanes. Sounds pretty logical, which is why we have seen most of the knowledge development and advancements of the 20th century centre around these technologies. But this model is in crisis, not only in cities but on a global scale. Cities are responsible for the largest amounts of CO2 emissions and the largest population concentrations on earth. In our current linear economy, the cities of today consume most of the world's resources and generate most of the world's waste (according to the United Nations). Unchecked, these impacts will continue to increase, which is why it is necessary to establish an economic model for cities that is regenerative, spiral, and restorative. A model in which atoms stop traveling thousands of kilometers from city to city to get to our hands and stomachs but stay local; where the digital bits are that which travel thousands of kilometers around the planet, thanks to the digital revolution in computing, communications (Internet), and fabrication to turn them into atoms at the local level.

Digital fabrication technologies allow computers to be connected with machines to make and produce (almost) anything; to turn bits into atoms, and atoms into bits. 3D printers and scanners, laser cutters, computer controlled machines, are some of the examples of processes that allow converting bits into atoms in a matter of minutes, or a few hours, and for people to share designs digitally on a global scale, while manufacturing or producing locally.

Manufacturing and production in cities could help to increase the resilience of citizens, and regaining the ability to meet the needs of communities locally, providing them with technology that could help in:

- The production of a large amount of food within urban perimeters
- The production of energy on a local scale, using different complementary micro-generation and distribution technologies
- The use of materials that are considered waste as new raw materials for a local industry
- The reduction in the movement of materials on a global scale, since cities can produce what they need on demand, using mostly local materials
- Rethinking the urban infrastructure necessary to provide cities with the capacity to be productive, having infrastructure for urban metabolism, including biodigesters, material libraries, flexible factories as the key large scale, and fab labs as learning and prototyping centers.

Although future cities will have to be smarter and have many technological layers that allow the provision of services to citizens, it is also necessary to challenge the Smart City model, which has not demonstrated social and ecological sustainability.

21st century urbanization needs to look to how cities are going to produce (almost) everything they need to consume. The exponential growth of digital technologies (computation, communication, fabrication) offer the opportunity to enable a transition towards a spiral economy (an open circular economy approach), in which data (and knowledge) flow globally, and materials flow locally: from networks of logistics that move atoms, to networks of information that move bits.

From Fab Labs to Fab Cities

> *Fab lab (noun)*
>
> *A local fabrication laboratory which aims to democratise access to personal and collaborative invention using digital technologies to make almost anything.*

Started (almost) accidentally as an outreach programme at MIT's Centre for Bits and Atoms in 2002, Fab Labs have since become an emergent network of digital fabrication laboratories. First established in the South End Community Center in Boston as a joint collaboration between the National Science Foundation[2] and MIT's Center for Bits and Atoms[3], you can now find 2,000 of them dotted all around the world, from Bolivia to Ethiopia.

Using digital fabrication as the main focus, Fab Labs promote the idea of distributed manufacturing. Designs can be sent to the other side of the planet, and using CNC machines, laser cutters, 3D printers and other simple tools, citizens can create nearly any object, big or small. The informal network has been growing exponentially during the last ten years, doubling every 24 months, similar to the rate established in the Moore's Law for microprocessors speed and cost.[4]

Fab Labs have the potential to profoundly impact how we live, work and play. However, they need better governance, validation and value exchange tools to incentivise the impact within the network and in the places where they are located.

The main Fab Lab community values and mission are simplified in the Fab Charter[5], extended here:

- **Collaborative community:** For the last ten years, the Fab Lab network has gathered in a different country every year for an annual Fab Conference. Taking advantage of tools that aid

2 nsf.gov
3 cba.mit.edu
4 https://www.fablabs.io/labs/map
5 fab.cba.mit.edu/about/charter

global collaboration – such as GitLab[6], GitHub[7], fablabs.io, Whatsapp[8] and Slack[9] – Fab Labs are organised in regional networks, with the most consolidated examples being in Latin America, Asia and Europe. Networks collaborate on educational programs such Fab Academy[10], Textile Academy11 and Bio Academy.[12]

- **Open source philosophy:** Thanks to digital fabrication technologies, the open source movement is moving from software to hardware as Fab Labs exchange code, files and instructions to design and produce things anywhere in the world, without the need to ship any materials. Because of its very nature, open source software lacks incentive mechanisms, but this is not the case when it comes to hardware. All the content of the Fab Lab network is publicly available online – the inventory[13], educational program curriculums, video lessons, project designs, platform source codes and online tools.

- **Circular economy and open innovation:** The ultimate goal of Fab Labs is to build the vision of the Fab City project. Under this mission, it is data, not things, which is shipped globally, enabling objects to be made locally. The circular economy is not based in the management of materials, but in the creation of value from waste, and its ability to be reinserted in the supply chain at the local scale. This ambitious goal requires open innovation at its core – a fundamental value of the Fab Lab network.

- **Social impact:** Neil Gershenfeld, Director of MIT's Center for Bits and Atoms, claimed back in 2005 that the network's intention was to "encourage hands-on activities and invention by bringing 'science and technology' to peripheral and marginalised communities". Today we are seeing that in action as people in Fab Labs all around the world are challenged to get out of the comfort zone of the empowered and self-satisfied geek culture, and to use their knowledge to help their

6 gitlab.com
7 github.com
8 whatsapp.com
9 slack.com
10 fabacademy.org
11 textile-academy.org
12 bio.academany.org
13 fabfoundation.org/getting-started

local community, and then measure and document impact. Digital fabrication has the potential to provide solutions for specific needs anywhere in the world, especially impacting communities with a lack of access to water, energy or communications. An example of this is the Vigyam Ashram Fab Lab[14] in rural India, which has implemented successful solutions such as an LED lighting solution, precision agriculture control devices and a sanitary incinerator. Fab Labs are physical spaces which hold the potential for social inclusion; to empower like-minded people (individual and collective agency); and to enable their capabilities. Digital empowerment takes another dimension when bits and atoms are connected, and people and communities can satisfy their local needs through access to new means of production.

- **Access to digital fabrication tools:** The core objective of the Fab Lab network is to democratise access to digital fabrication tools through the development of educational programs and facilities for communities worldwide. There are a growing number of Fab Labs being promoted by public and private sectors that provide free access to spaces and machines for their use. However, this access is not limited to machines: the aim is to give citizens the knowledge and tools to expand the network's potential around the world.

- **Development of educational programs:** Individual Fab Labs, regional networks and the global community have been developing and implementing new educational programs around the world, including certified programs such as the Fab Academy or Bio Academy, as well as STEAM school programs (Science, Technology, Engineering, Arts and Mathematics). These new educational programs teach the next generation skill sets needed in today's digital economy that are requested by large companies, startups and innovation organisations when hiring new personnel. Fab Lab educational programs stimulate entrepreneurship, with a large number of Fab Labs started by alumni as new businesses, as well as the development and creation of new products.

- **Development of a new economic model based on new urban industries:** Fab Labs support the Fab City vision,

14 vigyanashram.com

which aims to transform the urban dynamics and space with an industrialisation based on clean technologies, on-demand production, circular economy and citizen innovation. Fab Labs have the potential to become the articulators of a transition towards a new productive model in cities – able to provide access to tools; build a new set of skills; and deliver new types of services and products that will challenge the 150 year old industrial model.

- **Catalyst for a new model of distributed production:** Fab Labs won't replace industry, but will accelerate the transition to a new model of manufacturing on various scales within cities and regions. They can help provide the services and products needed in cities without compromising the planet's resources or exploiting workers. Fab Labs are the places where ideas are turned into reality; prototypes are designed and tested with users, and business models are developed, while connected with larger manufacturing ecosystems at the city and regional scales. For example, the approach of open access factory finder Make Works is complementary within the Fab Lab network worldwide, since it registers the manufacturers and suppliers at industrial scale in cities and regions.

Fab City brings the impact of digital technology available in Fab Labs to cities. It connects distributed networks of hyper-local and productive ecosystems. By adopting the Fab City challenge, cities can radically transform the way production and consumption happens within their metropolitan regions, by replacing standardization with smart customization, focusing on interconnected processes instead of isolated products, and more importantly: empowering citizens and communities while reducing the environmental impact of urbanization. The Fab City Global Initiative is an action plan for cities to make this shift possible and then become more resilient through the re-localization of the production of energy, food and products. It enables a global community of designers, makers and thinkers to amplify and multiply the scale of this important transformation together with government and industry.

The Fab City Global Initiative

Being a city with a long tradition in urbanism and design, Barcelona has been a critical node in the growth of the Fab Lab Network since early 2000's. This is where Ildefons Cerda or Enric Miralles dreamed about future cities years before. We launched the Fab City Global Initiative together with the Center for Bits and Atoms at MIT, the Fab Foundation, and the Institute for Advanced Architecture of Catalonia, as a call for cities to invest in local invention as an accelerating engine of urban transformation in the model of production and consumption that powers our cities.

The Fab City Global Initiative established a 40 year road-map that started in Barcelona in 2014, when the mayor of the city challenged other leaders of the world to develop a new urban model: cities that produce everything they consume locally, while sharing knowledge globally. That challenge has been followed by 33 other cities, regions and countries such as: Detroit, Amsterdam, Bhutan, Shenzhen, Ekurhuleni, Santiago de Chile, Boston, Paris, São Paulo, Seoul, Hamburg, Rennes, among others. The Fab City Global Initiative is now a living project being articulated by a distributed network of urbanists, designers, makers, innovators, artists, developers, engineers, and other professionals and enthusiasts around the world, representing institutions such as the Danish Design Center, the Royal College of Arts and Design, Waag Society, Parkhuis de Zwijger, Metabolic, Materiom, Open Dot Milano, Fab Lab Berlin, Fab Lab Santiago, Fab Lab Barcelona, Green Lab London, Fab City Grand Paris Association, Politecnico de Milano, Incite Focus Detroit, Dark Matter Labs and Fab Lab Bhutan, to name a few. The Fab City Global Initiative is comprised of three parts:

- **Fab City Collective:** the group of individuals (urbanists, designers, makers, innovators, artists, developers, engineers, and other professionals and enthusiasts around the world) who contribute to the development of different projects at the local level, with the support of organizations, governments and other actors. This group participates in different projects worldwide, especially concentrated in Europe right now, but that has started to have more activity in Asia and the Americas.

- **Fab City Network:** a network of cities that have joined Fab City since 2014, currently 34. This network operates at the other end of the Fab Labs network (almost 2000), and allows public policies to be articulated and to have a more institutional layer from Fab City locally in each city. The current list includes: Barcelona, Zagreb, Thimphu (Bhutan), Shenzhen, Georgia, Curitiba, Occitanie Region, Puebla, Mexico City, Auvergne-Rhône-Alpes, Amsterdam, Cambridge, Kerala, Sacramento, Plymouth, Hamburg, Yucatàn Region, Belo-Horizonte, Ekurhuleni, Brest, Boston, Toulouse, Paris, Santiago, Velsen, Seoul, Oakland, Somerville, Detroit, Kamakura, Sorocaba, Rennes, São Paulo, Recife.

- **Fab City Foundation:** Recently we saw the need to generate a certain organizational structure, so we have launched the Fab City Foundation. The foundation has been established as a legal and organizational structure in Estonia to enable the location-independent work of the globally distributed Fab City community. It is enabled by the Estonian e-Residency program which allows individuals and organizations the ability to function more seamlessly across borders and bureaucratic lines.

The Fab City Full Stack

Full stack approach: "In computing, a solution stack or software stack is a set of software subsystems or components needed to create a complete platform such that no additional software is needed to support applications.Applications are said to "run on" or "run on top of" the resulting platform." - Wikipedia

Being part of the Fab City initiative does not mean that the results immediately occur. We are dealing with fundamental transformation of our centuries old urban model, which needs to address problems with high complexity. That is why within the project we have developed a strategy based on an analogy in software development: a "full-stack" approach. This means that we think that cities are platforms, with complex networks internally, and that they need different parts, actors, technologies, and strategies to make them work. It is true that the city is much more complex than software, and that at the same time it is a living element, it has a life of its own and it is impossible to control it. But if it is true that you can influence the city, you can experience it, and generate the conditions for innovation to take place. Our strategy has the following layers:

Cities Network
Shared metrics to evaluate progress towards self-sufficiency in cities. Policy-making, regulation, and planning for regenerative urbanization.

Platform Ecosystem for local needs
Project repositories for urban transformation. Distributed and decentralized repositories and value exchange mechanisms for global collaboration. Fab Chain, the blockchain project to enable distributed design and manufacturing.

Shared Strategies Adapted to local needs

Global programs for urban transformation related to local production and processing of food, energy, water, information, or other production systems. Implementation and deployment strategies by the Fab City Collective. Fab City Prototypes.

Distributed Incubation for urban innovation

Engage the power of a distributed network of knowledge to envision, design and create open source technology for urban regeneration.

New forms of learning

New skills to learn how to learn, learning by doing principles, lifelong learning basis. The Academy of Almost Anything (Fab Academy, Bio Academy, Fabricademy), STEAM education and professional training.

Distributed infrastructure for innovation in digital fabrication

People, communities, spaces (Fab Labs, Makerspaces, Hackerspaces), machines, tools. Thousands of spaces and communities already in place in every major and middle city in the world.

The Full Stack Approach goes hand in hand with the following Fab City principles and strategies:

- **Actionable urban planning based on experimentation at the neighbourhood scale.** Test strategies, new forms of citizenship, technology platforms, and emergent business models. Big scale visions and long term plans are fundamental to this, as long as they are based in values, and not in the perpetuation of existing paradigms, that are in constant challenge and change.

- **Regulatory frameworks that support civic rights** (physical and digital) from extractive practices from only-for-profit real estate businesses, and large digital platform monopolies. We are aware of the gentrification that the so-called “creative class” could bring to certain areas, as is happening in Barcelona, New York and every other major city in the world.

- **New narratives that invite to imagine emergent futures,** which need specific actions to make these ideas real. Techno-centric approaches tend to simplify scenarios, without considering their side effects.. The traditional extractive corporate model often wins through well resourced marketing and communication strategies. Narrative is a powerful force to enable change.

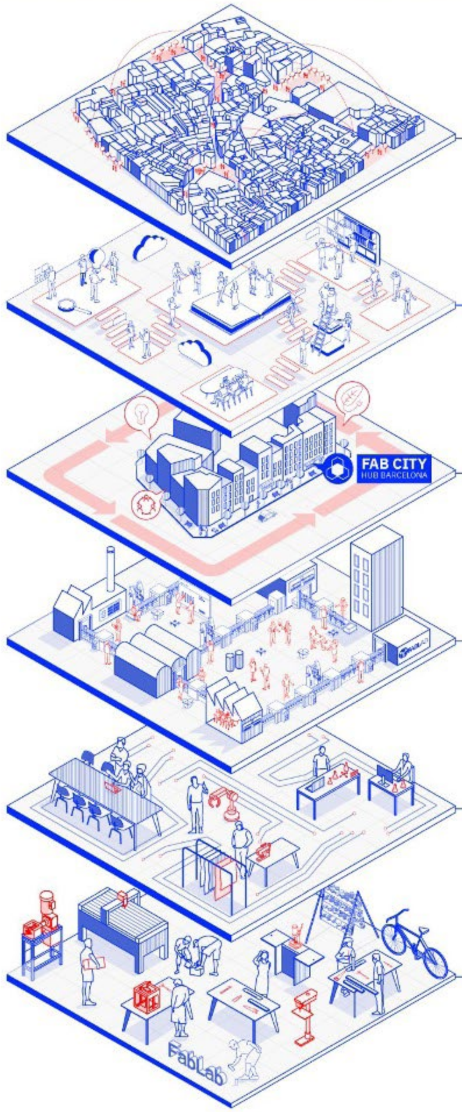
- **Be inclusive and generative by design.** Values are embedded in the design of systems, products, buildings, and almost every interface we create to interact between each other, with the environment and the rest of support elements that sustain life on this planet. We need to create inclusive processes to on-board communities and citizens into urban transformations.

- **Act glocal, think glocal.** We simultaneously inhabit both local and planetary activities and decisions, which encompass our built environments and the digital world.

- **Measure progress and iterate strategies**. Cities need to test new approaches to transform their metabolism, and to validate these by collecting and analyzing extensive data sets from sensors, logistic centers, customs offices, vendors data, citizen data and other information streams that would help to establish metrics that advance the Fab City strategies.

FULL STACK

The Fab City Global Initiative is envisioning and constructing possible urban futures by working at multiple and interconnected scales.



Cities Network

Shared metrics to evaluate progress towards self-sufficiency in cities. Policy-making, regulation, and planning for regenerative urbanization.

Platform Ecosystem

Project repositories for urban transformation. Distributed and decentralized repositories and value exchange mechanisms for global collaboration. Fab Chain, the blockchain project to enable distributed design and manufacturing.

Shared Strategies

Global programs for urban transformation related to local production and processing of food, energy, water, information, or other production systems. Implementation and deployment strategies by the Fab City Collective.

Distributed Incubation

Engage the power of a distributed network of knowledge to envision, design and create open source technology for urban regeneration. "Grow with Fab" program as a distributed accelerator within the Fab Lab network.

New Forms of Learning

New skills to learn how to learn, learning by doing principles, lifelong learning basis. The Academy of Almost Anything (Fab Academy, Bio Academy, Fabricademy), STEAM education and professional training.

Distributed Infrastructure

People, communities, spaces (Fab Labs, Makerspaces, Hackerspaces), machines, tools. Thousands of spaces and communities already in place in every major and middle city in the world.

Conclusion: designing 'emergent futures' for 21st century urban transformation

The meta-domain of 'Design' can give us new capacities to shape our environments and new imagination to create our preferred futures.

Designing emergent futures for 21st century urban transformation[15] entails the creation of learning environments for experimentation, and the development of new narratives around desired futures. It calls for small-scale interventions to approach large-scale challenges; to dissolve wicked problems at multiple scales, instead of solving them with single solutions. So-called solutions can create more problems, so problems need to be addressed from a multidisciplinary and collaborative perspective. It also means to de-objectify and de-colonise design, and to focus on designing interventions in the present, to create new narratives about possible, desirable futures that we cannot anticipate – but we can play with, and learn from.

The world used to be more predictable, as were the behaviour of markets, the demand for products and services, and human behaviour itself. On the contrary, today's modern world seems to be more and more fluid, or 'liquid' – and our reality consists of getting to grip with what we would have called fiction, or science fiction, some years or decades ago.

> *"What has been cut apart cannot be glued back together. Abandon all hope of totality, future as well as past, you who enter the world of fluid modernity."*
> *– Zygmunt Bauman, 'Liquid Modernity'* [16]

Could it be possible for anyone to become a designer with the support of algorithms or machines? What if these designs can be materialised and fabricated immediately thanks to access to a new means of production? How will distributed design make it more difficult to predict the many entangled realities being created all at once?

To conclude, I offer these issue to consider:

- **Context:** What is the world in which we live today? Consider that it is ever-changing, all people, institutions, organisations and living beings. There are more worlds than people; we might live on one planet, but each of us creates our own world.

15 iaac.net/educational-programmes/masters-programmes/master-in-design-for-emergent-futures-mdef
16 Bauman, Z. (2013). *Liquid modernity*. John Wiley & Sons.

- **Technology convergence:** What are the tools shaping design? As in many times in history, we are in a massive moment of convergence, it is an ideal time to rethink fundamental questions around how we organise society and our economy.
- **Access:** How will access to computing power, instant global communication and production tools shape the design of cities; enabling new processes of learning, innovating and creating our own reality? Wikipedia has made an entire encyclopedia obsolete (Encyclopaedia Britannica). Can we make 'Made in China' obsolete?
- **Learning:** What kind of learning environment do we want to foster in the coming years? How can we design urban environments in which students, faculty, machines, algorithms, local impact and global collaboration becomes one collective effort to address the most difficult problems locally?
- **Innovation:** How can innovation happen as a networked process, outside labs and companies, involving as many stakeholders as possible? Innovation is not an option in a fluid, constantly changing reality. We are not talking about innovation that creates the next smartphone, but micro-innovation at a personal level, connected with peers and communities physically (local) and digitally (global).
- **Design:** Can design be more distributed, circular, ecosystemic and decolonized? Of course it can, as long as it disconnects from the industrial paradigm of efficiency, ego and economic growth. A more holistic design approach needs to be developed; hence the need to create learning environments and spaces for convergence between cultures, narratives and philosophical understandings of the world.
- **Cities:** How will cities supply the demands of a growing population? Cities need to transform dramatically the way they have access to the world's resources needed to satisfy the demands of the populations. We have to keep the atoms in the cities – and move the digital bits globally.

Financing Cosmo-Localism

Andrew Ward

A Bright Future Is Possible

Cosmo-Localisation or Cosmo-Localism has been well-described in other areas of this book. It's exciting to think what will emerge as the digital "light" world meets the physical "heavy" world.

- Could it be; the "investor thesis" that is required for Community Wealth Building to be considered preferable to "Unicorn Hunting"?

- Is 'cosmo-localism' the design principle for the green industrial transition that 'continuous improvement' was to the industrial era?

- Or could cosmo-localism be the "school of thought" that enables distribution of planetary-saving solutions to our biggest issues?

Perhaps Cosmo-Localisation can do all of this.

Dynamic Definitions of Cosmo-Local Enterprises

As exciting as Cosmo-Localism is as a thought piece, for it to become something more, it needs to have a compelling "investment thesis". A logic must exist that enables market-based flows of finance to join the party and make stuff happen. To understand the financing requirements of Cosmo-Localism you have to understand that it isn't a singular business model or enterprise. Nor is it an industry (yet).

Not unitary: Cosmo-Localism isn't limited by type of enterprise - in fact the examples throughout the rest of this book represent a diversity of enterprises and business models. These enterprises might be at various stages of development too i.e "seed", "growth", "mature" or "converting from a previous form". As well, the market in which these enterprises operate may be relatively mature (i.e software / hardware) or relatively immature (i.e blockchain / crypto). Given such dynamics this chapter provides only a brief analysis. A full analysis of financing Cosmo-Localisation and Cosmo-Localism would be a book in itself.

Cosmo, Localism and Cosmo-Localism Differ

In the 'Cosmo' and 'Local' elements of Cosmo-Localism you see different drivers for development by founders and interest from investors. First, the drivers behind open-source - a very 'Cosmo' element - is really about distributing or sharing far and wide. This differs from the drivers for localism, which is often about contextualised tribalism and keeping things geographically local. The profile of an introverted software developer ('Cosmo') and that of the extraverted local community organiser ('Local') means that often the motivation for Founders differs too. The difference between a 'Cosmo' / tech-based investment thesis - with corresponding low tangible asset-backing - and a 'Local' investment thesis - with asset backing but purposely limited market - will appeal to different investors with different risk appetites.

When combined Cosmo and Localism become something new - Cosmo-Localism. This combined 'business model' produces something new in terms of an investment thesis. The changes in this combined investment thesis that we will get to soon, but first let's establish some principles of financing and why this new investment thesis is cause for interest.

Debt and Equity Still Likely Instruments

The typical world of financing is concerned with debt (that accrues interest) and equity (that accrues capital gain). Cosmo-Localisation and Cosmo-Local enterprises will be financed via debt and equity too. However, newer and more novel instruments linked to revenue will be comparatively more prevalent.

We may also see typically non-financial values like "impact" or "environmental services" being accounted for in the financing of Cosmo-Localism. At the minimum we will see "impact" and or "social, cultural and environmental" outcomes play a role in the "terms of financing".

Terms of Financing

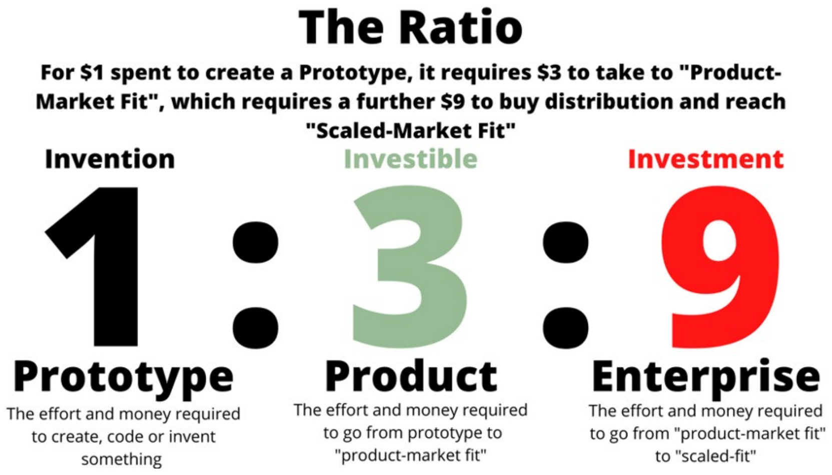
Financing terms are the core, heart, "centre of importance", of any deal. You can pretty much set any price you want with me - if I get to choose the terms. Terms are important. Financing as it applies to all investments requires an understanding of the capital requirements, business model, risk : reward ratio, instrument being used, investors requirements etc. Financing terms in respect to financing Cosmo-Localism is no different. What this means is that the suitability of any example, instrument, investor class, or strategy that works in one context cannot be assumed to work in any other.

The 1 : 3 : 9 Ratio

New stuff coming into existence is not new. Humans have been doing "new" for over 100,000 years.

In fact the way new stuff develops follows rules and norms. One such rule or norm is known as the "1 : 3 : 9 ratio". The 1 : 3 : 9 ratio states: that for every 1 hour (or $1) spent inventing something i.e getting it to prototype, it takes 3 hours (or $3) to turn that prototype invention into a real "product" and 9 hours (or $9) to get the same product "distributed".

The invention of 'new' stuff is comparatively not hard, not long and not expensive. The hard, long and expensive stuff comes after 'new'. This rule directly affects the financing of Cosmo-Localism.



The Internet Didn't Change The Ratio

> *"The future is already here – it's just not evenly distributed".* [1]

When it comes to the 'Cosmo' world, it is clear that the best ideas, software and designs are presently travelling around the world via the internet. Sometimes or mostly for free.

The founders / inventors (and those close to them) are under the mistaken assumption that the work and costs have already been borne by the enterprise in coming up with the idea. In truth, the "idea" is 1/12th of the job or money and effort required - at best.

Some would argue that the internet has broken these old 1 : 3 : 9 distribution of funding algorithms. They might argue that the internet allows the best things to rise to the surface. But I believe this is naive. It ignores the essential oligopolies that enable distribution online. The fact that the internet 'could' put this widget, software or gadget in the hands of billions of people for free doesn't mean it will or does. The fact that it may be an elegant solution or not is not nearly as important as whether it has the financial means to productise and distribute. That is why money goes to proven things looking to scale i.e looking to distribute.

1 William Gibson *The Economist*, December 4, 2003

The 'Cosmo' problem is not the individual brilliance of some pioneers or the collective wisdom and capacity of an open-source community, it is the lack of the capital to pay for productization and distribution coupled with the delusion that... once invented, not much else needs to be invested.

There's just a plain mis-match of expectations and reality in play. And it all comes down to not understanding that the 1 : 3 : 9 principle still holds in the internet age.

The VC Investment Thesis Understands the 1 : 3 : 9 Ratio

Why do Venture Capitalists so often go on about "product-market" fit? It's because they understand that an invention no matter how novel, an idea no matter how self-evident or startup no matter who its Founders are, is "easy" to create. The venture has nothing - nothing - until it has graduated past the idea stage - part 1 of the 1: 3 : 9 ratio and is clearly also past the product part of 1 : 3 : 9 ratio. This is the earliest stage that an investor can enter. Any earlier is just gambling. This presents a problem for the current 'Cosmo' part of Cosmo-Localism.

The 1: 3 : 9 ratio helps to explain a few things:

1. Why Founders and Investors view differently the required effort of making something unique.

2. Why digital products in the early days still radically underestimate the investment required for scale.
3. Why Angel / VC investors are obsessed with product-market fit.
4. Why some community-owned business models seem to "hack" the ratio to be more like 1 : 2.5 : 6 i.e When stakeholders have an *actual* stake it reduces costs of customer acquisition and increases lifetime customer value. (See section Localism Investment Thesis Benefit that follows)
5. Why giving stakeholders an *actual* stake means a faster time for product-market fit and scaled fit.
6. Why investors familiar with this ratio but unfamiliar with giving stakeholders an *actual* stake still insist the world is full of unicorns

The "Chasm" for 'Cosmo'

It is clear that the best ideas, software and designs are presently travelling around the world via the internet. The problem is they are not widely distributed, applied or understood. A novice would assume that the work is done when these ideas simply exist. That solutions in the form of softwares and designs that can solve a host of real-world problems exist, but you already understand from above the 1 : 3 : 9 ratio, so you also understand that investing in novel, P2P, or "open source" software that is accessible to only a few people with a specific skill set isn't enough.

The investment thesis in distribution of open source software, especially open source software with advertising, freemium or "wrapped services" as the primary business model is a pretty ordinary return on a very high risk outcome. That's why you don't hear about success with it. That is why there are very few open source software success stories.

Instead you more often hear stories of how an idea originally of the open source domain "sold out" to Corporations. GitHub to Mircossoft, Android to Google. Ideas that were once free online, or in the commons, become enclosed by global patents, held by incumbents, used as weapons or used against the interests of the community. Also at this point they become financial successes because they have overcome the 1 : 3 : 9 ratio because of the funding in distribution that only VC backed or established tech oligopolies can provide - and they only provide this when they "lock in" accelerated returns on their investment.

The ‘Cosmo’ investment thesis at it’s crudest is essentially about investing in products that have passed prototype and product stages and are attempting to scale and take on the truly expensive bit of getting something ‘new’ into the market. Investors know that many of these product hardened ventures will fail and so the ones that do not fail, have to not only succeed in their own right, but exceed to such an extent that they cover the losses accumulated elsewhere using the Cosmo investment thesis.

‘Localism’ Improves The Investment Thesis of Cosmo-Localism

It is easy to get excited by the ideas and inventiveness of the ‘Cosmo’ part of ‘Cosmo-Localism’, but it is much harder to get excited about the “investment thesis” of digital products, open source software and novel ideas from the ‘Cosmo’ part of Cosmo-Localism. By contrast, the ‘Localism’ part of Cosmo-Localism is so powerful that it has a chance to improve the investment thesis of pure ‘Cosmo’ plays and causes the creation of a new Cosmo-Local investment thesis that is far more exciting for some investors.

Localism On The Up

There is a much overlooked area of the economy that is set to boom. It’s local enterprises and community-owned infrastructure i.e community owned renewable energy businesses. These parts of the economy are anti-fragile - meaning the worse things get in terms of recession, global trade disruption, inequity, civil unrest etc the more they become sensible alternatives.

The Localism investment thesis on it’s own is capped to place. This caps the return and size of available market for each enterprise. So ‘Localism’ on it’s own doesn’t make for a wildly compelling investment thesis that would attract Venture Capital from the ‘Cosmo’ space. Typically, instead, the ‘Localism’ investment thesis is more contextualised. The people who are investing in the community enterprise or infrastructure are likely to also use it.

‘Localism’ ventures break the rules of scale: i.e they are small and capped and break the rules (in a good way) when it comes to distribution. This explains why giants in the energy sector powered by oil, coal and gas are not being replaced with other giants powered by solar and wind, but are instead being replaced by hundreds and thousands of smaller community-owned ventures using locally generated, distributed and consumed renewable energy.

Localism Investment Thesis Benefits

Economics:
Some things are cheaper when the points of production and consumption are closer together. This gives local production a cost advantage.

Agility:
Advances in the technology, software and management techniques that have enabled (well financed) startups to beat larger incumbents have reduced the cost of establishing businesses. This in turn allows these new businesses to out compete larger corporations with their sunk costs and higher overheads. Often the cost of establishment for a new local enterprise is less than the annual maintenance costs of incumbent out-of-towners, giving local startups an incredible advantage.

Propinquity:
Propinquity describes the effect whereby a 'place' modifies the behaviour of people due to proximity. A nightclubber in a church is likely to behave reverently and a priest in a nightclub is still likely to sway along with the music. Propinquity provides a basis for common understanding between locals and allows community enterprises to get an efficiency in communication that out-of-towners can't replicate.

Marketing:
Growth in any business is really down to the "cost of customer acquisition" and "lifetime customer value" of that customer. Local businesses can more effectively use word of mouth, advertising and neighbour-get-neighbour strategies that reduce the cost of customer acquisition. Also, loyalty amongst local stakeholders is improved, increasing the lifetime customer value. Localism becomes an investment thesis that works far better for locals than if those locals were investing elsewhere.

'Cosmo' and 'Localism' Combined

Localism when combined with the Cosmo part of Cosmo-Localism provides not only critical paths to product-market fit for new enterprises, it provides better growth metrics (customer acquisition cost and lifetime customer value) for enterprises in the growth stage, it provides more opportunities for aligned investment during the scaled and mature stages and it provides a meaningful and robust financial exit for early investors and Founders taking a local risk.

Localism and the growth in Community Wealth Building can provide for the cosmo economy (developers, designers and "ideas people") a livelihood. For 'Cosmo' types this compares favourably to slogging it out in the hyper-corporatised, internet-enabled world that only serves the people and organisations already setup to scale and distribute i.e VC's backing their Unicorn Hunting thesis and / or incumbents.

Localism on the other hand breaks the rules of scale and distribution because of proximity and its cost reducing effects on distribution and, propinquity and its effects on marketing costs in respect to acquisition and lifetime value. You see when most people think of local enterprises, they often imagine something unsophisticated. The opposite is true. In fact, local enterprises are often innovative and more efficient than corporate out-of-towners.

The poor "self image" of local businesses is not warranted and if combined with the best ideas, inventions, designs, plans and talents the 'Cosmo' world has to offer, then it provides 'Cosmo' 'Localism' and 'Cosmo-Local' entrepreneurs a chance to flourish with a decent investment thesis.

Open-Collective: A Cosmo-Localism Investment Thesis In The Making

OpenCollectives is a crowd-funding-budgeting-and-spending platform that enables unincorporated groups to quickly establish. OpenCollective is used by XR, Students for Climate Strike and Code Like A Girl to enable local instances to operate autonomously. On OpenCollective a group of neighbours forming a community support group or a group of coders interested in the same open source code get a decentralised "organisation" that in turn allows them to govern and act in normal commercial ways i.e raise an invoice, apply for a grant, pay for services, sell tickets to events etc

This is possible because established businesses also join OpenCollective as 'Fiscal Hosts'. The Fiscal Host provides an auspice service for the unincorporated community group. For example, the New Economy Network of Australia (NENA) is a Fiscal Host. NENA is establishing with every Hub in the network an OpenCollective. This means the Sydney, Newcastle, South East Gippsland or Fremantle Hub can all run locally organised events without each needing insurance, banking and an ABN. They use instead the Fiscal Hosts (NENA) insurance, bank and ABN. OpenCollectives make this easy.

The "Cosmo" part of this business is that it's open source software. The

"Local" part of this business is the customer base. Specifically those Fiscal Hosts that auspice in each country or sector.

The Open-Collective team has been able to go from Prototype to Product-Market fit and is on its way to scaled-market fit. This has seen this Cosmo initiative of OpenCollective receive funding from Angels and aligned VC's (noting there aren't too many aligned VC's in the world).

The external capital does want a return on its investment - even if it doesn't want an "accelerated return" on capital.

The Local Part of this investment thesis is upon "Exit". Exit is the point at which the Founders and Investors get paid back their capital and return on capital. This typically takes the form of an IPO (sale of the shares on a public stock exchange) or Trade Sale (sale to a competitor). The Localism part of the thesis is that OpenCollective management and investors are looking at novel "Exit to Community".

This type of exit is in the early days of planning, but theoretically allows the Local Fiscal Hosts to buy out the OpenCollective founders and investors. A customer buy-out. The transaction may be staged to occur over time, but should result in a fair return on capital for all who risked their money and efforts taking the invention of OpenCollective through the 1 : 3 : 9 ratio.

These investors have taken open source software through the product development cycle and into the size of business that it makes sense - and is possible - for the Local Fiscal Hosts to buy the business where they are currently just loyal customers. Certainly loyal customers make for a different style of "Exit" than the public markets or a merger with a competitor.

The OpenCollective story may be an emerging example of the new Cosmo-Local investment thesis at work. At the time of writing the "Exit to Community" for OpenCollective is only a plan - and not yet a transaction. But should the transaction happen it would be exciting to understand how the investors thesis panned out.

By investing in Open Source Software that had lots of Localisation instances, did the opportunity of a New Exit appeal become viable? Did the loyalty of the open source community (Cosmo) and the marketing advantages of peer-to peer (Localism) materially de-risk the underlying enterprise? Does the new exit option and de-risked enterprise mean that a return is safer in CosmoLocal investments? When adjusted for risk, what is a fair return when investing in Cosmo-Localism?

Conclusion

In summary the Cosmo part of Cosmo-Localism is a hard game to finance because of a general misunderstanding of the 1 : 3 : 9 ratio and because the VC-backed corporate financing model of Hunting Unicorns, as flawed as it is, is the only model that can afford the 3 and 9 part funding requirements of digital innovations. In fact, VC's and "smart money" are interested very specifically in "accelerated returns" because they have so few "winners". But when winners do "win", they need to "win" big in order to cover a lot of losers.

This is a "locked in" investment thesis and is more compelling than funding the same risks for open-source software that comes with no upside, limited upside or capped upside, which is generally what happens with open source innovations that don't attract the capital to take them through the 1 : 3 : 9 effort.

Fortunately though the Localism part of Cosmo-Localism is able to change the dynamics and costs of distribution i.e the 3 and 9 parts of the 1 : 3 : 9 ratio. They change these distribution costs to such an extent that together, Cosmo-Localism makes for a good alternative investment thesis, if it can be successfully formulated in its context.

When combined, 'Cosmo' and 'Localism' becomes a new set of Cosmo-Local business models. This will provide opportunities that sit well alongside a more sensible investors thesis based on fair returns and less risk. It will suit investors that want to use the services and products locally. This might apply to things like Food, Energy, Water, Waste, Education, Social Services and more. These sectors whilst not "sexy" like Apps and Software have significant asset-backing, market durability and near constant demand.

The cosmo-localism investment thesis could encourage many 'Cosmo' pioneers out of pure digital plays. We hope to see them combining with Localism or networks of Locals to benefit both parties when it comes to raising flows of finance. The Cosmo-Localism investment thesis could be more compelling than Unicorn Hunting and see a relative and large shift in early stage venture funding. Much will still need to be seen as the Co-operation between Cosmo and Localism continues and that is why financing Cosmo-Localism is so fascinating.

Cosmolocalism, a Tool for the Social Appropriation of Knowledge and Rural Development

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In developing countries like Colombia, rural communities are vulnerable to a number of serious issues including inaccessibility to basic services and infrastructure, inadequate resource management and neglect by both local and national government. The added friction results in delays to social development and interventions that do not address the real issues. This in turn generates other problems such as urban migration, abandonment and deterioration of land, inappropriate use of natural resources, and many others.

Different efforts have been made to tackle this problem, relying on partnerships between communities and the state, who support communities by providing them with human, financial and material resources and technologies. However, these interventions have had mixed results, and sometimes even create new problems of their own. Taken together, such situations prevent sustainable and management and efficient use of different technologies.[2]

The last months have been important to quickly validate actions and ways of working with these communities, bearing in mind that many of them have been blocked by the COVID-19 pandemic, both in the possibility

2 Ceballos, Y. F., Zambrano, J. J. A., y Velásquez, J. R. (2015). La Energía como una Herramienta de Desarrollo en Zonas Rurales no Interconectadas. *Investigación e innovación en ingeniería*, volumen 3(1). doi: 10.17081/invinno

of continuing face-to-face projects in the regions and in the physical accompaniment of the scientific personnel hired to carry out these projects, so that the virtual, decentralized and cosmolocalized work has been essential in maintaining the accompaniment of these projects and has allowed the use of work models from other types of projects in practice to give continuity to the presence in the communities.

In the study of the way in which communities develop their own technologies or designs, Manzini[3] describes that there are two factors that must occur for a community to generate adequate solutions to its needs: the actors who develop them and the necessary competencies to achieve it. Based on this, four possible fields of action are given that allow innovation or the application of solutions. Generally, when searching from the different entities to generate some type of solution to a particular problem in the community, experts or existing technologies are assigned to solve the identified problem, but this also entails some problems in its implementation, associated with knowledge of the territory and the relationships between the actors involved. The solutions rarely take into account the previous ways, knowledge and work that exist in the communities, negatively impacting these problems.

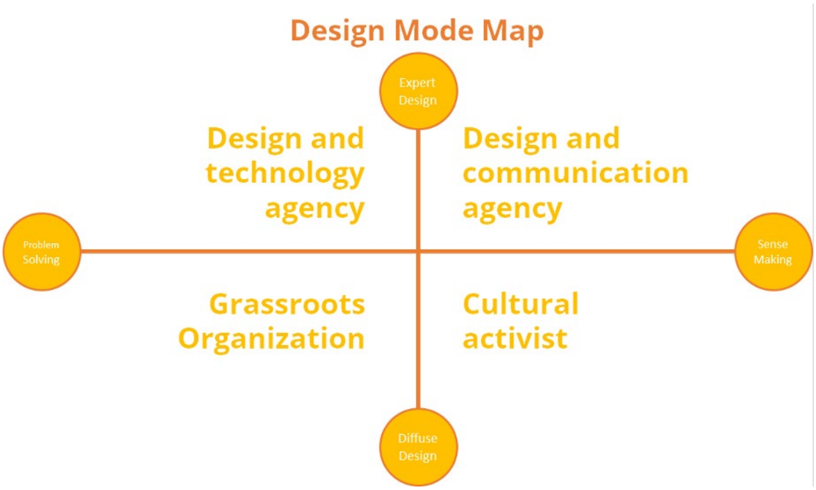

Figure 1. Design Mode Map propose by Manzini

Source: Manzini (2015) Design, when everybody designs: an introduction to design for social innovation. the MIT press.

For this reason, it is proposed that community development planning, management and implementation is inclusive of the direct beneficiaries. Their meaningful participation in finding solutions to their problems keeps the work aligned to the real goals, expedites the implementation and

3 Manzini, E. (2015). *Design, when everybody designs: an introduction to design for social innovation.* Milano, Italia: The MIT press

improves efficacy. In recent years, many changes have also been observed in the quantity and quality of these processes, both in the number of people involved and in the type of relationships that are generated between grassroots associations and their involvement in these projects. In 2008, the National Policy for the Promotion of Research and Innovation in Colombia recognized the need for knowledge as an integrator of society, having a particular interest in articulating science, technology and society with innovation as its main nucleus, and focusing on that innovation does not belong to a specific group but depends on the relationship between all the actors in society.

This also implies the development of four factors that define the current national strategy of Social Appropriation of knowledge: Knowledge transfer and exchange, Citizen participation, Knowledge management for the appropriation and Communication of science, technology and innovation.

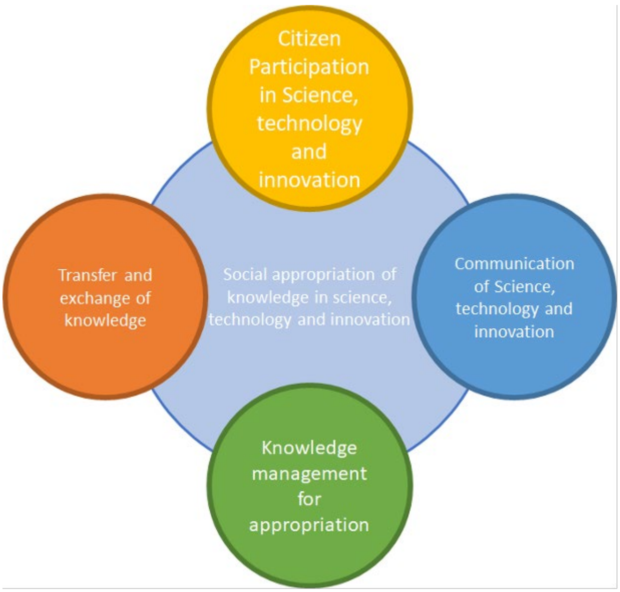

Figure 2. The four lines of development for Social appropriation of knowledge in science, technology and innovation.

Note. This diagram specifies the basis of the modality proposed by the Colombian Ministry of Sciences MINCIENCIAS for the development of projects with a strong impact on communities in the country. Source: COLCIENCIAS. (2010). *Estrategia Nacional de Apropiación de la Ciencia, la Tecnología y la Innovación.* ISBN: 978-958-8290-50-8. Pag. 22

Only by integrating these guidelines can real ownership of community-generated knowledge be developed and implementation processes accelerated with rapid and real impact. The lack of any of these factors can impact the development of this type of project.

Additionally, it is also necessary to implement a communication strategy that supports open innovation dialogue between teams that seek to collaborate, but are separated by great distances. The following case studies highlight how successful integration, using cosmolocalism as approach improves and strengthens this collaboration.

Projects

Sajoa in home Aqueducts

This project seeks to solve problems related to water supply in rural areas of Santander, region state in Colombia. In this project, cosmolocalism played a central part in the development and the social appropriation of knowledge, from its planning and design phases based on local needs, through the validation of proposals and meetings with experts from various areas and professions that together with community leaders, identified the best way to implement possible solutions.

Process: They worked with the community to understand the particular situation of the families in the territory and these workshops led them to identify the technologies that could be implemented for that purpose. From this, cosmolocalized work meetings are developed integrating experts in water, production, sociology and leaders and inhabitants of the territory, integrating in these meetings inhabitants of other territories with similar problems but with projects and ideas developed in a different way that were develop taking into account their own resources, the development of these meetings managed to improve the original design and take advantage of the shared knowledge of the various groups.

Achievements: The entire process allowed the aqueducts to be maintained for a longer time after being implemented, since having already generated contacts and a closer dialogue with people of different communities, projecting maintenances, redesigns and new processes that complemented the initial solution. In the end, these have been replicated and adapted in various areas of the country (the latest news has been the planning of 300 units in the region) beyond the initial 50 units, all different and unique at the end.

Figure 3. Meetings of collective construction with the community

Source: Samir Reyes Gomez

Rat Relay

Meetings developed for 10 years organized by the members of the design factory global network, with an academic focus that seeks to collaboratively develop with interdisciplinary design teams (engineers, architects, designers, among others) and agile solutions in project resolution, in which the teams work hand in hand, integrating their cultures, knowledge and subjectivities in the development of quick solutions to the problem posed

Process:
It all begins by structuring teams from six cities, in which each one develops a particular challenge contextualized in their culture; inviting companies, entities, government to be part of the ideation during the event. In this, the members must send the proposed challenge to be developed in six stages, each one completed by the local team from another city and the guests who can openly share their ideas and solutions. In this way, once a phase is finished in a process no longer than 36 hours, the results are shared with the next city, and so on, getting each one to participate in the construction of the six solutions, sharing with everyone the information developed, for at the end these can be implemented locally.

Achievements: The appropriation of knowledge related to cosmolocalism occurs above all in the possibilities of knowledge and permeate the culture, understanding how globally the people have great similarities and although there are particular ways of solving problems, thanks to dialogue and activities it is possible to identify similarities in the ways of doing and the great value of these processes is given in understanding the other as a being global, inhabiting a planet with common problems.

Figure 4. Rat relay in Pontificia Universidad Javeriana Design Factory Bogotá

Source: Design Factory Javeriana

Social projects with ex-combatants and victims of the colombia armed conflict

The projects developed within the framework of University Projection Projects (PPU) of the Pontificia Universidad Javeriana de Bogotá, Colombia, focus on putting at the service of the communities the knowledge and academic developments so that they can generate a positive impact in society. These have been developing for several years, although in the last period they were strongly affected in the realization of their objectives by the problems generated by mobility to territories and contact with communities under the COVID-19 situation. This situation, implied the non-possibility of direct work in the communities and confronting the projects with other modes of implementation, made cosmolocalism a key for the continuity.

Process: In this particular case, developed in the eastern Colombian plains, there are two totally different situations related to the resources of each territory. The most negative case had to do with the fact that one of the communities is located in a space with little or no access to communication networks like phone or Internet, causing the development of the project not to advance at the expected pace and leaving in evidence the difficulties in working virtually. That is why the work with a community team was developed and coordinated directly by them, transmitting the information in a bidirectional way between the different actors and focusing on the particular way that each region provided a solution with the few materials that were available. The second community, unlike the previous one, had better communication networks, but not the interest of all its members to work, which implied making adjustments in the way of work as a team and the internal and external dialogue.

Figure 5. Work teams designing the characteristics of the new territory

Source: Author

Achievements: Although initially it was thought that the execution of the project would be more complex, virtualization allowed entities to approach and open their doors to the development of the project on the one hand; since the communities were more participatory so they no longer depended exclusively on visits from external entities. that make them more active in project execution, implementing themselves, working on the initial information presented and sharing the results with each other. In a way, the mandatory use of communication technologies made more people analyze different options to maintain direct contact with entities and allowed them to ongoing projects in development before covid-19, in addition to generating a dialogue between different parties to the conflict, as victims and perpetrators, understand that with their differences they are all working for a common good: rebuild society.

Results: The development and implementation of projects of this type evidences the need to form work teams and methodological models that are adequate to the needs of the community to be more appropriate and do not become a wasted investment of resources. Open source collaboration emerged as a practical solution to disruption caused either by causes such as COVID-19 or other situations in the local context. This methodology has allowed the scientific team and the communities to move to a pragmatic alternative solution, allowing the collaboration to continue. This pivot introduces communities the power of open source in a highly relevant and impactful way. Such community-scale, collaborative design practice opens the door to cosmolocalism in a very natural way. The community learns how to leverage the information and communication channels to effectively solve community problems they could not have done on their own. Through the ongoing transfer of their design solutions to an open knowledge commons that will be shared with many communities, they also learn about the transformative power of peer production and common-based cosmolocalism in a natural way.

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Ceballos, Y. F., Zambrano, J. J. A., y Velásquez, J. R. (2015). La Energía como una Herramienta de Desarrollo en Zonas Rurales no Interconectadas. *Investigación e innovación en ingeniería*, volumen 3(1). doi: 10.17081/invinno

03

Challenging Cosmolocalism

Repositioning Cosmo- Local in a ´Beyond´ Space Place

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In articulating the concept of cosmo-localism, the futures thinker and social theorist José Ramos argues that conceptually it is an inversion of the neo-liberal globalization and production model that is currently at the locus of the global economic order[2]. I would argue that while this is undoubtedly the case, for cosmo-localism to cohere as an alternative system narrative and praxis it needs to be much more than that. This 'much more' requires a profound shift in representations of socio-economic relational dynamics. Ideally, it should have at its core, a rethinking of arrangements that are systemically different for what exists now. This requires world views that are beyond or 'post' the capitalist-socialist narrative through which it is normally contested. These will represent themselves in deep narratives, incipient mythologies if you wish, that are ecological rather than mechanistic in their understanding of time, form and space. While this profound rethinking is both difficult to articulate and perhaps for a time even a space of considerable confusion, the failure to conceptualise the alternative will result in both the theory and the practice of cosmo-localism, no matter how worthy, being inexorably overwhelmed by conventional orthodoxy. In other words, the 'relational difference' between current meanings of 'cosmo' and 'local' and an alternative 'cosmo-local' matters in both essence and relationship.

Uncovering and probing deep narratives, mythologies or deeply embed metaphor is a journey to that part of ourselves that is rarely undertaken. It requires us to be careful about what is taken as given, beginning with the hidden codes of meaning and value that are contained within the very words we use. It demands of us that we are sensitive to the multiple contexts

[2]Ramos, J. (2017). Cosmo-localization and Leadership For the Future. *Journal of Future Studies*, 21(4), 65-84. p. 64.

that both define yet confuse our focus and it reveals that little of what we thought was certain or taken for granted really was. This is a condition of radical uncertainty that will frame for the next few years the conditions under which cosmo-localism will need to operate. “It is the beginning of the end for the old Reality Principle and the artificial [technologically determined, cosmopolitan] environment that strives to become its perfect embodiment”[3]. It is though not simply some kind of postmodernist deconstruction into the kind of existential meaninglessness that always worried global south epistemologists like Zia Sardar,[4] rather it is an opening up; a breakthrough into a space that acknowledges that all the realities (past and present) that humanity have known are real and that each may have a role, in part or in concert, in fashioning a viable human construct that is not defined by the constraints of mechanism and progress. The question that this essay explores is; under what conditions can cosmo-localism be part of these new realities?

3 Roszak, T. (1972). *Where the Wasteland Ends. Politics and Transcendence in Post Industrial Society.* London: Faber and Faber. p. 460.
4 Sardar, Z. (1998). *Postmodernism and the Other*. London: Pluto Press.

Cosmo-local is more than an inversion; it is a different thing

The profoundness of this narrative of cosmo-local relational difference begins through understanding that the words ‘cosmo’ and ‘local’ have embedded within their essence contemporary world views that will continue to exert influence at both a systemic and world view level unless both are deconstructed. This baggage of unexamined meaning is what Runia describes as metonymy, “a figure in which the name of an attribute or adjunct is substituted for the thing meant”.[5] If we are to avoid both the continuity and the discontinuity that accepted definitions of ‘cosmo’ and ‘local’ bring with them then it is necessary to rethink those definitions in a way that is most likely to bring into existence the different kind of cosmo-localism Ramos proposes. In one sense, even the term is problematic as ‘cosmo’ so easily slips into ‘cosmopolitan’, a conception that in turn denotes a very western model of existence and way of being in the world. However, ‘cosmo’ might just as easily denote the potential to reach out to almost anywhere on the planet with the choices and an ease that is normally only available in cities. In this later definition, ‘cosmos’ is a reconception of the global space-form that is not necessarily determined by the western imitative cosmopolitan space-forms it is often confounded with. This consideration of difference is not some kind of exercise in philosophical sophistry. Rather it is the beginning of a great unbundling of accepted norms and a potential escape from the confines of the labyrinth in which we have unwittingly chosen to dwell, at least until recently.

5 Runia, E. (2014). *Moved by the past: discontinuity and historical mutation.* New York: Columbia University Press. loc. 1384

Notwithstanding the differences alluded to above, for the most part 'cosmo' (the word not the robot) in the contemporary condition, is a unique carrier of a Western dominated 'universal' model that by design embodies systems (ways of living) and worldviews that privilege hierarchy, economism (society that serves economy), dualistic thinking, rationalism and the objectification of most things and people. In its 'renaissance' and perspectival consciousness,[6] it anchors a civilizational mythology of progress, growth and consumption and more importantly it binds the 'local' to it. The systemic effects of 'cosmo' and 'local' integrating in this way are interesting. This remaking of the 'local' in the image of the 'cosmo' at first attracts people (the lure of modernization) and but then, because it systemically privileges the few over the many, it later repels or rejects the very 'local' people it once sought to attract, as the few with excessive wealth disengage from the engines of progress and societies they once relied upon. The philosopher Bruno Latour describes this almost hyper-incarnation of 'cosmo-local' orientation as a 'forward everything' model whereby the 'global of modernization' has either remade the local in that same image or it has caused some to retreat into a counter-reactive retrospective of "tradition, identity and certainty within national or ethnic boundaries".[7] The challenge to the forward everything model of course emerges when its compositional dynamics for some reason or other (such as the collapse of life systems or untenable inequalities) cannot be sustained. If and when this occurs then all that is available is either a discontinuous reordering based on a viable but very different narrative (social revolution)[8] or alternatively a long interregnum whereby the system collapsing as a result of its own internal contradictions defines a prolonged period of social entropy, uncertainty and indeterminacy.[9]

While justifying these statements would take longer than this essay will allow,[10] an alternative cosmo narrative might be articulated as "a peaceful, though tense coexistence of a multiplicity of models, a world where many worlds fit, a pluriverse".[11] There is though an important caveat to this pluriverse of coexistence. That is, notwithstanding its diverse nature, it must exist in what has been described as a 'doughnut space' defined by planetary limits as an outer limit and the shared dignity of humans and all life systems

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6 Geber, J. (1953, trans 1985). *The Ever-Present Origin*. Ohio UP. p. 22.
7 Latour, B. (2018). *Down to Earth: Politics in the New Climatic Regime*. Cambridge, U.K.: Polity Press. p. 29.
8 McAllum, M. (2018). All Revolutions are Equal But Some are More Equal than Others. *Journal of Futures Studies*., 23(2), 1-12
9 Streeck, W. (2016). *How will capitalism end?: Essays on a failing system*. London: Verso. loc. 330.
10 The case is well argued in Santos, B. D. S. (2013). *Epistemologies of the South: Justice Against Epistemicide*. Boulder: Paradigm Publishers.
11 Escobar, A. (2019). Civilizational Transitions. In Kothari, A., Salleh, A., Escobar, A., Demaria, F. & Acosta, A. (Ed.). *Pluriverse: A Post-Development Dictionary*. Autonomous University of Barcelona.

on the other.[12] This definition of pluriverse defines the parameters that might facilitate emergent civilizations spaces while 'the doughnut' defines or contains the necessary conditions for the continuation of human existence on the planet-spaceship we call earth.

Pluriversalism or the 'making of many worlds' begins to reconceive and redefine localism in ways that are neither necessarily entirely modernist nor constrained by the unrealizable backward nostalgia that Latour referred to. The locus is different. It emphasizes community, commons and conviviality rather than consumerism, contract based relational arrangements (like franchises) and the effects of wealth inequality. It conceives of spaces of reflection and action that are "diverse, ethically negotiated practices that support the livelihoods of humans and non-humans to build flourishing habitats".[13] Clearly this conception of localization is vastly different from urbanized (cosmopolitan) city model that the majority of the world's population inhabit. It portends a completely different way of living; one that restructures value transfer and wealth creation through arrangements which largely contain and distribute benefit within local communities in contrast to the current models which look to extract as much as possible from communities, leaving only sufficient residue to generate future demand. This kind of localism has long been advocated by alternative thinkers like P.B. Sarkar, Cavanagh & Moore and more recently by Appadurai (how histories make geographies) and Holmgren.[14] It also is part of a global response to current unsustainable practice, responses that are now moving from the periphery to the core.[15] Neo-localism of course is often fragmentary and is likely to remain that way until there are pluriversal civilizational narratives through which they can cohere and expand.

Cosmo- transcontextuality

What has been asserted thus far is that the failure to take care about exactly what is being meant by cosmo-localism makes invisible the complete difference in world-making it envisages. It is a misunderstanding of

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12 Raworth, K. (2017). *Doughnut Economics: Seven ways to think like a 21st-century economist*. London: Random House Business.

13 Gibson-Graham, J.K. (2019). Community economies. In Kothari, A., Salleh, A., Escobar, A., Demaria, F. & Acosta, A. (Ed.) *Pluriverse: A Post-Development Dictionary*. Autonomous University of Barcelona.

14 Inayatullah, S. (2002). *Understanding Sarkar: the Indian Episteme, Macrohistory, and Transformative Knowledge*. Boston: Brill; Cavanagh, J Mander, J. (2003) *Alternatives to Economic globalization*. San Francisco: Berrett Koehler; Appadurai, A. (2013). *The Future as Cultural Fact: Essays on the Global Condition*. London: New York : Verso Books; Holmgren, D. (2010). *Permaculture: Principles & Pathways Beyond Sustainability* (1st UK ed.). East Meon: Permanent Publications.

15 Novaro, V. (2014). The case of Mondragon in Counterpunch. Retrieved from https://www.counterpunch.org/2014/04/30/the-case-of-mondragon/ and also Hopkins, R. (2008). *The Transition Handbook: From Oil Dependency to Local Resilience*. Totnes, Devon: Green Books.

its different space-form. Because it is conceptually challenging for those of us accustomed to a conventional discourse and the ways of living that convention embraces, the lack of interrogation also obscures multiple contextual dependencies (transcontextuality) that are necessary for a different kind of 'cosmo-local' reality to succeed. These include; the reconception of the public realm and institutions in a cosmo-local world, the emergence of organizing infrastructures that in a network world supplant those of a mechanistic 20th century and an escape from the 'time is money' production ethos that dominates so many lives. Still others go further and argue that the only way to survive the immediate and lasting impacts of the Anthropocene is to eschew the pseudo-abundance model of a material world that "proceeds from the point of view of permanent and unlimited growth, something that is both logically and physically impossible on a finite planet".[16] The point being made here is that cosmo-localism does not exist in a bubble. It is moved, shaped and morphed by the societal conditions in which it is experienced.

The social theorist Nora Bateson defines transcontextuality as "a starting place that opens the possibilities of better understanding the interdependency that characterizes living (and arguably non-living) systems".[17] It is post disciplines, beyond interdisciplinary – which is just a fancy way of saying disciplines should work together - and beyond the compartmentalism of objectification. Philosophically, it begins to break down the Cartesian and Kantian subject-object distinction[18] that is at the core of Western thinking because, if we exist in multiple contexts simultaneously (and all of us do),[19] it becomes difficult to establish just how to position ourselves as a subject to the exclusion of all else in such a plural space world. Seeing ourselves and others as floating in new relational arrangements frees us all from the 'othering' and objectification that is so dominant and abusive in our ordinary lives. It may even mean that we re-animate life systems that we have often considered de-animated things for our exclusive use and in the process begin to undo the existential consequences (for humans) of the follies and injustices we have perpetrated on all those systems.[20]

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16 Bauwens, M. Ramos, J. (2020) *Awakening to an Ecology of the Commons*. Retrieved from https://blog.p2pfoundation.net/awakening-to-an-ecology-of-the-commons/2020/05/25

17 Bateson, N. (2016). *Small Arcs of Larger Circles: Framing through Other Patterns.* Axminster, England: Triarchy Press. p. 79.

18 For a thoughtful deconstruction of the Cartesian and Kantian thesis see Ricœur, P. (2005). *The course of recognition*. Cambridge, Mass.: Harvard University Press. pp. 28-55.

19 A quick but useful exercise that proves the point is to denote the self with a simple cross on a piece of paper and then draw circles of contextual influence around that x. You as a parent, friend, worker, sibling, community member, etc. if you think about it carefully you are rarely at the centre of any of those circles except perhaps with the one you love.

20 The You Tube clip linked here, What if Rivers could revolt is a beautifully crafted expression of re-animating what we have long seen as being deanimate. Retrieved from https://www.youtube.com/watch?v=hkP0WSJdcu4

The Cosmo-local Public Realm

Transcontextuality also helps in redefining the nature of the public institutions and spaces that will help facilitate cosmo-localism. This extends from the reconstruction of public goods like health, education, justice, economy and infrastructure in ways that are not only reflective of the new network realities we now live but that also promote diversity rather than sameness, governance that is supportive rather than extractive and interrelational facilitation rather than anonymous service. While it is more likely that this will occur at a localized rather than a transnational level first, there is evidence that this has already begun. Despite nations acting in their own interest first in the recent COVID-19 pandemic (and hollowing out cosmo-local modernization in the process) there is sitting alongside that uncoordinated and probably counterproductive selfishness, a cooperative, depoliticized, global race to control, understand and perhaps soon inoculate against the virus itself. In 'the recovery' the local will have to be rethought as the state now standing as the protector of the local seeks to find a new role. One possibility is to reframe itself as a partner with the civic where the "logic would move from being ownership-centric to citizen centric" and "the state would strive to maximize openness and transparency while systematizing participation and deliberation and real time consultation". [21] Perhaps it would be only through adopting a model of this kind that the state could truly constrain and potentially redirect the social fabric now manipulated by either network technology barons for their narrow interests (netarchy) on the one hand or powerful state actors (China and Russia – the state as network oligarchs) on the other.

However, if the public realm fails to reassert its rightful role in the social fabric,[22] if it fails to reinvent itself in a technologically networked world within which a pluriversal cosmo-local will be at least partially framed, then other actors will create alternative public realms. The Bangladeshi based agency BRAC for example in its quest to 'create chances for the world's poor' offers public good services to 126 million people in 11 countries through almost 100,000 employees, 70% of whom are women.[23] In a similar fashion the African based branchless banking system M-Pesa has created a parallel value exchange and value storage ecosystem that facilitates access to the same kinds of services that are normally only available to the wealthy and the middle classes.[24] In some countries in Africa this represents over quarter of all economic activity. What these examples demonstrate, and there are many more like them particularly in the Global South, is an urgent search for alternative frames of localized existence that create social spaces beyond the hegemony of a rapacious and exploitative private sector and an often

21 Kostakis, V., & Bauwens, M. (2014). *Network Society and Future Scenarios for a Collaborative Economy.* Basingstoke: Palgrave Macmillan. loc. 1064.
22 Both Sandel, M. J. (2012). *What Money Can't Buy: the Moral Limits of Markets.* New York: Macmillan Audio,. and Mazzucato, M. (2018). *The Value of Everything: Making and Taking in the Global Economy.* London: Allen Lane. have written extensively on this subject.
23 Retrieved from: https://www.economist.com/business/2010/02/18/brac-in-business
24 Kane, A., (Nov. 28, 2016), *What Kenya Gained By Going Cashless.* Retrieved from https://swarajyamag.com/world/what-kenya-gained-by-going-cashless

self-interested, corrupt and colonized public sector. It is for these reasons that the frames of public existence and the spaces that they create matter in the cosmo-local debate.

We define our infrastructures and over time they define us

Further complicating our understanding of this alternative cosmo-local space-place is the emergence of an entirely new arrangement of essential infrastructures. The fossil fuel dependent, electrical, centralized, siloed and mechanized conglomerations that have evolved and underpinned modern existence since the early part of the 20th century are quickly being overtaken by a convergent, integrated and digitized communications, renewable energy, autonomous mobility/logistics and embedded intelligence (Internet of Things) infrastructure platform. This 'infrastructure shift' will have in all probability a more profound effect on the shape of human existence than the current Anthropocene inducing infrastructures have had already. "They will change society's temporal/spatial orientations, business models, governing patterns, built environments, habitats and narrative identity".[25] The issue for the purposes of this essay is that given this is a contested space, where global modernism might seize the opportunity to reassert its hegemony, how might the cosmo-local narrative influence the changes described above?

At the risk of some level of repetition, there are three ways that cosmo-localism might enlist this dynamic infrastructure shift for its own purposes. The first is to make sure that it has a distinct alternative narrative and that there are explicit advocacies and infrastructure investments that both conceptually and realistically link cosmo-localism with the fabric of the new infrastructure platform. The work done by Kostakis and Bauwens with respect to dangers and possibilities with respect to the communications platform[26] needs to be replicated across all the other parts of the emergent infrastructure and then further effort is required to ensure that there is a relational coherence between these elements given their integrated nature. The second is to explicitly link the rethinking of a new localism to these emergent infrastructures as there are many aspects of these that with some care, design and public institutional backing can become the foundation of a new kind of local value capture. This is because all have by definition distributed elements that cannot be subsumed by economies of scale, centralized infrastructure providers. The third is to link elements of these first two to create powerful visual relational maps that demonstrate how many local endeavors (including activities in a vibrant and reconceived commons) form part of a pluriversal mosaic, if you like maps that describe a potential 'attractor' territory. In this manner a reconceived infrastructure,

25 Rifkin, J. (2019). *The Green New Deal: Why the fossil fuel civilization will collapse by 2028, and the bold economic plan to save life on Earth* (First Edition. ed.). New York: St. Martin's Press. p. 16.

26 Kostakis, V., and Bauwens, M., (2014), *Network Society and Future Scenarios for a Collaborative Economy* (Palgrave pivot; Basingstoke: Palgrave MacMillan)

providing its elements are localized and distributed, once free from the constraints of mechanism, efficiency and economies of scale becomes an enabling platform for a different kind of localism. It is for these reasons that the infrastructure shift that is underway requires the attention of cosmo-local thinkers and actors.

Designing local spaces beyond the banal

The emergence of a new kind of 'local' that by its very nature demands a new kind of 'cosmo', by design is expressly different from the local of Latour's 'forward everything' modernism and also the 'backward looking' reaction to the dislocations that it creates. It is part of the beginnings of a counter hegemonic narrative, what De Sousa Santos describes as an insurgent cosmopolitanism,[27] that will spawn different kinds of socio-economic arrangements acting in systemic opposition to those people and systems that either expressly or unwittingly oppress and victimize those whose lives are marginal to their interests. This new localism with its attendant redesigned public realm and infrastructure demands a completely different kind of design thinking. The anthropologist Arturo Escobar, channeling the work of Marturana and Varela,[28] proposes that the design of a new localism should be essentially autopoietic. To paraphrase the slightly obscure definition, by this he means that many future entities could and should be designed in ways whereby they control and activate whole system cycles (the processes of production and destruction) so that they can continuously both do what they want to do and also regenerate the sources that are necessary for those activities. Finally, these entities will seek to act as nodes in networks that through their interactions or relations also realize the ambitions of the (in this case localized) networks that they seek to be part of.[29]

The idea of an emergent autopoietic localism has some interesting implications . The first is that the nature of what is suggested to us seems strange because the culture of the machine has made this way of thinking invisible to us. It considers a different type of success, one that measures completely different things. For instance, it may and probably will make mutual care and wellbeing as one of its highest priorities. The second is that what is value and what is valued is completely different in the creation of these kinds of entities. The third is that this is a completely different kind of relational arrangement and communing. Finally, it is by its very nature both an overarching narrative (a way of design thinking, in the same way that wheels are a component of design thinking) and also at the same time a means of enabling diverse world making at a local level.

27 Santos, B. D. S. (2013). *Epistemologies of the South : Justice Against Epistemicide.* Boulder: Paradigm Publishers. p. 135.

28 Maturana, H., and Francisco V., (1987), The Tree of Knowledge: The Biological Roots of Human Understanding. Berkeley, CA: Shambhala. p. 43

29 Escobar, A., *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds (New Ecologies for the Twenty-First Century)* . Duke University Press. Kindle Edition. Loc. 3693.

One of the first steps in making autonomous entities valued is to pay attention to and strengthen its 'liminal relationships'. While almost all of us are aware of the existence of these relationships only a few know how to nourish them as liminal leaders. As the philosopher and social narrator Nora Bateson[30] notes, these 'between spaces' of interdependence (liminality) are where we can find the markers of mutual care and well-being (referred to above) or the lack of the same. These stand in sharp contradiction to the depersonalized and mostly exploitative consumer relations that are the dominant feature of contemporary localism and service delivery. Interestingly, in this consumer obsessed world these attributes of unsolicited, uncosted acts of mutual care and well-being, are often evident in times of crisis. These occasional manifestations in times of great stress seem to indicate that, despite all efforts to convince people otherwise, the flows, patterns, anomalies and affordances they create are what most humans crave for. Where this is institutionalized, we describe these 'caring relationships' as family, community, club, band or some other entity of belonging. Importantly, however these relationships are constructed, their success or otherwise is not always found in the form of such things but rather it is constructed through the interdependencies and reliances that rely on experiences (patterns) and memory. It is for this reason that interdependent relationship thinking, design and practice must sit at the core of future cosmo-localism, where the ordinariness of the relational worlds it creates makes it extraordinary.

30 Bateson, N. (2017). Liminal Leadership. *Kosmos Journal* (Fall/Winter), 1-10. p.2.

If it is successful, does cosmo-localism becomes a hyperobject in the making?

The narrative of cosmo-localism and new forms of local world have an opportunity to rapidly evolve in a vacuum occasioned by the collapse of neo-liberal globalization that may never fully recover from the pandemic dislocation. If it becomes a dominant narrative and an almost universal design principle (in the way that neo-liberal globalization has been), it could reach a point where it cannot be really seen as an object or thing in the way it is now, because its adoption, effects and relational qualities are so complex and diffuse, they can never be fully known or described. This state of pluriversal beyondness is what the philosopher Timothy Morton describes as hyperobjectivity, "a high dimensional phase space that results in them [hyperobjects] being invisible to humans for stretches of time.[31] I would argue that it is highly desirable that this becomes the case because it would mean that it has both extended beyond measurement (in its ubiquity) and relationally we are immersed in it. In other words we cannot get any kind of distance from it to adequately objectify it. While this does not mean that we cannot see cosmo-localism under any circumstance, on the contrary we will constantly see and experience a variety of local manifestations, it does position cosmo-localism, under these conditions, beyond objectification, rationalism and human centeredness. This larger sense of unknowing should therefore be the state that cosmo-localism ideally achieves. There are several points that flow from this conclusion. Firstly, cosmo-local narratives cannot be constituted in the frames of the past it seeks to escape from. This is why I strongly argue that constituting it inside the socialist – capitalist narrative is insufficient as the foundations for an alternative system, although it must be recognized that in its early stages it often arose as a new socialist variant. Secondly, it should not be some kind of recipe or training or tool that can be slavishly copied. Every community and every story will need to find its own path. Thirdly, as it is designed, explored and experienced it must escape from one of the defining tenets of the mechanistic age; to wit that time is something that can be owned, bought and sold. Humans should always be able to give their time freely. Indeed, I would argue that cosmo-localism in the way I have described it cannot logically sit within hyper-clocktime as we now understand it. Such a position is not consistent with the praxis of autopoietic entities and networks which are continuously transforming and decaying.

Landing place-form spaces

This essay began with the assertion that if the concept of cosmo-localism is to establish itself as part of a post modernist, post normal then it needs to develop narratives and world making that moves it beyond the constraints of contemporary mechanistic ways of doing things, systems and world views. This requires a rethinking of the global relationship system (cosmo) and also the many of many worlds at a (local) level. For this to be true it must therefore situate itself among many knowledge systems not just the western way of knowing. The profoundness of this difference should not be underestimated for it requires ways of thinking that do not have Cartesian or Kantian subject-objectivity as the sole basis for thinking and recognition. In that sense it is not just something that gets added to our bodies of knowledge, rather it is one way into the great unlearning that will take us through the western knowledge systems into a new civilization way of being.

At a more prosaic level, cosmo-localism requires the affordances of a rethought public realm and an emergent platform infrastructure that in their own way will help reshape societal arrangements and relationships in the way described above. By affordances, I mean that reconceived institutions and infrastructures in their interactions with cosmo-local activities will enable or afford it to do the things that it wants to do. The importance of this interactivity should not be underestimated, nor should the impacts of interactions with those systems that are still reliant on the mechanism forms that were their genesis.

Cosmo-localism defined in these ways is therefore part of both the rethinking and practice that makes up the post mechanistic, post colonial and post capitalist narrative. It is not in any way the whole answer rather it is part of it. It should be seen as a frame for rethinking about how alternative forms of value are created and exchanged in societies while at the same time accelerating the quantum of well being and mutual care that is cynically marginalized in consumerism. This undoubtedly extends cosmo-localism conceptually well beyond its maker origins and in so doing asks it to be part of something bigger, to land in a place-form space that can only be dimly seen in the chaos of today's challenges.

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Cosmo-localization & Localization: Towards a Critical Convergence

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Introduction

For many, 'cosmo-localisation' may seem like a contradiction in terms. Localizing our economies can, at first glance, seem antithetical to the notion of internationality. However, after four decades of ongoing work in many countries, we at Local Futures are convinced that international collaboration and cross-cultural information-sharing are, in fact, indispensable elements in building up grassroots movements for localization everywhere.

Grassroots information-sharing – particularly between industrialized parts of the world and more traditional, land-based societies – is important in overcoming the conventional narrative of 'progress' that has been used to reinforce the globalizing trajectory. The internet can serve as an important tool in bringing this international perspective to the forefront of environmental, social justice and new economy movements. However, a big picture, international perspective also appreciates the urgent need to prevent further leaps into increased dependence on technological systems, in favor of rebuilding face-to-face, place-based relationships.

In this chapter, we explore the congruence as well as areas of difference between localization and cosmo-localization, recognizing that these terms are themselves not rigidly defined, and contain within them a diversity of perspectives. We critically assess some of the distinctions made between the two movements within the cosmo-localist literature, and identify two broad topics where substantive – but not irreconcilable – differences appear to exist, namely around questions of technology and urbanization. Finally, we explore the fertile ground for further convergence between the two.

Cosmo-localization *versus* localization?

An obvious question that emerges, one that is addressed in the cosmo-localization literature, is why the need for the prefix, 'cosmo'? How is it different from simply *localization*? Many of the keywords that are frequently encountered in the cosmo-localist literature – sharing, autonomy, reciprocity, small-scale, decentralized, resilient, sustainable, and locally controlled – are guiding principles and values underlying the localization movement. So what are the differences? In the cosmo-localization literature, the 'cosmo' or cosmopolitan element is deemed necessary 1) to prevent localization from veering towards isolationism, insularity, nativism or xenophobia, and to instead embrace global solidarity, collaboration, tolerance and humanistic values; and 2) to avoid narrowly working on relocalizing one's own life or community – a form of depoliticized individualism – rather than contending with the formidable political-economic forces driving the planet towards the precipice. Localization initiatives must, in other words, be embedded in webs of mutual learning, open sharing and solidarity to form a movement sufficient to the task of systemic change. They must be cosmopolitan in outlook even as they are local in application.

Jose Ramos sees these two shortcomings apparent in localization theory.[2] He writes that "Relocalization advocates argue for the need to eliminate imported goods and relocalize trade and production for a variety of goods,"[3] and that from a cosmo-localization perspective "Decoupling from a global knowledge/design commons would … be fundamentally detrimental to the very goals of localized sustainability efforts."[4] Absent a cosmopolitan ethos, he and other cosmo-localist scholars5 worry about 'life boat relocalization' – an inward-turning and self-centered survivalist retreat, usually by the well-off, that abandons duties to global solidarity, assistance and cooperation. Ramos believes that, "…the very goals implicit in the relocalization agenda require political and social action at national and transnational scales,"[6]

2 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies*, 21(4), 65-84.
3 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies*, 21(4), 67.
4 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies,* 21(4), 68.
5 See, e.g., Kostakis, V., Niaros, V., Dafermos, G., & Bauwens, M. (2015). Design global, manufacture local: Exploring the contours of an emerging productive model. *Futures,* 73, 126-135.
6 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies*, 21(4), 68.

implying that hitherto the localization movement has neglected this necessary element of political action and resistance. Again, the warning is against retreating from the world, with cosmo-localization emerging to avoid precisely that.

But are these fair characterizations of localization? How different really is cosmo-localization from the prior and ongoing localization movement? In his 2019 paper, Gideon Kossoff discusses some of the earlier localization theorists, and shows how they all insisted on a strong cosmopolitanist ethos, anticipated the understandable worries about isolationism, and drew clear conceptual distinctions to right-wing versions of localism or anti-globalization. Kossoff writes that, "Cosmopolitan Localism is the theory and practice of inter-regional and planet-wide networking between place-based communities who share knowledge, technology, and resources."[7] Later, he points to Manzini's cosmo-localist SLOC formulation – small, local, open, and connected – which allows "communities to develop local self-managed economies and lifestyles wherein manufacturing and agricultural production would be largely for local consumption. Such local communities would be globally networked for the exchange and sharing of knowledge and resources (when appropriate)."[8] Finally, he drives home the point that a cosmopolitan localist society is "a planetary network of culturally diverse and self-organized communities."[9]

In their 2020 paper, Schismenos et al. similarly emphasize how, within a cosmo-localist framework, "the local remains independent within the interdependent network that constitutes the global, thus promoting autonomy within complementarity on both levels."[10] They make the further important point that globalization, far from spreading virtuous values of tolerance and cooperation that its partisans consistently claim for it against 'narrow' localisms, is actually intolerant of diversity in the imposition of monocultural economics and has "intensified the contradictions of nation-state capitalism."[11]

If we look at an early key text of the-then burgeoning anti-globalization and re-localization movement, the 1996 book *The Case Against the Global Economy, and For a Turn Toward the Local,* as well as later writings by many

7 Kossoff, G. (2019). Cosmopolitan localism: The planetary networking of everyday life in place. *Cuaderno*, 73, 51-66.
8 Kossoff, G. (2019). Cosmopolitan localism: The planetary networking of everyday life in place. *Cuaderno*, 73, 58.
9 Kossoff, G. (2019). Cosmopolitan localism: The planetary networking of everyday life in place. *Cuaderno*, 73, 62.
10 Schismenos, A., Niaros, V., & Lemos, L. (2020). Cosmolocalism: Understanding the transitional dynamics towards post-capitalism. *TripleC*, 18(2), 670-684, 677.
11 Schismenos, A., Niaros, V., & Lemos, L. (2020). Cosmolocalism: Understanding the transitional dynamics towards post-capitalism. *TripleC,* 18(2), 676.

of the contributors to that volume, the congruence with these later cosmo-localist formulations is obvious, while signs of parochialism, autarky, isolationism, or depoliticization are completely absent. The final section of that book – 'Steps Toward Relocalization' – contains repeated and clear articulations of what is, basically, a cosmopolitan or open localization. The importance of intercultural, international open flow of knowledge and even technology within and alongside economic and political relocalization, is flagged again and again, along with policy changes needed to protect local polities and communities from the depredations of footloose global corporate capital, allowing for local economic and cultural security, from which a tolerant internationalism can emerge.[12] Rather than calling for elimination of all imported goods, the subsidiarity principle is called for in the provision of real material needs, which is something cosmo-localists also endorse.

If we look at the localization movement in practice, we see repeated instances of cosmopolitan solidarity, knowledge exchange, sharing, etc. These are seen as essential to, not separate from, efforts to reduce the material footprint of the economy through initiatives of local renewal and regeneration. This has been a central plank of our own work since the outset. At Local Futures' international 'Economics of Happiness' conferences,[13] you might come across a Japanese community organizer describing a local food action plan to a group of South Korean officials, or a Brazilian activist telling Australians about new kinds of climate action. You might hear Italian farmers echo the experiences of their Japanese counterparts, and students from Bangalore share struggles and concerns that are equally familiar to Londoners and New Yorkers. When tied into a big-picture, systemic analysis, stories from the other side of the world can help us recognize that the many ecological, social and psychological crises we all experience actually stem from the same source – an out-of-control economic system that is, first and foremost, a *global* system. From this vantage point, epidemics of depression, unemployment, a growing gap between rich and poor, toxic pollution and climate change are all symptoms of an underlying systemic disease that knows no borders – a disease that is closely tied to the spread of a profit-hungry techno-economic juggernaut.

Even as we critique that global system, we are working to link hands across

12 See e.g., Hines, C., & Lang, T. (1996). In favor of a new protectionism. In J. Mander and E. Goldsmith (Eds.), The case against the global economy, and for a turn toward the local (pp. 485-494). Sierra Club Books; and Norberg-Hodge, H. (1996). Shifting direction: From global dependence to local interdependence. In J. Mander and E. Goldsmith (Eds.), The case against the global economy, and for a turn toward the local (pp. 393-407). Sierra Club Books. Norberg-Hodge continues to make these arguments over two decades later, e.g.: Norberg-Hodge, H. (forthcoming). Ancient futures: Localisation and the simpler way. In S. Alexander, S. Chandra-Shekeran, & B. Gleeson (Eds.), Post-capitalist futures. Palgrave.
13 https://www.localfutures.org/programs/the-economics-of-happiness/international-conferences/

borders and ideological divides, in order to localize, globally. As we see it, localization is about enabling communities to take back control of their own lives, to prioritize production for their own needs and to trade when it makes sense to do so. By strengthening community autonomy and self-determination everywhere, localization opens up possibilities for genuine communication between diverse peoples, enabling them to collaborate in ways that are healthy for people and planet alike.

The global food sovereignty movement, led by the international peasant's organization La Via Campesina, comprising 182 organizations in 81 countries, representing some 200 million small-scale farmers, is another exemplary cosmo-localist expression. They are engaged in political resistance to global agribusiness domination on multiple levels including the international, while focusing on food sovereignty and food system localization.[14] Through international agroecology training schools, conferences, conventions, and protests, the movement brings peasants from a huge diversity of locales and backgrounds into dialogue and mutual learning, creating a potent force for change.

Because there is undeniably a resurgence of anti-immigrant, xenophobic sentiment in right-wing movements that are – at least rhetorically – anti-globalization, it is essential for the localization movement to make clear that their anti-globalization stance is rooted in international solidarity, intercultural openness and exchange, environmental justice, pluralism, fraternity, solidarity, and love, while it emphasizes the fact that globalization is intolerant of differences in its relentless dissemination of a global consumer monoculture. This is what people's movements against globalization and for localization have been doing for decades, being from the outset fiercely internationalist, and emerging in large measure in opposition to global injustice.[15] Nevertheless, the corporate media is happily using the rise of the right-wing to discredit the spirited, leftist opposition to globalization that has stalled such corporate power grabs as the Trans Pacific Partnership, Comprehensive Economic and Trade Agreement, and the Transatlantic Trade and Investment Partnership.[16]

The Technology Question: From High-Tech Solutionist to Low-Tech Degrowth Cosmo-Localization

14 https://viacampesina.org/en/international-peasants-voice/

15 Jensen, A. (2017, January 24). Trump's populist deceit. Local Futures blog. https://www.localfutures.org/trumps-populist-deceit/

16 An inspiring case of cosmo-local, municipal city-level policy resistance was seen in the pan-European CETA and TTIP-Free Zone movement. See: https://friendsoftheearth.eu/news/2000-ceta-and-ttip-free-zones-in-europe/.

On the question of technology, there is undoubtedly a diversity of opinion within both the localization and cosmo-localization movements, ranging from the low-tech/vernacular/local natural material end of the spectrum through the high-tech/mechanical/digital end. At the risk of overgeneralization, localization tends towards the former, and cosmo-localization towards the latter – with most cosmo-localist advocates placing strong emphasis on the internet and digital technologies like 3D printing as an exemplar of distributed fabrication whose design is part of an open source global knowledge commons, but whose material creation takes place locally (hence the motto, 'design global, manufacture local').

Apart from applications like 3D printers, however, there is significant convergence between localization and cosmo-localization around what is loosely called 'appropriate technology,' usually referring to lower-tech, manually-powered tools both traditional and quite modern. For example, both movements laud initiatives like L'Atelier Paysan[17] and Farm Hack[18] which produce and freely share designs for convivial tools in support of small-scale, agroecological farming and overall technological freedom from the onerous patents, debt traps, and criminalization of repair inflicted by the corporate world. There are other non-electric, low-tech movements – like the bicycle-powered machines of Maya Pedal[19] – that also make plans and designs freely available, and are also congruent with the ethos of both movements.

Indeed, the idea of globally-shared, open source designs for sustainable living is not new or unique to cosmo-localization. Movements like ecovillages, permaculture and appropriate technology have long been promoting this sort of knowledge exchange, experimentation and locally-relevant design adaptation, often predating the internet era and instead relying on in-person trainings, exchanges, courses, publications, etc.[20]

Nevertheless, many cosmo-localist writers fail to acknowledge this older history, and consequently ascribe too much credit to the internet for enabling a global knowledge commons. For example, Schismenos et al. write that, "...cosmolocalism has the potential to address the dependence of

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17 https://www.latelierpaysan.org/English
18 https://farmhack.org/tools
19 http://www.mayapedal.org/machines.en
20 *This point is acknowledged by Bauwens in Gerhardt*, H. (2019, September). A Commons-based peer to peer path to post-capitalism: An interview with Michel Bauwens. *Antipode Online*. https://antipodeonline.org/2020/02/19/interview-with-michel-bauwens/; and Kostakis, V., & Giotitsas, C. (2020, April 2). Intervention – Small and local are not only beautiful; they can be powerful. *Antipode Online*. https://antipodeonline.org/2020/04/02/small-and-local/. Additionally, the traditional technologies and tools documented by Julia Watson are not only ecologically sustainable, but still tremendously effective, and despite emerging in deeply specific socio-ecological contexts were and are shared and spread widely. See: Watson, J. (2019). *Lo-TEK: Design by Radical Indigenism*. Taschen.

local communities on global value chains for its subsistence and the global corporate extractive model that spurs global warming"[21], and Ramos writes, "With the internet and crowdsourced knowledge a knowledge commons becomes a reality."[22]

By way of example, Ramos points to a recent initiative in India that makes solar lamps based on open hardware design that is in the public domain for others to freely copy from all over.[23] This is good, but this sort of free exchange of knowledge is not new, and predates the internet, to say nothing of 3D printers. Local Futures' early work in Ladakh, India establishing the Ladakh Ecological Development Group (LEDeG) in the 1980s, introduced and locally adapted appropriate technologies like village-scale micro-hydro electric systems, collectively owned and maintained by the entire village. This was an example of a technical innovation originating from outside, from a knowledge commons that long pre-dated the internet. Many people from many countries contributed to the various low-tech solutions promoted across the region by LEDeG, and many people in turn received training and took new ideas from there to other regions, in a system of open, non-commercial, convivial exchange in the shared project of bypassing fossil fuel based dependency and fortifying local autonomy against the onslaught of corporate globalization, that anticipated much of the cosmo-localist agenda. This exchange was largely based on physical, in-person interaction, and it could be argued that the internet more readily facilitates information exchange. Yet there is an extent to which the in-person element was – and remains – vital to cross-cultural learning and exchange that, we believe, cannot be replaced or replicated by digital communication.

Ambivalence around embracing high-tech cosmo-local technologies like the 3D printer from some quarters of the localization movement turns on a number of issues. The first concerns the still-dubious claims of environmental superiority, and even potential environmental toxicity and waste, of the technology from a full life cycle assessment perspective. Though it is often assumed that 3D printers can help eliminate waste and herald a circular economy, this is far from proven. Reid Lifset cautions that much more critical analysis must be done on the "the recyclability of polymers, metals, or mixed materials used in nonindustrial settings or the possibility of dramatic increases in throw-away products facilitated by endless customization. (Imagine being able to produce shoes, costume jewelry, or household goods in varied colors or ornamentation on demand.

21 Schismenos, A., Niaros, V., & Lemos, L. (2020). Cosmolocalism: Understanding the transitional dynamics towards post-capitalism. *TripleC*, 18(2), 678.
22 Ramos, J. (2019) Cosmo localism: Tech trend, post-capitalist commons transition, or something else?. *New Economy Journal*, 1(7). https://www.neweconomy.org.au/journal/issues/vol1/iss7/cosmo-localism/
23 Ramos, J. (2019) Cosmo localism: Tech trend, post-capitalist commons transition, or something else?. *New Economy Journal*, 1(7).

This could bring fast fashion to a whole new level.)"[24] Cosmo-localists would reject such reckless use of the technology, but the question of how to prevent it from being appropriated to further spur consumerism, or by corporations hoping to commandeer it for expanding profits, remains an important question, a worry that Ramos[25] and Schismenos et al.[26] have also expressed.

Another issue is the matter of electrical dependency and mechanization, and the consequent displacement of human labor and engagement with the material earth. As Alexander Langlands writes, "Mechanisation … and especially the small electrical motor, has largely robbed us of the need to be physically skilful and dextrous."[27] With increasing automation and digital complexity, he continues, "we're in danger of losing touch with a knowledge base that allows us to convert raw materials into useful objects, a hand-eye-head-heart-body co-ordination that furnishes us with a meaningful understanding of the materiality of our world."[28]

Of course none of this is to ignore or minimize the terrible destructiveness of conventional centralized heavy industrial production under capitalism, and the urgent need to find alternatives to that system. Yet 3D printing, in our view, only goes part of the way in that urgent task. It challenges proprietary patents, corporate control, and production for maximum turnover and profit, but it fails to sufficiently question the ends of production, with advocates touting its potential to make everything from prosthetics to cars to space modules.[29] But how do we determine what are socially necessary and ecologically benign products? This is a political and ethical question. A reasonable case could be made for distributed 3D printing of prosthetics or replacement parts for already-created products (ideally, non-toxically, using decentralized renewable electricity), but 'printing' new cars would fail on social and ecological criteria.

Others claim that, "Arguably the real issue is not how to produce and consume less, but how to develop new productive models which are capable of outperforming capitalist models, i.e., by doing things differently and

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24 Lifset, R. (2017). 3D Printing and Industrial Ecology. *Journal of Industrial Ecology*, 21(S1), S6-S8., p. S7 https://onlinelibrary.wiley.com/doi/epdf/10.1111/jiec.12669

25 Ramos, J. (2019) Cosmo localism: Tech trend, post-capitalist commons transition, or something else?. *New Economy Journal*, 1(7).

26 Schismenos, A., Niaros, V., & Lemos, L. (2020). Cosmolocalism: Understanding the transitional dynamics towards post-capitalism. *TripleC*, 18(2).

27 Langlands, A. (2017). Craeft: An inquiry into the origins and true meaning of traditional crafts. W.W. Norton & Company. p. 12.

28Langlands, A. (2017). Craeft: An inquiry into the origins and true meaning of traditional crafts. W.W. Norton & Company. 22.

29 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies*, 21(4); Schismenos, A., Niaros, V., & Lemos, L. (2020). Cosmolocalism: Understanding the transitional dynamics towards post-capitalism. *TripleC*, 18(2).

better."[30] Surely this is mistaken. As critics of economic growth have made clear, in a world facing ecological catastrophe the real issue is in fact how to produce and consume less overall while satisfying basic needs and justice – as well as how to do things differently and better. The ends and means of production must be radically evaluated.

Distributed digital fabrication may have positive qualities of decentralization and autonomy from the tyranny of corporate commodities, but does not – compared to the older appropriate technology movement – constitute a sufficiently radical break with the alienation of industrial production itself. Thus even the example of a 3D-printed earthen house, while admirably resolving the problem of toxic plastic feedstocks, still presents an alienated form of production where the human element (and thus, potentially meaningful employment) is largely replaced. The same critique obtains in the case of the WikiHouse, another initiative regularly referenced by cosmo-localists. A traditionally-built vernacular house of adobe or cob achieves the end of a comfortable and environmentally sustainable dwelling, while employing the head-hand-land connections and faculties of multiple people. Why substitute the human labor element and the need for place-based ecological knowledge with machines, at a time when the labor-absorptive potentials – and psychological benefits if done in cooperative conditions – of manual production could help alleviate both unemployment and anomie? The same argument applies in the face of increasing pressures to digitize, automate, and further mechanize agriculture and other vocations.

A related factor that cannot be elided since it underpins the technologies of digitally distributed manufacture, is of course the digital part – namely the internet and its associated infrastructure. As with manufacture itself, there is no doubt about the importance of the goals of cosmo-localism in this regard, including getting it out of the hands of profit-seeking corporations and making it open-source, democratically run, publicly funded, etc.

These steps would certainly make a big difference, but the fact remains that the production and use of digital tech has and will have huge social and environmental costs, no matter how many such reforms are implemented. This shortcoming is commendably acknowledged by some cosmo-localists,[31] even as they emphasize the centrality of the internet to cosmo-localism. The energy footprint of running the internet is monumental and utterly unsustainable today, and will be even more so if its reach is expanded still

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30 Kostakis, V., Niaros, V., Dafermos, G., & Bauwens, M. (2015). Design global, manufacture local: Exploring the contours of an emerging productive model. *Futures*, 128.
31 See, e.g., Ramos, J. (2019) Cosmo localism: Tech trend, post-capitalist commons transition, or something else?. New Economy Journal, 1(7); and Schismenos, A., Niaros, V., & Lemos, L. (2020). Cosmolocalism: Understanding the transitional dynamics towards post-capitalism. *TripleC*, 18(2).

further. According to a recent study, "Current estimates suggest the internet accounts for five per cent of global electricity use but is growing faster, at seven per cent a year, than total global energy consumption at three per cent. Some predictions claim information technologies could account for as much as 20 per cent of total energy use by 2030."[32] Likewise, the sourcing and processing of the rare earth minerals essential to digital technology is currently inseparable from horrible socio-environmental devastation.[33] One could also point to the many psychological and physical problems for end users associated with ever-expanding screen culture,[34] and to the manner in which the internet and computers in general continue to act, in the main, as vectors of Western – and especially American consumerist – cultural hegemony and imperialism.[35]

Therefore, beyond democratizing and commoning digital technology, we need to politically and socially regulate it. Furthermore, we need to politically arrest further expansion and speed of the internet and digital tech, and radically reduce it and scale back, just as we need to do with the economy overall, if we hope to achieve a socially and ecologically sane and healthy future. This is daunting to put it mildly, and implies among other things a post-capitalist and post-corporate political economy. To be sure, cosmo-localists would strongly endorse such policy-level controls on technology and its runaway multiplication in the name of profit, yet interventions like 3D printers and other distributed production technologies tend to come across as a sort of depoliticized, individualized, technofix to the problem of Big Tech and corporate power in general. In this respect, cosmo-localization is susceptible to the very critique some authors level at localization, of ignoring "political and social action at national and transnational scales."[36]

In sum, it seems that since the benefits and costs of high-tech applications like 3D printers continue to be contested, it is unnecessary for cosmo-localists to place so much emphasis on such technologies, or to exaggerate the role of the internet rather than fit cosmo-localization within the limits of a downscaled and contained internet. Perhaps a 3D printer will come along that transcends all the problems described above, but given that there are already low-tech alternatives available and in circulation and action, it seems

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32 Lancaster University. (2016, August 11). World should consider limits to future internet expansion to control energy consumption. *ScienceDaily*. www.sciencedaily.com/releases/2016/08/160811090046.htm

33 Maughan, T. (2015, April 2). The dystopian lake filled by the world's tech lust. *BBC.* http://www.bbc.com/future/story/20150402-the-worst-place-on-earth

34 Twenge, .J.M, Joiner, T.E., Rogers, M.L. (2017). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S. adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, 6(1), 3-17. http://journals.sagepub.com/doi/full/10.1177/2167702617723376

35 Bevins, V. (2021, January 4) Surfin' USA: Why the internet remains a tool of American hegemony. The Baffler. https://thebaffler.com/latest/surfin-usa-bevins

36 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies*, 21(4), 68.

like a distraction. Even as localization is sometimes accused of "fetishizing the small", cosmo-localization would do well to avoid fetishizing high-tech solutionism. Despite the potential for the internet (de-corporatized and open-source) to play an important role in connecting our movements and sharing knowledge across the world, its shortcomings and costs must be kept constantly in mind, and it should not be construed as the sine qua non of knowledge commons, or conceived as an adequate substitute for face-to-face sharing and learning. Sharing open-source designs for autonomous tools for sustainably meeting basic needs that are – whenever possible and practicable – built and crafted by hand from local natural resources rather than by machine is, we believe, a viable compromise going forward.

The Urbanization Question: Towards an Agrarian Cosmo-localism

While Ramos argues that urbanization – especially the rise of mega-cities – is both compatible with and conducive to cosmo-localization,[37] we contend that cities should not be conceived as a crucial element of cosmo-localization. This is because, despite what many 'green city' advocates claim, urbanization is inextricably tied to increased ecological impact. Today, cities account for 78% of energy consumed and produce more than 60% of global carbon dioxide emissions worldwide.[38] The consumption and resource demands of urban-dwellers greatly exceeds that of non-urban residents,[39] which explains why GDP and energy use of megacities is growing faster than their populations.[40] Meanwhile, the expansion of mega-cities will "displace vast tracts of farmland by 2030", with especially dire consequences for food security in Asia and Africa.[41]

Ramos is clearly aware of these impacts, and sees cosmo-localization as important precisely because of the need to mitigate them. There is obviously an urgent need to reduce the extensive ecological footprints of cities, and there are important anti-corporate initiatives around the world working

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37 Ramos, J. (2017). Cosmo-localization and leadership for the future. *Journal of Futures Studies,* 21(4)
38 Estrada, F., Wouter Botzen, W.J., & Tol, R.S.J. (2017). A global economic assessment of city policies to reduce climate change impacts. *Nature Climate Change,* 7, 403-406. https://www.nature.com/articles/nclimate3301
39 Ketchum, C. (2020, September 7). Cities and green orthodoxy. *Counterpunch*. https://www.counterpunch.org/2020/09/27/cities-green-orthodoxy-and-the-future-of-sustainable-development/; Smaje, C. (2020). *A small farm future: Making the case for a society built around local economies, self-provisioning, agricultural diversity and a shared earth*. Chelsea Green Publishing.
40Kennedy, C.A. et al. (2015). Energy and material flows of mega cities. *Proceedings of the National Academy of Sciences.*112(19), 5985-5990. https://www.pnas.org/content/112/19/5985.abstract
41Bryce, E. (2016, December 27). Growing mega-cities will displace vast tracts of farmland by 2030, study says. *The Guardian*. https://www.theguardian.com/environment/world-on-a-plate/2016/dec/28/growing-mega-cities-will-displace-vast-tracts-of-farmland-by-2030-study-says

on this.42 Cosmo-local distributed production could also help realize this shift to an extent. However, an even more urgent task is to question and resist the sorts of policies and development trajectories that are driving mass urbanization and the growth of mega-cities in the first place. Indeed, mega-cities must be downscaled to achieve a more balanced and distributed inhabitation of the planet.43 In this, sociologist and farmer Chris Smaje offers what seems to us a realistic and sensible vision, a "settlement pattern of a small farm future _ suited to deliver less extractive relationships based on renewable local resources_. It would most likely be a world of farmsteads, hamlets, villages, market towns, and regional hub cities, with little need for today's mega-cities_. There are already political developments of this kind: in a new municipalism of smaller towns and cities stranded by super-urbanism that are trying to reconnect to their hinterlands in ecological re-localisation movements, in peasant movements and so on."44

The COVID-19 crisis and the grueling social dislocations caused by lockdowns have, in many countries, brought the fraught nature of rapid urbanization into sharp relief. As food supply chains and employment opportunities unraveled and dense crowding became anathema to public health, there has been a renewed appreciation for the rural, for local and regional food production. In countries of the Global South that are still majority agrarian, there has been a reverse migration from cities back to villages, and rural farming communities that are food sovereign have not only absorbed this exodus from the cities but also contributed significant food aid to their urban counterparts.45

This demonstrates the importance to resilience and material security of a distributed settlement pattern and – very much in line with the spirit of cosmo-localism – robust networks of distributed food production with a strong agrarian/rural base supporting neighboring towns and cities, where urban agriculture can also play an important role.

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42 See, e.g.: European Network of Corporate Observatories, Corporate Europe Observatory, Observatori del Deute en la Globalització, Observatoire des multinationales, & Transnational Institute. (2020) *Cities versus Multinationals*. Ritimo.

43By this, we do not mean merely geographically dispersing high-consumerist, wasteful modern lifestyles in the mode of contemporary suburbia, but a structural shift towards decentralized but interlinked settlements based on sustainable consumption patterns and local agrarian economies.

44 Smaje, C. (2020). *A small farm future: Making the case for a society built around local economies, self-provisioning, agricultural diversity and a shared earth.* Chelsea Green Publishing, 214.

45 See, e.g., Kothari, A. (2020, June 5). What does self-reliance really mean? Amazing stories emerge from India's villages. *The Hindu*. https://www.thehindu.com/society/what-does-self-reliance-really-mean-amazing-stories-emerge-from-indias-villages/article31756580.ece; Valdivia, M. (2020, August 8). In Peru, ancestral values shine during COVID-19 crisis. *Local Futures Blog*. https://www.localfutures.org/in-peru-ancestral-values-shine-during-covid-19-crisis/

Conclusion

Human-scale, face-to-face relationships are essential to our wellbeing. A decentralized fabric of meaningful, intimate, lasting relationships – between producer and consumer, between the individual and the community, between people and the plants and animals on which they depend – enrich our lives; they are how we evolved, and they are what it means to be human.

The localization and cosmo-localization movements clearly share important perspectives. Importantly, both recognize the urgent need to encourage international collaboration and information-sharing as a means of building powerful movements to oppose further centralization and top-down control, and to enable local autonomy. On a deeper level, both might concur that 'cosmo-localization' can refer to the goal of an economic, cultural and cognitive adaptation to the cosmos itself – a scaling down and slowing down that allows us to connect with the communities and living ecosystems on which we depend. There are important differences in how the movements envision realizing this broad consensus. In this chapter, we have argued for a cosmo-localization that takes a more critical stance on questions of technology and urbanization, while striving for a balanced, selective acceptance and engagement with both. In this tension, there is the opportunity and imperative for a very constructive dialogue and collaboration.

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The Australian Bush Mechanic and her Potential in Helping to Save the Planet

Paul Wildman interviewed by Michel Bauwens

Bush mechanics in the Australian context

Michel Bauwens:
Dear Paul, I met you in Melbourne in September 2018 and have been fascinated by your work on bush mechanics and artificing leading to the Planetary Bricoleur. I have a first complex question for you: 1) what are bush mechanics, 2) how do you place it in the context of Australian history and what is the current conjuncture, 3) how do you place this in a more generic history of modern technology and society.

Paul Wildman:
'In Australia there is a term for someone who links thinking and doing, and can act forward wisely and solve problems with what is available while developing innovations in the field that respond to broader needs:

'A bush mechanic is committed to self-reliance and excellence at their task and is not to be confused with a 'backyard mechanic' who does shoddy work. And a Bushy can look both ways to the mechanic and the bench and to the bush to find patterns in nature as with indigenous folks.' (Paul Wildman and Bob Dick)

'Bush Mechanic' in the Australian vernacular has the same meaning as

Handwerker in the German language. Mechanic can also be translated as Arbeit or labour – a chiro-ist so to speak - someone who works with their hands as in chiropractor. Finally, Mechanic is also related to the German 'Spiel', i.e. play called 'Mechanisch'. So we have the tri-unity of Mechaniker (practical person), Mechanic (Handwerker), and Mechanisch (as in play).

It has a long history: due to the colonisation process self-reliance and DIY were vital in a rural and sparsely populated context. Even today in driving around country areas one sees 'Mechanics Halls' and 'Schools of Arts' now in disrepair yet these were the DNA of Adult Education in the 1890's and early last century. These drew on the British Guild system and were close to Peer to Peer systems – the curriculum was not centralised and learning was distributed. In NZ and South Australia Workers Education Associations (technical school + being a good citizen) were also developed. Now all of this is in disarray.

Vocational Education is now completely centralised and uses behaviourism – in a methodology called 'Competency Based Training' (CBT) as the basic unit of curriculum – a Taylorist method of behaviour conditioning. I have excoriated CBT in my work from a pedagogical critique perspective (even when I was Deputy Commissioner for Training in Queensland in the early 1990's) however billions have been spent on it and whole bureaucracies erected and gain succour from this top down shibboleth.

Permaculture in certain regards pays homage to this top down process and now has accepted State Supported Training permaculture courses and funding whereby the curriculum is decided centrally and assessment done on the basis of CBT - Competency Based Training that is measured behavioural outcomes. I have given up on these para-neo-liberal systems which, seem clueless regarding pedagogy and thus in effect become para-conservative. So while espousing change and having many good points they also embrace some of the worst parts of Australia's/neo-liberal pedagogical system.

In the West we have confused what the ancient Greeks called Techne (seeing tools as an extension of the human – an approach Boeing use in development of new aircraft) and Technique (human as extension of the tool – an approach Airbus use in this process)[3] This is similar to the distinction that Aristoteles made between Oikonomia (the household economy – from which we get Oikonomics = Economics) and Chrematistics (i.e. the love of

[1]http://www.crafters-connect.com/
[2] https://www.kal.net.au/

money). The Greeks are utterly foundational in our Western disaster today – and some of their thinking is just well scintillating and a lot is horrible and divisive.

For instance Craft in those days was done by what were for them 'nobodies such as slaves or women'. And how they separated thinking and doing this is the genesis of the disaster that is western civilisation. So in contraposition to this I set myself the task of trying to understand what was behind craft? What is the meta-pattern that connects crafters?

The Bush Mechanic/Artificer/Bricoleur approach stands or sits in contraposition to this approach. Research shows that such an approach helped Australians die at significantly lower rates for example in Changi POW camp in Singapore in WW2, as compared to the Americans and the British. This is because their society was essentially hierarchical whereas ours was based on mutual aid ('mate'-ship). But this has all been destroyed over the past 50 years. Clearly, semi-autonomous bush mechanics are inimical to top down neo-liberal bureaucrats. Chris Hedges shows the same process happened in the US with the Wobblies etc.

Modern technology is profoundly totalitarian and destructive of democracy – so the Bush Mechanic represents the periphery against the centre i.e. against this fascistic inclination. It seems that our western culture cannot address massification without becoming fascistic.

This is why I am interested in say distributed technology systems such as say medieval craft based systems, which leads to my interest in an Archaic Renaissance.[4] These are Peer with Peer systems, which I will differentiate from Peer to Peer (P2P) in my next responses.

The counterculture movement, out of which Permaculture and the Men's movement/maker movement and so forth grew, is a case in point. This has, in Australia degenerated into what I call the 'dope and dole syndrome'. Self-reliance has fallen away in a way that ridicules our foremothers – who knew this stuff but failed to understand how the whole pensions and benefits from the mainstream system had on our psyche. I call this Western pathology, TUD – which stands for Techno-Utopian-Driftand which reifies, even romances, the above Technique approach.

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[3] For background, see https://www.youtube.com/watch?v=kERSSRJant0

My concern is that P2P (Peer to Peer), and to a lesser extent PwP (Peer with Peer), can act as TUD support/fanboy clubs. In my opinion, hacker clubs notoriously fall into this trap with little or no understanding of the difference between techni-que (humanity as extensions of our tools) and techne-que (tools as an extension of humans). Similarly, Men's Sheds are also hierarchical, bureaucratic and part of the neoliberal control pattern. However, the Bush Mechanic approach has not been entirely successful in countering these mainstream tendencies.

Syzygy'istic

Michel Bauwens: By now you have encountered our own approach, which is centered around commons-based peer production. Can you tell us how you see your approach is related to ours?. Do you expect something specific to happen in terms of convergence? Or mutual learning? What is your assessment and evaluation of what we do in relation to your own project ?

Paul Wildman: The two approaches are intervolved and complimentary indeed syzygy'istic[5] that is the sum of the parts is greater than a simple addition i.e:
P2P + PwP = >2.

When I was an academic I suggested that my students (masters) keep an esoteric thesis/diary as well as an exoteric one, to help with depth learnings not only disciplinary/horizontal insights.

P2P is a profound expression of our human wish to be with one another and to co-operate and offer mutual aid which these days extends to other species and ultimately to the planet itself, in many ways it is the counterpoint to the commodification and dollarization of everything inc. Nature and thus us.. The focus in P2P on good governance is, for me, vital to having a system of governance in the civic sense that resists co-optation, embraces innovation and manifests mutual aid.

These social or interaction type ends (for me they are ends) are not as strongly manifest in the Bush Mechanic and in the transition of the Bush Mechanic to the Planetary Bricoleur (a Bush Mechanic that uses her hobby to help heal the planet), from the local to the global/planetary. Where the practical projects we do with our own hands are consciously related to our planetary predicament. Consequently, such developments from P2P need

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[4] Further info on the concept of Archaic Renaissance can be found at: http://www.crafters-connect.com/craft-issue-8/

to be incorporated. Thus the two sides of the one coin support the one coin so to speak.

Again, for me, P2P offers an alternative to main street showing a certain horizontal consciousness moment whereas PwP offers a certain vertical consciousness gaze/glance/moment. For instance the six principles of the Bush Mechanic can be mapped onto the Pagan four directions (which can also be mapped onto the four Jungian personality types) with the other two principles representing the vertical dimension of up: sky–spirit–king/sky king, and down–earth–soul–queen/earth mother.

In my view, P2P has an esoteric or depth dimension to it,[6] which is not generally seen as viable or valid in the exoteric or day to day, especially in academia – yet for instance the two overlap and can be seen in the view that Jesus was a carpenter!!! This vertical aspect, i.e relation to transcendence, is something that is echoed in the second Bush Mechanic Principle of inner outer harmony that is the outside work/world is reflected within and vice versa. Thus one hears the saying 'work it out', 'work it through' and so forth.

This is then the synergy generated by the combination of opposites by yin and yang. Jung called this syzygy[7] and is a huge reason to have craft classes in pre-school, primary school, high school, vocational school, university courses and ultimately revivify Adult Education.[8] This then is the arena of Math (P2P) | Myth (PwP).

Yet, in Australia 'play' is now excluded from the curriculum in Child Care, craft shop is closed for primary school and barely existing for high school, home economics/oikonomia no longer exists in anything other than say 'cooking', and basically Adult Education courses have evaporated and AE has replaced ACE – Adult and Community Education…

Where is LifeLong/LifeWide/LifeDeep learning in all this ? … No where!!

And this PwP learning seeks to show the King has no clothes so to speak and to point out the vitality and importance of re- engaging this form of pedagogy before it is too late.

In my discussions with you Michel I brought up the idea of including PwP on your P2P website. Although PwP has some exposure and workshops in Australia it has almost none overseas or on the international scene.

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[5] See https://www.lexico.com/en/definition/syzygy

For instance, one arena P2P seems somewhat silent is say on TransHumanism and this emergent field is in my view a key TURD expression that calls for a technology value filter say like how the Amish filter social discussion and conclusions – which can vary across communities. Both P2P and PwP are post-nation state – which is a breath of fresh air. ***PwP offers this possibility to P2P***.[9]

So in a sense P2P is big brother to PwP which, again in a sense, is little sister. ***P2P offers the possibility to breathe some life into PwP.***

Relationships with other traditions and issues

Michel Bauwens: (1) Have you looked at other countries for similar traditions, like for example Jugaad in India. (2) How do you see your practice related to 3D printing and similar technologies. (3) How do you see human thriving and survival in our dangerous future, marked by climate, energy and economic disruptions, which you may already have felt in the Australian bush ?

Paul Wildman: In one of my eBooks, I have a list of 15 or so such terms so in various more mainstream cultures: the Jugaad lives on yet is relatively silenced. For instance in many Asian cultures there are no Hardware Stores no DIY as this is considered beneath a male's role and in some of my wife's relatives' situations the house is in dire need of repair yet the male of the household will not undertake repairs himself !

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6 To deepen this aspect, see the following references:
Wildman, P. and L. Cundy (2002). The Esoteric Thesis: Making inner sense of the ineffability of knowledge obtained during the exoteric research process. *ALAR (Action Learning and Action Research*) 7(2): 3-21.
Wildman, P. (2002). The Esoteric Thesis: Unspeakable Things, unknowable truths - making inner sense of the ineffability of knowledge obtained through research for the Exoteric Thesis. *Journal of Psychospiritual Transformation* 1(1).
Wildman, P. and I. Miller (2012). The Esoteric Thesis: Unspeakable Things & Unknowable Truths. *Scientific GOD Journal* (SGJ). 3(6): pgs. 593-605.
7 Jung applied it to the combination of anima and animus - unique http://changingminds.org/explanations/identity/jung_archetypes.htm
8 For more insight into this aspect, see the following references:
Wildman, P. (2011). A*ction Learning Circle Participants Handbook: Biochar Action Learning Circles for transforming Agriculture and Environment - toward a future Nature can live with*. Action Learning Circles based on Paul Taylor's *The Biochar Revolution book* (2010). P. Wildman. *Brisbane: The Kalgrove Institute, with Topic Guides* - 40pgs.
Wildman, P. and H. Schwencke (2003). *Your Community Learning - action learning circles for learning and earning through community economic development*. Brisbane, Community Learning Initiatives and Prosperity Press. Multi Media CD Rom with explanatory booklet explaining action learning and including cross walk between community economy development questions and ALC topics integrated through *Community Economy Development Actions*. Brisbane: Prosperity Press and Life Long Learning Council of Qld (then Community Learning Initiatives).
Wildman, P. (2013). Action Learning Circle Facilitators Training Course: Workshop Manual draws from the facilitator handbook Biochar Action Learning Circles towards a future Nature can live with, based on Paul Taylor's book The Biochar Revolution (2010). Brisbane: The Kalgrove Institute, with Topic Guide 50pgs.

Where the Jugaad does still live alive today, is in indigenous cultures where the crafter and their skills in doing women's business or men's business is deeply respected and is intrinsic to the tribe/cultures survival. Indeed one of the reasons I have to believe I am onto something is this in that the West dis-considers 'the other' inc. the indigenous, and women. And so, in a reverse psychology approach, we find what is important to our survival (and even sustainablity) is that we have to look into the contents of this 'other' and when we do there is the Jugaad!!! In our detritus (used here as a noble concept)[10] we find our survival, our future – CRAFT-PwP is one such detritus gem – in my view.

(2) To me this second question should be to stepped up i.e. we should query about how do 3D printing and similar technologies relate to Transhumanism. I argue strongly in my work that we need to become fully human, through for instance PwP & P2P, before we become transhuman! This is the Amish critique of our culture yet no one is listening as we are naturalised to TUD's and other approaches such as and CRAFT is silenced. I worry that P2P will only be accepted if it uncritically accepts hard technology of say 3Dprinting.

I have always argued for good governance as that is for me a social technology as are friendship, networks (such as P2P and PwP), netweaves, family and social policy … yet all this is lost in the on rush of a giant Techno Utopian Drift (TUD).

If P2P chooses to continue to remain silent on this calling yet speaks out re governance and economic liberation (both excellent), it runs the risk of being yet another TUD fanboy. Whereas PwP tends to remain silent in relation to governance yet speaks out transhumanism .

(3) Human thrivability requires a nuanced notion of what it is to be so. So what is human and what is 'thrival'? Certainly mainstream churches have failed to answer the first and thrival and survival are very different notions.

This I argue is where CRAFT/PwP is strong and P2P is significantly less so.[11]

Human survival and thriving

Michel Bauwens: How do you see human thriving and survival in our dangerous future….

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9 see: http://www.crafters-connect.com/craft-issue-10/ .

Paul Wildman:
When the centre collapses and the global digital dictatorship fails and degenerates into a series of digital gulags that is all that will be left. Electricity will be intermittent, our web wobbly, Localism will be a form of resistance, Fascism will be rampant we will have turned the whole globe into a Auschwitz – a gas oven. All our gift to our children's children…

The Bricoleur PwP is a survival meme, burning man, essentialist yet also a peak achievement for our, and other, species. Yet hardly thrival…. That is up to our souls. Yet now I fear a bridge too far. We will crash and burn and after that what???? We need a social technology that works alongside a technocratic one we need PwP and P2P that allows us in community to obviate the need for the centre in the first place, without the nation state for extractive neo-liberal system that we have now dominating our mother Gaia. That is where P2P and PwP work together best that interstice that luminous space as Leonard Cohen says the crack between the worlds where the light gets in.

Michel Bauwens: Do you have a message for humanity and for the readers in this relationship between our Peer to Peer vision and your own concept of Planetary Bricoleur (PB)? The PB concept is quite unique but that takes a lot to explain and there is no space left - I have an appendix in my eBook on this difference and overlap between P2P and PB. This article is not about P2P it is about PB. So… in answer to your question:

Paul Wildman: I would say re message to humanity something like: With C-19 the local is back - and back to stay. So over the past 20 years I have seen a slow increase and in the past two and explosion of interest in methods to engage and expand this local. Such methods are now seen as crucial in planetary survival. So methods such as P2P and PB are becoming accepted as efficacious practical ways to help our planet transition to a more sustainable future.

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10 i am using detritus here in the sense of exfoliation of say a basalt rock where over millennia flakes split off and fall around the rock through the act of heat and weather esp. in cold climates. This is different to the work debris where any washed up bric a brac on the shore say from a sunken ship or other disaster!!
11 References for Q3 can be found in http://www.crafters-connect.com/craft-issue-8/:
Wildman, P. (2008). [BMARP1] Zen and the Art•ifice of Ingenuity eBook1: An action research report (2001-2008) into the practice and prospectivity of the bioneering Artificer/Bush Mechanic (Australian term) in the process of Exemplar System Development (ESD) for a better world: Vol 1- the Artificer. KALGROVE/Prosperity Press - eBook 1 - Bush Mechanic Action Research Project (BMARP): Report No. 1: Brisbane. p. 370pgs. Codifying the results of a 7 year research program. Project commenced late 2001 and Learning Insights coding started in early 2003. V71 by 02-2008.
Wildman, P. (2009). [BMARP9] Zen and the Art•ifice of Ingenuity eBook2: Comparative Educational Pedagogy's – towards an emergent Chiro-pedagogy. . Kalgrove. Brisbane. eBook 2. 220 pgs.

And in conclusion:

Things fall apart; the centre cannot hold;
Mere anarchy is loosed upon the world,
The blood-dimmed tide is loosed, and everywhere.
The ceremony of innocence is drowned;
The best lack all conviction, while the worst, the worst is yet to come….

Irish poet William Butler Yeats, written in 1919 in the aftermath of the First World War.

Appendix:

Wildman, P. (2013). [BMARP11] Zen and the Art•ifice of Ingenuity eBook 3. Archaic Renaissance: Reprising the Bushy ~ towards the emergence of a post-capitalist political class and pedagogy, based on experience and transcendence rather than commodification and exploitation. Brisbane: The Kalgrove Institute. 230pgs.

Wildman, P. (2014). [BMARP12] Towards an Archaic Renaissance: Re-membering the Bushy Artificer as an archaic phenomenon now vitally relevant for our post-modern era of environmental, political and social decline in the West. Overview Report on the outcomes of the Australian Bush Mechanic/Artificer Learning action research program 2001-2014 incorporating eBooks 1,2,&3 and substantial related material and weblinks. Brisbane, The Kalgrove Institute incorporating Prosperity Press. Digital book/CD.

What is a Briloceur ?

Languages all around the world have words for Bricoleur/Artificer. This unknown yet amazing fact speaks volume's about the suppression of the importance of 'hand wisdom' in our Western culture. Our great and shameful Sociological blind spot.

An Artificer is a skilled worker who is a master-craftsman practiced in set of related skills, especially hand skills/handicraft, and takes responsibility for a whole project in this area inc. design, fabrication and testing for improvement, rather than a highly specialised narrowly focused artisan or plug and play technician. Generally, there is an intense combination of head, heart and hand. The '3H's' so to speak. Our species ancestors in archaic times used their hands to help their, and ultimately, our heads develop the large brains that distinguish us today. Handiwork is headwork – make no mistake.

The Artificer is also aware of the other aspects of his/her trade so to speak that is fitness for use, exemplar project, inner/outer balance, mutual aid, global problematique, harmonisation of the various parts of the project and Action Learning. The Artificer is to the Artisan what the General Physician is to the Specialist Surgeon. Generally, there are three aspects of the Artificer; labour, utility, beauty – some would add philosophy and empathy. My experience over the past two decades supports these two additions.

In overview, this 'hands on' way of knowing is all around us yet largely invisible in today's culture. This for me is a genuine authentic 'truly human' therapeutic way of working, living and being that needs urgently to be rehabilitated into our mainstream society.

Five aspects of the Artificer/Bricoleur:

(1) labour(er) – physical work - hand,

(2) Utility/empirical knowledge – mechanic, engineer – head/design,

(3) craftsman – symbolism – practical artist – handwerker (German) - as in design

and beauty the aesthetic principle the heart,

(4) care and concern for other artificers and our planet, and

(5) co-llaborator i.e. working together i.e. P2P&PwP.

So in this way the Artificer/Planetary Bricoleur is well a sort of Alchemist. In this regard we can see skilled labour as embedded in (1), (2) & (3) and synergised by (4) & (5).

Artificer/Bricoleur in other languages:

Exoteric: Bush Mechanic, Artificer (UK and Australia esp. in military), Juggard (Hindi), Bricoleur (Fr - tinkerer), Handwerker/Kunstler, (Gr – hand worker/one who creates works of art), DIY (Aust and US), Astronaut Farmer (US – actually used at a US conference I presented to), Techne (Ancient Greece), Homo Habilis (Latin), Artisan (Eng – restricted meaning cp. Artificer), artigiano (It), Artesina (Sp – craft done manually/chiro), daiku (Japanese – also designs houses – master carpenter), Jesus (exoteric & esoteric artificer/craftsman/carpenter – bible), carash (Heb - Tradesman), tekton (Heb – carpenter – Jesus was a tekton), Homo Faber (Arendt – man the maker).

Esoteric: Daedalus (builder of the labyrinth who constructed a pair of wings for himself and his son Icarus to escape Crete where they had been imprisoned by King Minos), Enneagram (point 1 - The perfecter), Enki (patron of therapists – as in restructuring psychic scaffolding – a psychic carpenter, god of craftsmen – improviser and empathic male). Hephaestus – the crippled Artificer - A rejected son – god of the forge, loner (he was [is] physical, manual rather than mental, motivated by emotions, did not use his mind or words. 'Rejected and betrayed, Hephaestus put his feelings into the objects he made, using tools for a creative purpose.' Often ridiculed or called names by others, yielding low self-esteem). Jesus as the carpenter for instance the Tekton.

04

Cosmolocal Stories

Let there be light: IIT Bombay's SoUL Project to Energize Rural India[1]

1 https://www.soulsiitb.in/

Raji Ajwani Ramchandani & Snehal Awate

While on their way to address the Million Solar Urja Lamp (Million SoUL) Program team at the Indian Institute of Technology Bombay (IITB) in December 2016, Professors Chetan Singh Solanki (Chetan) and Jayendran Venkateswaran (Jay), reminisced about the journey that had started in 2004 when Chetan had returned to India, with a purpose of using his education for developing solar products and solutions that could make a positive difference to the poor in rural India. The team had just received a letter from the Ministry of New & Renewable Energy - Government of India (MNRE), approving their distribution of 7 million solar study lamps to rural students across five Indian states. This was a great pat on the team's back which had steered the SoUL project through different phases to achieve their first major milestone - distribution of 1 million solar lamps to rural school children in select Indian states.

As the duo finished sharing the news of the award with the team, the room echoed with the sound of gusty clapping and cheers. A sense of pride and accomplishment seemed writ on everyone's face as they disbursed. However, Chetan and Jay knew they had a big task on hand. They had to strike a balance between altruism and sustainability. The government wanted them to forward integrate into manufacturing solar modules to better serve the local rural markets and achieve scale while Chetan and Jay had to make the project sustainable in the long run. They knew that the fulcrum of this balance was economic viability. Various aspects like the product design, pricing, sourcing and distribution that were crucial to ensure long term success at the implementation level had to be keyed into the project as it evolved. Their main concern was - how to scale up rapidly and transition from the current grant-based approach to a market-based one?

Rural Electrification

Rural areas in developing countries often face inadequate and erratic power supply due to poor physical infrastructure and the economics of supplying electricity to relatively low-density areas. The traditional method of distribution of grid electricity to the rural areas is through central and state level government machinery. However, the policy makers often lack the resources to meet the challenges of rural electrification. While most South Asian countries have access to abundant sources of renewable energy or off-grid energy, the proportion of usage of such clean energy sources has traditionally been very low in rural areas. Most energy service projects to rural households through off-grid options usually involve private-sector NGO models and consumer credit delivery mechanisms. Off-grid solutions offer basic energy services- lighting, operating radio/television, and small appliances - using solar home systems. Since such systems eliminate or reduce the need for candles, kerosene, liquid propane gas (LPG), and/or battery charging, they offer direct economic benefits as well as increased convenience and safety, improved indoor air quality, higher quality of light, and reduced CO2 emissions.

The Indian context is not very different. India accounted for a third of the world's population without access to electricity and about 40 percent of those without access to modern energy in 2017. Over the years, the Government undertook several policy initiatives to facilitate grid electrification solutions in villages, but kerosene usage continues to remain significantly high (See Exhibit 1). Usage of kerosene has several adverse effects on health and safety. Electrification is thus the way to go - electrified villages have lower instances of forced migration or poverty with improved income generation opportunities and the schools have lower drop-out rates. Due to limitations of grid-based energy solutions, off-grid energy options are critical in India.

Exhibit 1: Major Sources of Power in India (2001-2011)

Source	2011	2001	% change
Electricity	67.3	55.9	20.39
Kerosene	31.4	43.2	-27.32
Solar	0.4	0.3	33.33
Other Oil	0.2	0.1	100
Any Other	0.2	0.2	0
No power / light	0.5	0.3	66.67
Total (% age)	100	100	

Note: These figures indicate the changes in the population usage of various forms of sources to obtain power, from 2001 to 2011. Source: Census 2011

The Million SoUL Program: Sustainable off-grid solar solutions

Chetan and Jay focused on the time-critical issue of facilitating education in rural India. According to them, the schooling of rural children had a timer attached where age and opportunities for formal education were inversely related. Every lost year made them more likely to drop out of school and join the work force. “The clock is ticking,” Jay said when Chetan told him about his village.

The Beginning: (2004-2008)

In 2004, Chetan returned to India from Europe and started New Energy Foundation (NEF) in 2006 in his village Bikangaon, Khargone District in the state of Madhya Pradesh (M.P.). His goal was to increase energy availability in the surrounding areas. As part of this initiative, NEF partnered with Ekal Vidyalalya Foundation (EVF) (literal translation: single or solo teacher schools) in 2008 to procure and provide solar lamps for the students in 500 villages in M.P. The EVF schools catered to poor rural youth, who could attend classes only in the evenings after working on the farms or assisting their guardians in seeking livelihood. Shortly after distributing the solar lamps, many faults with the lamps began to surface. Trying to fix faulty lamps was a cumbersome process in the rural setting. As Chetan recalled, "initially when we had started on this endeavor, we were all very enthusiastic. When we lit up all the lamps before their distribution, it was simply amazing. We got a lot of appreciation and it was a great feeling in the beginning but then the problems started …."

Second Attempt: (2010-2011)

In 2010, Chetan tried again to bring solar to the villages of M.P., this time under the aegis of the "Light a Billion Lives" (LABL) scheme, facilitated by The Energy and Resource Institute (TERI), an independent non-profit organization. Under this scheme, users could obtain solar lamps[3] from TERI. They could get the lamps charged at a central location in the village for a nominal fee. Chetan channelized TERI procured lamps as follows: 30 lamps for the village Nemit and 50 lamps each for the villages[4] Shivna and Ighriya. Initially there was a lot of excitement, but the euphoria dissipated fast, and the challenges arose when some lamps failed. Despite diligent attempts by the village level co-ordinators as well as Chetan to follow up with TERI for repairs, TERI did not respond quickly. Eventually all the lamps failed.

3 The solar lamps were owned by TERI and the users had to pay a fee for getting the lamps charged. A solar panel was located at a central area in the village where the users could bring the lamp for charging.
4 All are villages in Madhya Pradesh

Learning from Failures: 2012-2014

He spent three months in the Education Park School in Bikangaon, Khargone District, which was 100% solar-powered since 2010. He prepared a rudimentary design to see if the lamp could be made by the local community and was able to make and sell 20,000 lamps in four months. The lamp costed INR. 400 of which INR. 200 were collected from the beneficiary students. For the balance contribution, Chetan approached the student community at IITB. He would make presentations in the student hostels in the evenings around dinner time. The initial website for this project was also set-up and maintained by a student from IITB. Since the funding from the IITB students was not enough to procure 20,000 lamps, he then approached the affluent schools and gave lectures to source funds. He also sought funding from the Government of Madhya Pradesh and individuals for bridging the gap. As soon as a lamp was sold, it would be updated on the website. This idea of a community- led approach augured well with the M.P. government, which decided to fund 10,000 lamps. The project was moved inside IITB for scaling the initial idea.

This laid the foundation of the project "Localization of Solar Energy through Local Assembly, Sale and Usage of 1 Million Solar Urja Lamps" (in short the Million SoUL Program). In 2013, Jay joined the team and in the same year, the duo submitted a research proposal to the MNRE to distribute one million solar lamps in several states across India. The project was initiated in January 2014 at IITB through a grant from the MNRE and the Ministry of Finance's National Clean Energy Fund (NCEF). It took only 5 minutes to convince the NCEF of the idea of the Million SoUL Program!

Phase I: Distribution & Repair

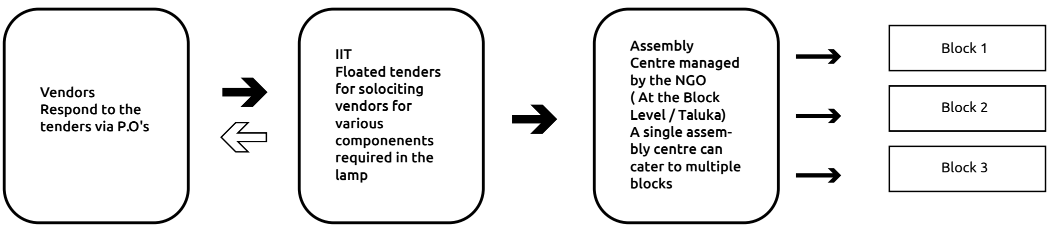
The project envisaged funding for the lamps from three sources: 36% from the MNRE, 40% from corporate social responsibility (CSR) initiatives of different firms, and 24% from the student. The rental business model that TERI had attempted earlier was neither scalable nor sustainable. Instead, the Million SoUL team converged on offering the solar lamp at very low prices. With ownership attached to the product, the team was confident that its owners, the school children, would use the lamp for their studies and care for it. "Let the economics work," as Chetan and Jay put it.

The value chain of the project comprised of the component vendors, IITB, and the NGOs responsible for distributing the lamps in village-level blocks. To meet the students' ability to pay, costs needed to be really low throughout this value chain. The economies of scale achieved through a million lamps only partly reduced the costs. The component vendors were already cutting their margins for the cause. The team worked out that the costs would reduce greatly if the lamps were to be assembled locally. Thus, instead of buying the assembled lamps from the vendors, the team sourced only the components from them, and instead, invested in training the locals to assemble the lamps. The training would also result in skill development in the local economy and create livelihoods. In addition to assembly, the lamps would require repairs. However, the vendors were less interested in repairs and the cost to transport the lamps to their repair centre was too high for the price of the product. The sustainability of the project depended upon sales as well as continued working of the solar lamps during the lifetime of the million SoUL project. Thus, the team decided to localize even the repairs. In addition to repairing the lamps, the Service Repair Centres (SRCs) also sold other solar products at commercial rates. Component vendors were in fact encouraged to sell new products through these SRCs.

Their business model was thus driven by three key principles namely (i) affordability: making the lamps affordable for the school children leading to a high speed of distribution, (ii) saturation: saturating the locality thereby building scale, and (iii) localization: localizing the assembly, distribution and repair activities which would result in skill development (see Exhibit 2). With this business model, the team hoped to facilitate improvement in attendance and performance of students in school, reduction in the school dropout rates, reduction in kerosene consumption, employment generation and enterprise creation, and encouraging development of photovoltaic products through greater awareness.

Exhibit 2: Flow of different project processes

A clear process flow was charted detailing the role of each stakeholder as on 2011.



Source: The Million SoUL Program team

The core team, based out of IITB, which was the central coordinating agency, quickly grew from 20 employees to 60 in just one year. There were five component vendors of the kits for the project. Then, there were 5-15 assemblers and distributors (A&Ds) per assembly & distribution centre (ADC) and several NGOs that worked on the ground. While the project went through different stages of execution over the course of two years, the IITB team remained consistent in following an open-source model for the project i.e., they made every lamp design and design iteration publicly available (See Exhibit 3). The total cost of each solar lamp was about INR 500, which was shared by a number of stakeholders (See Exhibits 4a & 4b).

Exhibit 3: Trainning

Basic training	Additional Training
3 ½ day residential training on the assembly of lamp	To maintain a proper record of the operations such as daily assembly and distribution data, record of defective components, and the receipts of consignments. Refresher training is held once a month comprising a one-day workshop to update the trainers.
Basic training about the need for renewable energy sources and options given	Training of Google Docs & Tally
Participants briefed about the working of solar technology	Additional training is given to assemblers and distributors so that they can provide repair services to beneficiaries
Shown how to assemble solar lamps	
Shown how to conduct quality checks	
Given an orientation regarding campaigning for sales promotion and conducting field visits in schools, night campaigning in schools, goals of the project and data collection (baseline data and maintaining receipt records)	

Source: The Million SoUL Program team

Exhibit 4a: Cost & Expense structure
Cost

Details of the Partner	Percentage of the Cost borne by the respective partner	Amount in Rupees
National Clean Energy Funds (NCEF), Ministry of New and Renewable Energy (MNRE), Govt. of India	36	180
Various philanthropic partners	40	200
Purchase Price paid by the rural student	24	120

Expense

Cost of Components (per kit for Soul)	Rs 380
Cost of Coordination & execution	Rs 47
Cost of Assembly & Distribution (NGO)	Rs 63
Total	Rs 500

Source: The Million SoUL Program team

- The NGO was given INR 73 per lamp to manage its staff and marketing expenses
- The NGO had the authority to decide the compensation (normally INR 10 per lamp) for the assembler, who would get paid at the end of the month
- A Repair and Maintenance (R&M) shop was established for every 3000 students (users). Such R&M shops were scattered across the block. People manning these shops were paid INR 2750 per month
- The sales revenue was transferred to IIT via RTGS
- The NGO was paid by IITB after depositing the sales proceeds

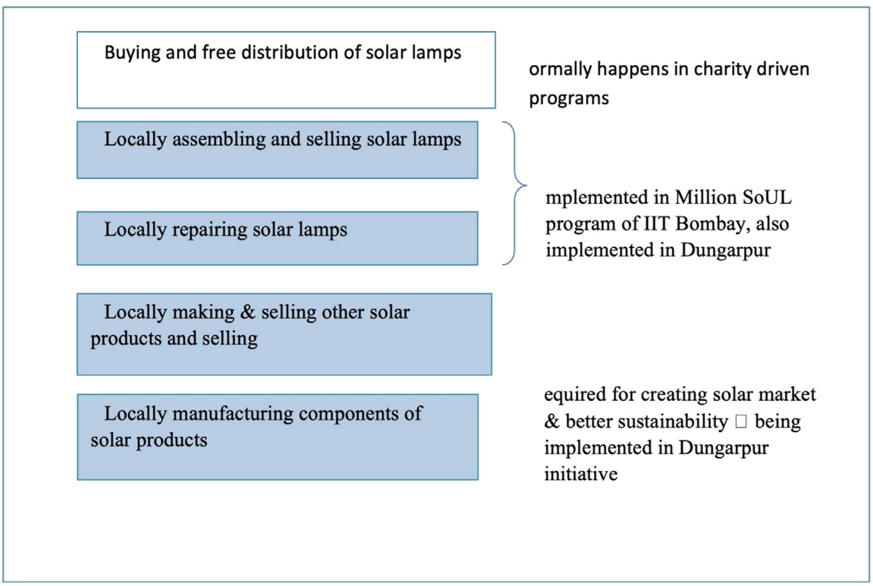
Exhibit 4a: Cost & Expense structure

Source: The Million SoUL Program team

With the help of nine NGO partners, the SoUL project spread its wings in the states of M.P, Maharashtra, Rajasthan, and Odisha covering a 65,000 square kilometre area across 10,900 villages in 234 districts, and 97 blocks (75% saturation in each block). Through its 54 assembly centres, 1,400 trained manpower and 350 repairs and maintenance (R&M) centres, the project touched 1,000,000 students in April 2015. The largest chunk of lamps (200,000 lamps) was funded in MP because the government took an active interest and lead in the project. The progression on the one million project was undertaken in Maharashtra, Madhya Pradesh, Rajasthan, Uttar Pradesh, Bihar, Jharkhand, Orissa and Assam. The positive results of the 1 million lamps project, achieved through speed, scale and skill laid the foundation for nation-wide expansion and the award from MNRE to ramp up the project scope to seven million SoULs in December 2016 (see exhibits 5a, 5b and 5c).

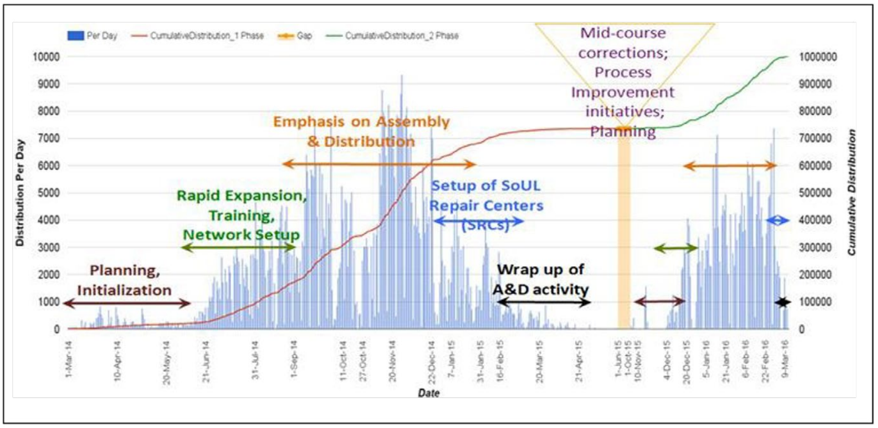
Exhibit 5: Evolution of the Million SoULs Program model

5a: Vertical integration



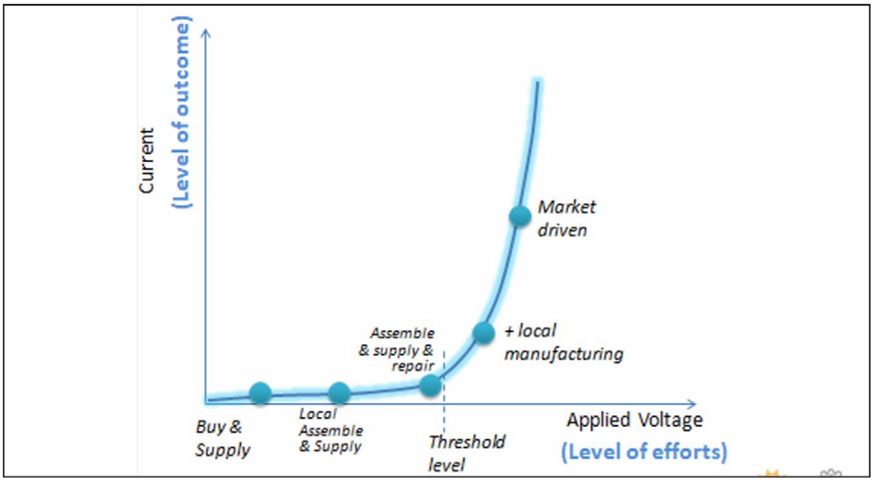
Source: The Million SoUL Program team

One Million SoUL Program execution



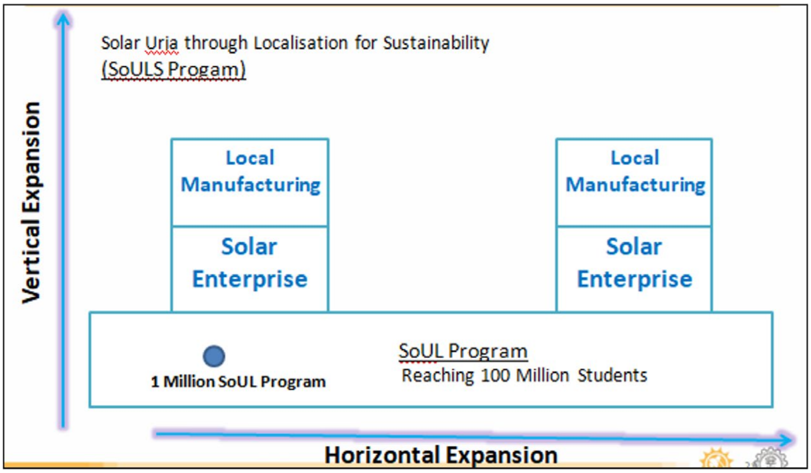
Source: The Million SoUL Program team

5b: Sustainability of solar solution (using diode analogy)



Source: The Million SoUL Program team

One Million SoUL Program execution



Source: The Million SoUL Program team

Phase II: Manufacturing, Distribution & Repair

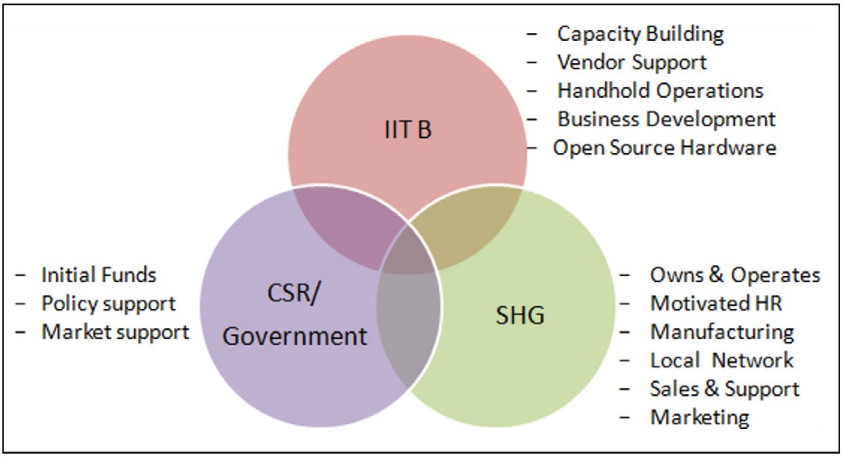
Under the aegis of the SoUL project, 60 tribal women were trained to assemble and distribute 40,000 lamps in October 2017. They created a corpus while this distribution for the photovoltaic (PV) module manufacturing. With the help of this corpus, the Rajasthan Gramin Aajeevika Vikas Parishad (Rajeevika) grant to 5 women to establish their own solar enterprises (shops). Encouraged by the state government of Rajasthan, the next step taken under the umbrella initiative of Solar Urja through Localization for Sustainability (SoULS) Initiative was that of manufacturing. In 2016-17, it was decided to set up a solar lamp manufacturing plant in the geographically challenging Dungarpur (Rajasthan) region in partnership with women self-help groups (SHGs). Dungarpur block had four Cluster level federations (CLFs), aggregation of SHGs, which were owned mainly by 20,000 tribal women. This plant also undertook training activities to make the partner women self-sufficient in managing the manufacturing, distribution, and repair activities.

Challenges and Road Ahead

The SoULS Initiative created local employment, helped local people learn how to assemble and repair solar lamps, and facilitated capability development. Given these achievements, the goal was to take the SoULS Initiative a notch up (See Exhibit 5c) to make it more sustainable. During their brainstorming session, Chetan and Jay discussed their present and future challenges:

> *We need to make this model - made by locals, for locals - sustainable in the long run. We need the locals to see value in this venture as a business, as a way of providing livelihood. Once the forces of economics take over, we think it will be sustainable. But how do we make it all happen?*

The answer to their question was not simple because despite their efforts at training to professionalize their workforce- primarily rural women- there was an air of informality. These women were often not punctual and unprofessional and sometimes their husbands would show up to take them back home before work time ended. In 2016, in their drive towards sustainability, the SoUL team planned to establish a company as a part of Solar Ecosystem by Local for Local (SELL) that would be owned and operated by women SHGs- Dungarpur Renewable Energy Technologies Pvt. Ltd., DURGA This company, initiated by IITB and Rajeevika in Dungarpur (Rajasthan), would be owned by the local community. The agenda was to move from local assembly to local manufacturing starting with solar modules. IITB would handhold operations up to two years including raw material sourcing, business development etc. till they become independent. The aim was to expand SELL to other parts of India as well. (See Exhibit 6).



Source: The Million SoUL Program team

Though the IITB team tried to formalize the project by developing a profit and loss statement, they had to do more than just serve the local areas if they wanted to achieve their goal of making the SoUL project sustainable. However, they were clear that they wanted sustainability without diverting their focus from local markets. They were concerned that any change in their direction would divert the focus of the locals away from local markets to more lucrative urban markets. Chetan and Jay wondered whether they had the capability to serve urban markets, in terms of training, finances, and supplier networks. They were also aware that the grant was given to them because they were serving local markets. While it was apparent that sustainability and scale depended on exposing the project to the interplay of market forces, the duo wondered if a solution could be found in them becoming an empaneled supplier to the existing solar product firms. The problem with this option was that they would be competing with the Chinese solar panel giants. Would this solution help meet the goal of supplying products to the local market?

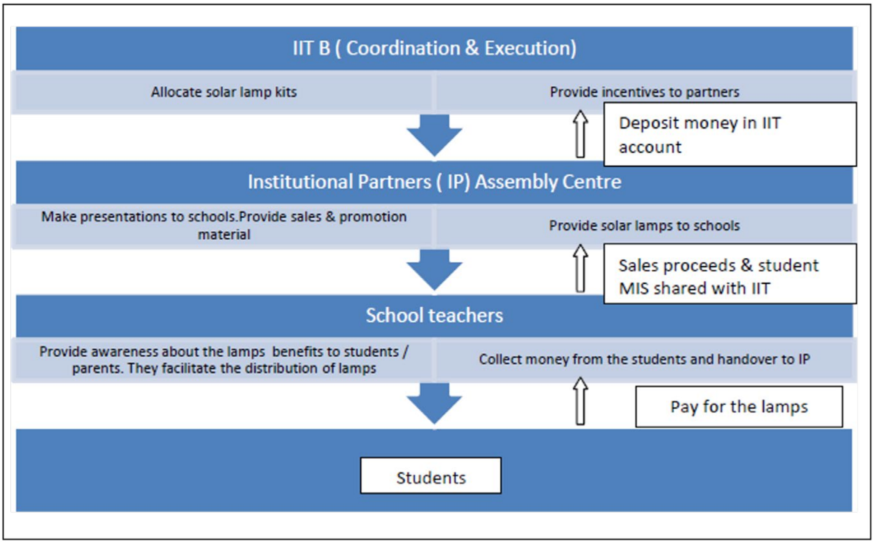
Concluding Notes

- The criteria for selecting the states and blocks[5] was the backwardness of the block, lack of power, and the do-ability of the project by the selected partner institutions. The 2011 census was used to study the backwardness of the region. Therefore, states/blocks with more than 50% unelectrified households (qualifying states: Uttar Pradesh, Bihar, Assam, Jharkhand & Odisha) were selected. Of these states, the blocks that were chosen were those which had over 40% households using kerosene as the main source for lighting. Blocks with significant percentage of tribal population were given preference.
- The ability of the selected NGO partners to deliver in the identified areas was considered. The NGO presence and do-ability was an important part of selection of the block in which this intervention was to be carried out. Factors considered while selecting the NGO were that the NGO should have a presence in multiple states, should be operational for more than five years and possess implementation experience, and it should have had a satisfactory record of implementation experience.
- Vendors were empaneled through a tendering process. The tenders were submitted to IIT/ MNRE. One vendor was

5 Blocks are also referred to as talukas. Many talukas or blocks make a district or zilla as it is known.

selected per location. The selected vendor procured all the components for the panel and lamp. Different areas had different vendors based upon transport cost and capacity and capability to provide during the agreed time.

- The Assembly Centre (AC), which had both men and women, would assemble lamps for two-three blocks depending upon the stipulated target. Assemblers and distributors were chosen from different village clusters in the block. The components were inspected for physical damage (battery/ LED/PC/ panel tested) and the focus was to use good components for assembly. Faulty components were returned to the supplier. There was a multi-step process to assemble and produce the lamps. The number of components per lamp was 18-25, depending upon the supplier. The assembly process



Source: The Million SoUL Program team

Rural Dynamism in the Digital Age

David Li

Chatting with Mrs. Cai at the reception area of her restaurant. Photo Credit: David Li

In our recent visit to Shaji in July 2019, we sit down with Mrs. Cai. She was born in this small rural village of fifty thousand in the north of Jiangsu province next Xuzhou. She is now in her late 30. We met her at the opening day of her restaurant. After a fantastic meal of Jiangsu cuisine in this first formal sitdown restaurant in the village. She told us her incredible story on how she transformed from a peasant in one of the most impoverished villages in China to a restauranter in 10 years by getting into the e-commerce for furniture along with tens of thousands of entrepreneurs just like her in the town. The village didn't have a long tradition of craftsmanship in making furniture. But e-commerce opened up an opportunity for the villagers to produce simple flat-pack furniture and market them all over China. She got into e-commerce through her cousin, who was also an e-commerce entrepreneur. She worked with others in the villages who operate factories, packaging, and digital services to get her shop started. Over the years, she built up her business to a company of 30 employees and millions RMB in revenue. She bought two houses, one in the village and one in the next-by city in an excellent school district to ensure her two boys' opportunities for good educations. For her, e-commerce gave her a way out of the hardship she would have endured being a farmer in rural villages. And in this small town, there are thousands more just like her. And in China, thousands of communities like Shaji change the lives of millions driven by the abundance of open technologies, platforms, and collaborations.

This chapter explores Shaji, first Taobao Village, on how the Internet and e-commerce brought out the dynamism of farmers in rural China and how they leverage the tools and technologies of digitalization to prosper and flourish.

Digitalization with the Internet is one of the critical drivers of China's economic reform. While the tremendous growth of e-commerce with Alibaba and Taobao in Double Eleven and the widespread use of Wechat payment have grabbed global attention, the foundational dynamism driving the growth remains invisible. The tremendous growth of e-commerce in China would not have been possible without the grassroots dynamism of adoptions to leverage digitalization tools and technologies for economic development and prosperity.

E-commerce Hot Spot in the Rural

Shaji village, a small township of population 50,000 in the north Jiangsu Province next to the city of Xuzhou, came into focus in Alibaba Research as it used big data visualization to analyze the e-commerce market in China in

2010. Shaji sparkled on the map as a bright dot of great e-commerce activities in the middle of nowhere rural China. The staff in Alibaba Research was puzzled, and their first reaction was to check the accuracy of the source data. The data was accurate, and the teams booked the earliest flights to travel to this village.

Residential House and Backyard Factory. Photo Credit: David Li

As they arrived in this rural farming village in the north Jiangsu, they met people young and old working in front of old computers in their humble houses to work on their e-commerce shops. They processed orders and handled customer services. In the backyard of their farmhouses, people worked in the makeshift factories producing flat-pack furniture and packaged them to be shipped all over China. In the early evening, the villagers carried packaged goods made in their backyard factories on the back of their electric rickshaw to the town's logistic center for distribution across China.

Ikea, Taobao and Three Young Guys

The origin story of Shaji had a humble beginning. Sun Han, a Shaji native, left the village for school and worked in the coastal area like most rural youth in early 2000. Sun returned to Shaji on the parents' request to prepare for the marriage around 2005. While going through rounds of matchmakings, he opened up a small Taobao shop to resell mobile phone accessories sourced from friends he made in Guangzhou. Once married, Sun took the new bride for a honeymoon in Shanghai. He discovered Ikea and the flat pack furniture that was becoming popular with the emerging middle-classes around China. He acquired a few simple Ikea pieces and brought them back to Shaji to study with two other friends. Working with local carpenters, they made the first version of the hacked furniture, photographed it, and put it on their Taobao shop. They sold a few in the first week and continued to get more demand, and business was booming. They soon renovated their houses and got new cars in their driveways. People all over the village became curious about how they made money. As the business expanded, they recruit villagers to join their operations and the knowledge of the e-commerce and the marketing of flat pack furniture spread. Their employees and relatives started to open up their e-commerce shops. With the low entry barrier to e-commerce and simple furniture, the village flourished with rapid multiplications of shops and factories, making flat-pack furniture distributed across China.

The slogan "Hundreds of businesses help thousands of households on the way to moderately prosperity" on the wall of a residential house. Photo Credit: David Li

Shaji Model

Inspired by what they see in Shaji, Alibaba Researcher worked with CASS (Chinese Academy of Social Science) on the Shaji model that summarized critical drivers of their success.

1. Bottom-up model: unlike the typical model of bringing e-commerce to the rural area in the top-down fashion, e-commerce was started from the bottom up by the rural residents themselves.
2. Copy to scale: the low entry barriers enabled others to copy the existing business and start their own. The paper called this a cell division copying with exponential growth.
3. E-commerce market drove industrialization: unlike the traditional model of manufacturing by offering a considerable amount of cheap labor to manufacture goods for others, industrialization is driven by the market reality to decide what kind of tools, equipment, and technologies to adopt.
4. The community that competes and collaborates: the core group of Shaji e-commerce is the new entrepreneurs who are mostly related to each other through family ties. The multiple layers of relationship create a system of competing and collaboration that further expand the complexity of the business ecosystem that contributes to the growth of diversification and specialization.
5. presence and not interfering" governing: the government did not try to lead the development policy or direction and focus on building infrastructures such as roads, electricity, and telecommunication. Also, the government is responsible for solving problems arising from the community, such as securing land usage for the factory. (e.g., Farmlands to industrial lands change is extremely hard in rural China).
6. Proper vertical markets. The furniture markets with large segmentation of the markets enable the cell division model of scaling to specialize in different segments. Thus, the correct vertical market facilitates the cell division model of the scaling of the Shaji model.

Taobao Village

The Alibaba researchers also came up with a definition of "Taobao Village" to study the phenomenon of e-commerce driven industrialization and modernization of rural areas. The "Taobao Village" is defined as an administrative area with more than 10% of the population involved in e-commerce activities, including sales, customer services, production of goods and logistics, and generates more than 10 million RMB annually in e-commerce sales. When the team discovered Shaji in 2010, they found 37 villages. As of 2018, 2,500 Taobao villages across China generate hundreds of billions of RMB in revenue. The Shaji village itself has grown from 1 e-commerce shop in 2007 to over 6,000 in 2018 and made over 10 billion RMB.

Logistic Distribution Center in Shaji, the largest in the Jiangsu province.
Photo Credit: David Li

Labor and Automation

Our filed work in Shaji shows a very different relationship between workers and automation in a distributed manufacturing environment. While Shaji has grown rapidly and prosperously in the past decade, it is still a small village in the north Jiangsu province. Attracting workers to rural villages is difficult. Young people who are willing to leave their town to work in factories prefer big cities instead of neighboring communities. The owners of factories would automate as much as they can afford. CNCs and other digital fabrications equipment are very common. Most of the workers are recruited from Shaji and a few nearby villages with less than 20 minutes in traveling distance. Most of the workers are farmers who still attend their farms.

I met Mr. Chen two years ago. He is in his mid-50s and owns about 3000 square meter farm in the village in which he grows vegetables and watermelons. He spent two months a year planting and harvesting his farm and one month off for the Chinese New Year holidays. For nine months a year, he worked in the factory earning RMB 7000 (about USD 1,000) a month. An assembly line job in the Foxconn factory in Shenzhen pays about RMB 5000, and a college graduate white-collar job in Shanghai starts at RMB 5,000, an excellent wage in the Chinese labor market. His works in the factory consist of what I would term "robot babysitter," where he watches over multiple CNC machines, loads up raw materials, and collects and inspects finished goods. The works are mostly from 9 am to 6 pm with an hour lunch break. When I asked him what he thinks of the works, he says it's easier than farming. His boss works with a team remotely on the programming of the CNC machines. I asked Mr. Chen's boss if he has any plan to replace him with a robot. He told me that his job is too difficult for robots.

Mr. Chen and the CNC machine he babysits. Photo Credit: David Li

Disruptive Innovations and Mass Flourishing

While it's easy to read into the story of Taobao village as a poverty alleviation measure, it is, in fact, a "disruptive innovation" that was coined by Clayton Christensen. The combination of Internet/E-commerce and the use of digital fabrications changed the cost of the flat-pack furniture verse the mass production and warehousing of Ikea. They are affordable and accessible to emerging middle classes in China. The open collaboration and sharing of the system further brought down the risk and cost of new product development. Coined in the early 1990s by Harvard Business School professor Clayton Christensen, the term has become virtually ubiquitous from Wall Street to Silicon Valley. Consequently, it's also one of the most misunderstood and misapplied words in the business lexicon. Disruptive Innovations are not breakthrough technologies that make products better; instead, they are innovations that make products and services more accessible and affordable, thereby making them available to a larger population.

The technologies do not bring about change; they are mere tools to facilitate changes in the hands of the right people. The high dynamism of the people of Shaji and other Taobao villages quickly adopt the new tools to capture the opportunities. While the number of Taobao villages has grown tremendously over the past decade, there is also a large number of failed attempts. While the technologies transfer could bring in some initial economic growth, the indigenous innovations enabled by high dynamism lead to sustainable long term growth. Edmund Phelps presents this in his "Mass Flourishing."

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An Open Source Preemptive Strike in the Coming War Over The Freedom to Make Your Own Products

Joshua M. Pearce

The relatively sudden widespread attention[2,3] of the concept of distributed manufacturing with 3-D printing is largely due to the development of open-source 3-D printers. One that could make its own parts[4,5], radically increased innovation rates and shrunk the costs of 3-D printers. Proprietary 3-D printers prior had cost hundreds of thousands of dollars and the least expensive sold for $20,000. Today an open source 3-D printer costs $160 and dozens of 3-D printers from different companies cost under $200. Several studies showed consumers could easily profit by 3-D printing their own products (even if the printers cost more than $1000).[6] The number of open source designs people can make profitably for themselves is growing exponentially.[7] In 2020 there are over 2.5 million 3-D printable product designs.[8] As Scott Grunewald of 3D Print pointed out "the ability to fabricate just about anything at home without the need of mass production

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8 https://www.yeggi.com/ 2,674,474 printable 3D Models as of 11.27.2020

is virtually inevitable. This ability to circumvent traditional manufacturing will essentially decimate current intellectual property (IP) law and grant consumers more freedom than ever before."[9] This on the whole will benefit innovation as there is a substantial literature that argues intellectual property in general, and the patent system in particular, actually stifles innovation.[10, 11, 12, 13 ,14, 15, 16, 17, 18,19,20,21,22] Microsoft's Bill Gates perhaps best summarizes the risks of IP: "[i]f 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 start-up with no patents of its own will be forced to pay whatever price the giants choose to impose."[23] Broad patenting of basic ideas in a field halts major innovation and technical progress for 20 years. "But that doesn't mean that IP lawyers or overly aggressive capitalists will pack it up and get new jobs, they will simply shift their focus on to something else that can still be patented and controlled–like 3-D printing materials."[24]

Patent trolls and their IP lawyers have already started combing through 3-D printing materials and if left unchecked could restrict innovation for decades. Although low-cost 3-D printing in metals[25] and ceramics[26] is

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available, by far the most mature material class for 3-D printing is polymers. Currently, most of these printers make products from polylactic acid (PLA) and acrylonitrile butadiene styrene (ABS), which retail for around $20/kg, but have been shown to be stronger than proprietary 3-D prints with the same material.[27] The development of an open source recyclebot,[28] which is a waste plastic extruder capable of producing filament at US$0.10-$0.025/kg from post-consumer plastic[29] is poised to accelerate distributed manufacturing by eliminating the cost of feedstock even for the world's poor.[30] In addition, the number of 3-D printing materials is growing as people are able to experiment in producing feedstock from waste using home-built recyclebots[31] (including those that themselves are 3-D printable).[32]

The threat of patents with broad claims stifling such innovation is real. Z Corporation (now after acquisition in 2012 owned by 3-D Systems) filed for a patent,[33] which claimed: "A powder adapted for three-dimensional printing, the powder comprising: a loose and free-flowing particulate mixture comprising: at least 50% by weight of a thermoplastic particulate material selected from the group consisting of ... polylactide". It is interesting to note that a restricted material is PLA, which is the most common material in the low-cost 3-D printer community. The patent was filed decades after thermoplastics were used in 3-D printing and well after thousands of people were using PLA in their printers. It should, be clear to the reader how such a patent (if interpreted broadly) could be used to limit the technical development of materials for 3-D printing. To stop attacks on the ability of people to use common materials for 3-D printing I published an algorithm[34] that can be used to obstruct:[35]

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of ceramic components using a customized 3D ceramic printer. *Progress in Additive Manufacturing*, 3(1-2), 3-9.

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34 3-D Printing Materials You Can't Patent on April 23, 2013 http://www.thingiverse.com/thing:73427

35 Pearce, J. M. (2015). A novel approach to obviousness: An algorithm for identifying prior art concerning 3-D printing materials. *World Patent Information*, 42, 13-18.

1. broad patent claims,
2. vague and generic claims,
3. formulaic patent claims, and
4. simple combination claims.

This obstruction comes in the form of making obviousness more clear for patent examiners because the idea (or IP) could be easily generated by a simple algorithm. A similar successful argument focused on DNA.[36] My algorithm can be used to protect 3-D printing materials in several ways. First, the USPTO has already expressed interest on the use of crowd-sourcing access to prior art[37] and the algorithm output can be provided to the USPTO before a patent is granted. Secondly, you or your patent lawyers can make use of the algorithm at during all stages of patent prosecution, opposition and litigation to ensure that obvious 3-D printing materials are maintained in the public domain.

Although in some countries like the UK, people are free to use personal 3-D printers for their own non-commercial use without concerns of patent infringement[38], in the US there is no personal exception. Thus, if a 3-D printed material is patented, no one may use it unless they pay for a license. If ever broadly enforced, this could destroy innovation in the 3-D printing and distributed manufacturing space and shows a clear need for a major shift in IP law (or even its demise).[39] Unfortunately, having prior art available online (e.g. the algorithm or even databases of libre materials) does not protect it, as the patent office is not required to search the Internet. Aggressive patenting in the 3-D printing space is already a problem[40] and the freedom of the maker/P2P movement is at risk. If left unchallenged, that could set the 3-D printing industry back for decades and even derail the advances that have already been made in distributed manufacturing. To combat innovation-stifling claims, the Electronic Frontier Foundation is using crowd-sourced prior art to support pre-issuance submissions.[41, 42, 43, 44]

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It is frustrating that the open community must work so hard to allow people to simply make things in their own homes for themselves. At the same time, however, would-be patenters risk having costly IP thrown out, when it is pointed out their 'novel' ideas were predicted years earlier by simple algorithms and open source designs. The first shot has been fired. Caution is clearly warranted for all those that attempt to patent a 3-D printing material.

That said, far more IP must be defended to retain the freedom of making now in the public domain.

The war has begun.

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Utopia Maker[1]

1 https://www.utopiamaker.com/

Chrystèle Bazin

In 2013, Philippe Parmentier launches in Colombia and Spain a project of 3D printing of prostheses for handicapped children. Since then, the Utopia Maker solidarity fab lab has come a long way, successfully entering the commons economy and demonstrating that people on the margins of society are the ones who most want to make the lines move.

Emancipate individuals through free access to knowledge. It is to embody the libertarian spirit of the pioneers of the Internet that Philippe Parmentier launches in 2013 "Materialisation 3D Madrid". A project conducted jointly in Madrid in Spain and... in Colombia, where a small town on the outskirts of Bogotá bears the same name as the Spanish capital. Why these two countries? *"Because I like to move around,"* answers the self-taught, kicking in the sidelines. *"We introduced children to 3D printing, inventing models in one city and making them remotely in the other."*

The Colombian class will enable him to put his ideals into practice. One of the students had an arm amputated due to an accident at work and his classmates decided to make a prosthesis for him themselves. They download plans of an open source model from the Internet and print it out in 3D. This small feat makes the headlines in the Colombian media. As a result, requests from families of disabled children began to pour in. And with good reason: in Colombia, the war with FARC has transformed certain areas of the country into minefields that claim thousands of victims and whose survivors find themselves handicapped.

"In the first two years, engineers, doctors and student volunteers produced about 50 prostheses adapted to children," says Philippe Parmentier. A large number, but not enough to meet the needs. So, in 2016, he is making a radical change: young disabled people and their families will start making the prostheses themselves. This is the birth certificate of Utopia Maker. Since then, one child has printed himself a prosthesis to play the guitar, another to ride a bicycle, while a young deaf engineer, Mauricio Carrillo, has developed a system for recycling plastic waste which he has installed directly on a 3D printer. With the self-manufacturing of 3D printers, recycled plastic and open source models, the cost of producing a prosthesis has become very marginal, opening up infinite possibilities for customization and innovation.

In recent months, Utopia Maker has spread to France (a branch in Marseilles has just opened its doors), Vietnam and the Central African Republic, putting into practice the ecological utopia of "cosmo-local", a thesis developed by Michel Bauwens, the Belgian peer-to-peer theorist, who posits that *"everything that is light is global (sharing technical and scientific knowledge), and everything that is heavy is local (production in micro-fabrics)".* But in the spirit of Philippe Parmentier, Utopia Maker goes far beyond the development of fab labs and the production of prostheses in open source. This project is a lever to contribute to a society of individuals emancipated from the rigid framework of States, institutions and the market. A society orchestrated by blockchain technology and knowledge sharing, which would make sure to leave no one by the wayside: *"Innovation can only come from those on the margins of society, because they are the most motivated to make things happen. Those on the margins guarantee a permanent renewal of society, which is what I call reverse inclusion,"* sums up Philippe Parmentier. He adds that, in his view, education, health and the preservation of the environment cannot be subject to an economic logic, be it "reasoned" or "sustainable". Sensitive to the philosophy of the commons, he advocates the removal of certain resources and contributions from the sphere of influence of the market and States and entrusting them to collectives of self-managed individuals, whose economy would be deployed on the periphery.

Text translated from the article « L'innovation ne peut venir que des exclus » of the French magazine Usbek & Rica. Originally published 01/05/2019.

AgOpenGPS and DIY Open Farm Innovation: An Overview

by Chris Bennett for AgroPro[1]

1 https://agopengps.jimdosite.cowm/

Agriculture is at a technological tipping point, according to Indiana producer Kyler Laird, who aims to plant 10,000 acres of soybeans in spring 2019, from Texas to Canada in a planting demonstration of equipment utilization and robot efficiency. (Anne Bartlett Photography)

The mavericks of DIY innovation are blazing a trail through the heart of agriculture. Yesterday's technological hopes are today's reality on many operations, evidenced by a growing number of farmers involved in automation and open sourcing. If the maxim of "money talks and theory walks" holds true as a measuring stick, then the increase of farmers transferring workbench prototypes to field activity is a plain indicator of success.

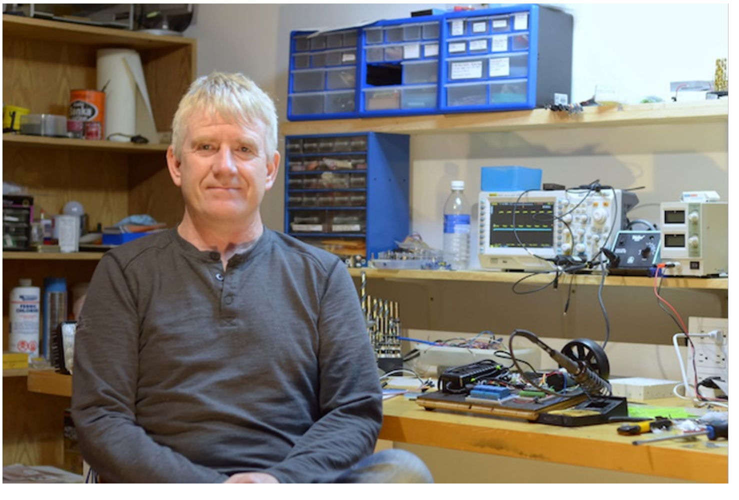
Geography once ensured the isolation of DIY innovation, as each farmer tinkered on his own island, but the physical barrier of distance has been spanned by the wireless wonder of a cellular signal. With smartphones in pockets and tablets in cabs, farm inventors from Mississippi to Manitoba are thriving.

Brian Tischler

"Some guys will continue to pay $500,000-plus for a new tractor and all the extras, and others will buy an older model and dress up it with open source and DIY," Brian Tischler says. "That's farming."

Located roughly two hours east of Edmonton, Alberta, Tischler[2] is driven by the possibilities of open source technology, and far removed from the comforts of armchair innovation. Growing field peas, fava beans, wheat, canola, barley, oats, flax, and sunflowers on 2,500 acres outside the tiny town of Mannville, Tischler is boosting open-source access with AgOPenGPS[3]—a free software program aimed at precision mapping and tractor automation which has gained global traction.

2 "FarmerBrianTee," YouTube (YouTube), https://www.youtube.com/user/FarmerBrianTee/videos.
3 AgOpenGPS, https://agopengps.jimdosite.com/



The potential for DIY-related savings and efficiency is exploding, partially due to a radical decrease in hardware costs, says producer Brian Tischler, designer of AgOPenGPS. (Photo credit: Brian Tischler)

Tischler began the project in 2016, initially creating a basic application on a Windows tablet that took GPS data and drew a continuous line showing where he had seeded last. "Agriculture is so proprietary and locked down solid. I thought it was time to go open source."

He placed the entire project on GitHub[4] for free download and posted it on The Combine Forum.[5] "I said, 'Here is a link and it does mapping.'" In short time, Tischler added section control and autonomous tractor control to the program. "There are lots of commercial systems that do all of this, but they are expensive. This one is free."

4 "Farmerbriantee/AgOpenGPS," GitHub, https://github.com/farmerbriantee/AgOpenGPS .
5 BrianTee, "AgOpenGPS," The Combine Forum, November 10, 2019, https://www.thecombineforum.com/threads/agopengps.278810/

Tischler doesn't shy from blunt assessment or criticism: "I want to give back to agriculture because I've been very fortunate in so many ways, but I don't think the future of farming technology is based on open source; it only has a role. Manufacturers continue to make software that runs with ease—the push of a button that does 800 things in the background. Everyone in ag has to make money."

The potential for DIY-related savings and efficiency is exploding, partially due to a radical decrease in hardware costs, Tischler explains. The *pièce de résistance* that has fueled tremendous innovation, and is almost ubiquitous among DIY farming advocates, is the Arduino, a simple, open-source microcontroller originally designed in Italy for high school learning. Essentially, an Arduino is a highly durable microcontroller on a board enabling basic understanding of how a computer works. "They took a $3 computer and built software. Now the silly little thing is used on an inestimable amount of projects around the world, including farming."

Tischler used an Arduino to connect with a driver which powers a tilt meter and an electric motor turning his John Deere 4560's steering wheel. "It's $3 for an Arduino, $3 for a tilt meter, and $25 for the motor driver. You now have autosteer. People are absolutely getting bolder with DIY projects by the month. DIY guys have never had this many affordable parts and pieces available, and it's happening everywhere."

Kyler Laird [6]

6 https://www.linkedin.com/in/kylerlaird/
7 https://www.facebook.com/lairdscape/

Agriculture is at a technological tipping point, according to Kyler Laird, an Indiana farmer growing 1,700 acres (Lairdscape)[7] of no-till corn and soybeans in Jasper County, halfway between Chicago and Indianapolis. At the vanguard of ag automation, Laird has developed a series of DIY robots, starting with a John Deere 420 lawn tractor and continuing up the driverless ladder—Massey Ferguson 2745, Challenger MT765, and John Deere 6330. In 2017, Laird planted his cornfields (535 acres) with a driverless tractor. In 2019, under the banner of his fledgling company, Sabanto,[8] and alongside business partner Craig Rupp, co-founder of 640 Labs, Laird aims to plant 10,000 acres of soybeans from Texas to Canada in a planting demonstration of equipment utilization and robot efficiency.[9]

8 https://www.linkedin.com/in/kylerlaird/
9 https://www.facebook.com/lairdscape/

Laird's "tipping point" analogy rests heavily on the marked decrease in hardware prices over the past decade. "I see more and more DIY. We've got access to cheap RTK and GPS, and that hasn't been the case before, and now it's a big difference. Anybody can buy a Raspberry Pi for $30 and put together a system. The tech has been there for 30 years, but now it's off-the-shelf easy items. Almost anyone with a technical bent can do it or quickly learn how to do it."

"One guy has to make a guide sheet and explain what hardware is needed, where to get it, what software to download, how to build it, and go. Once one person does it, it's over," says Kyler Laird. (Photo credit: Anne Bartlett Photography)

Laird is frequently contacted by producers trying to save costs and steer away from subscriptions. "Often, guys don't want to spend $4,000 on a guidance system and they're frustrated by the expense of subscriptions. They want something that's cheap, but works and is functional. Like never before, that is now possible. Then there are guys who aren't necessarily as concerned about price, but really want more control, and that's exactly how I personally got involved with automation: I wanted control."

The open-source collaboration of farm technology is set to jump, Laird contends. "You're going to see more projects like AgOpenGPS. Someone is going to come in and start banging out better hardware for these type of projects, and it's going to make things very accessible for a lot of people."

Laird cites the success of Purdue University's[10] open-source ISOBlue, comparing its functionality at a level similar to FieldView.[11] A significant open source issue is hardware access and setup, he explains: "One guy has to make a guide sheet and explain what hardware is needed, where to get it, what software to download, how to build it, and go. Once one person does it, it's over. For some people, there's no reason to buy systems of any kind when they can build for much less."

10https://www.isoblue.org/
11https://climate.com/

Matt Reimer

What did it take to make a driverless tractor in 2015? A batch of free software, some drone parts, a tablet, and one curious farmer to cobble the bits together. Matt Reimer, 31, built automated controls for his John Deere 7930 and uses the driverless vehicle to haul a grain cart during harvest.

"I still think grain harvest is one of easiest areas of ag to automate. I've seen where one tractor operates behind another, with the lead tractor having a driver, while the second tractor is automated. That makes sense to me for the future. I don't see dropping a machine in the field and letting it go entirely solo, but I see automation always needing a person in a lead vehicle to solve problems."

"We're at one of those times where tech reaches a point and people figure out how to combine things from multiple sources," explains Matt Reimer. (Photo credit: Matt Reimer)

A pioneer in automated tractor technology, Reimer[12], 31, farms in Killarney, Manitoba, and makes heavy use of Arduinos, monitoring tank fluid levels, controlling water pressure, and operating pumps. In addition, Reimer installs sensors and writes the instructions in code to turn on warning lights, and send texts or emails.

12 https://diydrones.com/profiles/blogs/reimer-robotics-autonomous-tractor

"I've sometimes felt I've worked in a vacuum, but it is always surprising when you find out somebody is working on something similar and you can see how your efforts have helped. We're at one of those times where tech reaches a point and people figure out how to combine things from multiple sources."

Currently in the market for a new tractor, internal cab component costs are a heavy source of frustration for Reimer: "It's $20,000 or more to set up autosteer and a lot of the time it's just a software unlock code to make the tractor work with other current equipment or your desired level of GPS activity. It's mind boggling to pay for hardware and then have to pay for an unlock code."

Steering and implement control via monitor is an area ripe for upset in the ag market, Reimer asserts. "Monitors might cost $7,000 or more, but do nothing more than an iPad. Someone is going to figure out how to stick an iPad in a tractor, open a single app, and let it do everything. In turn, that opens the door to developers all over the place instead of specific dedicated hardware. In the near-term, instead of dedicated monitors, we're going to have iPads for a tenth of the cost and still be connected to the net."

Perry Casson

Perry Casson, 54, part of an emerging group of growers versed in farming and computer technology, grows small grains—barley, canola and wheat—near the town of Medstead in west-central Saskatchewan.

In 2015, he owned a three-combine fleet, but lacked a single working yield monitor. The gap drove him to build an affordable monitor that uses a display most farmers already own, a smartphone. Casson's DIY prototype resulted in a commercialized product which debuted in 2018—FarmTRX,[13] an easy-on-the-wallet yield monitor system costing under $2,000.

13 https://www.farmtrx.com/

"This started when I had a measurement problem on my farm and I had the tools to fix it. My tool kit is a bit different than what many consider typical for a farmer in terms of things like hardware design and software development, but the tools to build these kinds of things just get more accessible all the time. A younger, more tech-savvy breed of farmer makes me pretty confident this is just beginning."

Recently, Casson wanted a test platform for a new RTK GPS receiver he and his team are working on, so in 2018, he began crafting a self-driving mower to cut his airstrip using drone technology and open source software packages. "It's almost an assembly process and not an engineering job. So much has already been figured out for you."

Casson is planning to test the mower in spring 2019. "Guys have already done this; I'm just following in their footsteps to build one for myself and wanted a useful device that allowed us to test some things. It's so cool because technology like this is already good enough to build useful machines for the farm and it's only going to get better."

Jared Schott

Driving an Allis-Chalmers D17 across his South Dakota farm lot in mid-January, exposed to a heavy wind and snow, agriculture's version of MacGyver isn't averse to old equipment; he thrives on it. Jared Schott, 50, grows 2,000 acres of corn, soybeans, sunflowers and wheat (in addition to Limousin cattle and commercial Angus) on land just west of the Missouri River and north of the Grand River at the north-central tip of South Dakota. Equal parts farmer, rancher and tech cowboy, Schott is hard-wired to improve the mechanical components of his operation, and he's done so with a never-ending DIY stream.

South Dakota producer, far left, is hard-wired to improve the mechanical components of his operation, and he's done so with a never-ending DIY stream. (Photo credit: Jared Schott)

Whether spending $20 on old backup cameras and monitors to create an equipment surveillance system to monitor booms, hoppers or belts; building an automatic gate entry for pasture access with parts from a remote control vehicle and lawnmower axles; or creating an online database (shopdrusa.com) with a $15 barcode scanner to search his inventory with a smartphone; Schott is equally comfortable behind a keyboard, in a cockpit, on a tractor, or in the saddle.

Schott graduated from college in the middle of a tough farm economy in 1991, and walked into the tech world, unaware his farming absence was merely an interval. He worked for several digital companies, moonlighting as a mechanic in a Harley Davidson store (and getting paid in motorcycle parts). Kodak caught wind of Schott's ability and sent him to Washington, D.C., where he was contracted to work on software at the Treasury Department, Justice Department, Pentagon, and Quantico. All the while, Schott learned skills to use on his farm 1,500 miles to the west. At night and on weekends, Schott built his own airplane using ribs from Cubs and other old models, and eventually dropped in a drone engine bought from a military testing facility. Built and flight-tested in D.C. just after 9-11, the aircraft currently plays a big role on Schott's South Dakota operation.

Farmers need a "go-to" forum for inventions and innovation resources, Schott contends. He wants to create a website (farminvent.com) as a central repository of agriculturally-related tech ideas. "I want to build a database of farmer inventors, with an app as well, so guys looking for a particular type of farming invention can find it easily: Machinery, 3D printing, robotics and everything else."

Each winter, Schott searches for like-minded innovators and DIY opportunity. "We're looking for ways to build profit per acre. Farmers are the best resource for other farmers."

In 2018, he bought a FarmTRX yield monitoring system for a 1680 Case IH combine, and hopes the device is part of a coming wave of similar cost-effective technology. Schott adheres to used equipment, purchases old combines at $5,000 or less, makes all necessary upgrades, and drives them until they die. "It's extremely expensive for the average farmer to buy in to new technology. I see more guys getting bold with their shop solutions and there is some impressive stuff out there. I think some of these guys didn't have the opportunity to farm out of college, and were trained in electrical engineering and similar fields. Now they're coming back with expertise and connecting it to technology already available."

Jim Poyzer

Jim Poyzer grows corn and soybeans outside of Boone, Iowa, and is crafting back yard digital solutions with a keyboard and hammer in hand. In 2012, ahead of the DIY curve, he spent $300 and used a microprocessor to build his own planter monitor for a 1969 John Deere 7000 planter with adjustable corn meters. In the spring of 2015, he began experimenting with variable rate technology to compensate for sandy areas of lower production in his fields, and wrote a GPS-responsive program to plant according to prescription.

This spring, Poyzer is building a mesh network (eight monitors) of temperature sensors and moisture probes that will report data to his smartphone and website (outfarming.com). Each monitor, including a case made by Poyzer on a 3D printer, costs less than $50. "For such a low cost, I will be able to know the condition of my fields before planting. As I continue to learn about mesh networks and sensors, I plan to post and basically give away the code I'm using and how to hook it up."

Iowa grower Jim Poyzer is building a mesh network (eight monitors) of temperature sensors and moisture probes that will report data to his smartphone and website. (Photo credit: Jim Poyzer)

Initially, Poyzer, 68, delved into 3D printing to connect electronic flow meters together. “I have liquid fertilizer on my planter, both in-furrow and 2x2x2. I’m migrating it all to electronic monitoring. The flow meters hook on my planter and talk to a tablet with an app showing the flow so I can monitor exactly what is happening.”

Currently, Poyzer is fine-tuning a RTK system with a fixed base and a rover. Beside his workbench, he has a box of parts for an RTK correction system that uses a cellphone to receive data, instead of a base station, getting a free correction service from a local airport. “It’s an extremely accurate alternative to a base station. The comparable price off the shelf from a major player was $10,000-$15,000 plus a subscription cost. My parts? Somewhere in the range of $350.”

Poyzer’s 3D printer (Creality Ender 3) cost $200, and the farm applications are “simply amazing,” he describes. “With 3D CAD software I can make almost any shape and even put in threaded holes. I’ve watched YouTube videos on how to make things out of plastic, place them in a mold, and then remold them in aluminum. I can print objects as large as 9”x9”x10”. This is no toy; this is a tool for me.”

Learn Code, My Child?

Considering the pace of change, what skills might tomorrow’s farmers need? Start with the basics, Laird advises. “Just begin a kid with the basics of code and programming. As things develop, I think you’ll be able to order hardware and it’ll be just a matter of putting it together; you won’t have to know everything. A basic understanding of code and programming is a valuable tool so you can jump in and change or fix the pieces when needed.”

Schott sees an inevitable move toward code instruction: “I can’t imagine any engineering side of any college not teaching you to buy a $20 processor off Amazon and being able to write some code. Kids in kindergarten are going to be able to do this at a basic level. To be able to write code and write your own custom application is going to be very advantageous.”

Reimer believes a mixed skillset will be necessary, but remains uncertain as to what pieces will be most vital. “It’s tricky predicting what a farm kid today needs for tomorrow. Knowledge of programming and mechanical ability is going to factor in, but I’m not sure at what level.”

“It’s tricky predicting what a farm kid today needs for tomorrow,” says Matt

Reimer. “Knowledge of programming and mechanical ability is going to factor in, but I’m not sure at what level.” (Photo credit: Matt Reimer)

The Big Tomorrow

How does the near future shape up for DIY, open-sourcing, automation and innovation? Tischler sees huge growth potential in weed control. “One big area for future application is robotic crop tending; making your own computer vision to remove everything but the crop. I don’t say this because chemicals are bad, but because we are running out of chemical options. Herbicide resistance may be an area that benefits from automation that people aren’t thinking about.”

Another of Tischler’s concerns: variable rate prescriptions. “The software for VR is so locked up. We send data to the cloud and then a company comes up with magical prescription based on who knows what. Instead, I want automation to get the farmer directly involved in deciding what rates and where to apply.”

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“Just begin a kid with the basics of code and programming,” advises Kyler Laird. “As things develop, I think you’ll be able to order hardware and it’ll be just a matter of putting it together; you won’t have to know everything.” (Erielle Bakkum Photography)

Agriculture is entering a period of unprecedented opportunity for DIY farmers or modest engineering firms to develop technology, according to Casson. “This is a golden age. All kinds of robotics, sensing, and communication technologies are just so accessible now. Literally, there are parts out there that now cost $100 that cost $10,000 just a few years back. It's going to be a fun next 25 years and I want to be around for it."

A large increase in intensive farm management is coming, Reimer adds. "I think we'll still go out and plant a single crop in a section, but we're going to seed at different rates and apply chemicals at different rates. I think smaller, automated machines will be involved, but we are quite a ways away from that whole package. DIY is on the uptick, but even if a given innovation works on a farm, it's still very tough to convince other guys. However, if something genuinely helps with profit, then other guys eventually will follow."

"Put yourself in the position of using a horse when then stationary engine came out," Reimer concludes. "In hindsight, it's always obvious where technology is going, but it's not so easy to predict in the moment."

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Chang'an: 3D Printing Cyberpunk Town on Pearl River Delta

by Vicky Xie, David Li, and Kangkang Zhang

The back alleys of Chang'an are full of small shops of industrial materials and services like laser cutting, welding. Photo Credit: Kangkang Zhang

"I wanted to make room for antiheroes."

– William Gibson

The township of Chang'an (东莞长安镇) sitting in the border of Shenzhen and Dongguan has emerged as the 3D printing capital of China. Design and engineering firms around China sell off their in-house 3D printer to use the services of hundreds of 3D printing firms. Chang'an was not a result of elaborate developments of high-tech advanced manufacturing centers. It emerged from its unique labor development practices that leverage the advanced digital fabrication capacity, open learning contents on the Internet, and collaborative business models. The practices turn a large pool of low-skill laborers from the villages into modern multi-skills professionals with continuous just-in-time learning and entrepreneurs. With the story of Chang'an, we present an alternative to the popular dystopian narratives of advanced manufacturing technologies such as 3D printers, open access to learning content on the Internet, and how communities benefit from the technologies and materials.

The advanced production technologies like 3D printing, automation, AI, and robotics have been touted as the destroyers of "low-skill" jobs. The dystopian vision has been articulated and promoted through articles, news, novels, movies, and memes. 3D printers caught the public attention a decade ago and have generated imaginations and speculations about their potential to transform the landscape of manufacturing, ranging from the end of massive centralized production to the displacement of low skill manufacturing labor. Countries rushed to establish advanced additive manufacturing centers and cities invested into makerspaces in order to ride the wave of this "new" industrial revolution. However, after a decade of explorations, discussions, and experiments with these advanced tools, most of these facilities still struggle to survive without sustainable business models.

In the meantime, Chang'an emerged from the Pearl River Delta region of Southern China to become the 3D printing capital of China in a human-centric approach to the adoptions and applications of the technologies. Instead of advanced manufacturing machines replacing low skill labor, the technologies empowered the people traditionally destined for assembly line work to acquire new skills rapidly with continuous just-in-time on the job learning. And the transformed labor forces propelled Chang'an to the 3D printing capital leveraging the technologies of modern additive manufacturing, Internet content sharing, and e-commerce.

The 3D Printing industry in Chang'an is just one example of how advanced technologies in manufacturing and production have helped communities in the small towns around China developing their economics and business. These small towns take advantage of the cutting edge automatic machines to make up for their lack of industrialization and trained labor. The advanced production machines level the playing field for small towns to compete with large industrialized cities.

The key to development is empowering the right communities to take advantage of the newfound capacities of the automated machines. In the case of Chang'an, instead of college graduated engineers and designers, 3D printers empowered junior high school graduates to compete for the same works with the just-in-time online learning and open content. Additional two external factors that enable the concentration of the 3D printing service industry in Chang'an are the extensive and efficient logistic networks and the popularity of e-commerce.

The take away from Chang'an experience is the human-centric approach to the adoption of new technologies. The eager and entrepreneurial young kids make the 3D printing business flourished. The techs come and go, but the human ingenuities are here to stay. One of the entrepreneurs in Chang'an says, "3D Printing may obsolete in a few years, but I believe that there will always be new winners in Dongguan. We've never been afraid of new technology. People will always find new opportunities with technologies in Dongguan."

"The cooperation is a win-win. Another PRD farmer has the opportunity to teach himself to become a mechanical engineer."

Kangkang Zhang shared his journey to Chang'an and his thoughts.

I work for a rapid prototyping services company, which helps the clients to iterate their product prototypes in the development phase until they are ready for manufacturing, especially in creating the molds. We help our clients from small earphones to large parts like a dashboard for automobiles. 3D printing is an essential tool for us.

The company purchased an industrial-grade SLA (Stereo Lithography Appearance) 3D printer, which worked well until 2017. The cost of operating the 3D printer in-house including labors, materials, and utilities, increased to about RMB 1 per gram for us. This is 50% more expensive than the 3D printing services provided by vendors in Shenzhen/Dongguan area. Our cost calculation did not even include the depreciation of the printer. This made me wonder what was going on in the Pearl River Delta. Were the 3D printing vendors losing money? 3D printing services in the PRD area are not only low cost but also high quality with service.

I had a client from my city with a last-minute urgent request at 8 p.m. He wanted to have the prototype ready by noon the next day. The client came to us because we were in the same city. But most of the people in my company already left at 8 p.m. and cannot help the client in-house. I thought why not give the vendor in Dongguan a try. I contacted the vendor and they started the printing job by 9 p.m. and finished the printing by 12 p.m. At 1:30 a.m., KY Express picked up the package in Dongguan, the package arrived in my city at 7 a.m. and in my office by 8 p.m. with plenty of time for us to do a last-minute check before handing it over to our client.

I was amazed when I got the package. Dongguan was not 2000 kilometer away but right next door. The concept of speed was also different from vendors in Dongguan. In China, our clients sometimes asked us to use SF Express (DHL/FedEx equivalence in China) for speedy delivery. But when I asked the Dongguan vendor, he said, "SF is too slow. We use KY Express." KY Express is an express air delivery service.

Even with the logistic costs, 3D printing shops in Dongguan still deliver the same prototype with high quality and excellent service at 50% of our in-house cost. How could that even be possible? I decided to find out and went to visit the supplier in August 2019.

Experiencing Cyberpunk in Chang'an

To visit Chang'an town, I first flew to Shenzhen, the Silicon Valley of China. Shenzhen is a modern metropolis of 20 million and the global innovation hub of information and communication technologies. It was easy to get to Chang'an from Shenzhen. I hopped on the Metro Subway Line 11 all the way to the end station Bitou and took a quick cab ride.

I arrived at Chang'an around 8 p.m. and settled down in a hotel near the bus station. After putting down my luggage, I went out for a quick dinner. The streets were rural, and the atmosphere was a bit worrisome for me. I worried a bit about being robbed walking to dinner. Chang'an was known for its prosperity and expensive housing. But what I saw was a rural town with empty streets at 9 p.m.

Walking a block or two from my hotel, I came to a major intersection and waited for the light for 3 minutes before I could cross. The road traffic was non-stop with semi-trucks, large trucks, and small vans all heading to Shenzhen. Later on, at dinner, I learned that the traffic would go all night long, every night, carrying finished Dongguan products to the Shenzhen seaports and airports.

Chang'an's busy traffic to Shenzhen airport/seaport at midnight. Photo Credit: Kangkang Zhang

When I walked back to my hotel after dinner, I was a bit disoriented about Chang'an with its super busy main roads and ghostly back streets.

"Unlikely" 3D printing engineer

3D Printed Ultraman mask tutorial. Source: 宁大侠饶命 on Bilibili

The next morning, I went to visit my 3D printing supplier. The engineer I had been working with for months came out to greet me and lead me to their "studio" inside a private home. I was a bit shocked when I met him. I envisioned him being a hipster designer but instead, he was in a wife-beater, shorts, and flip-flops with partially dyed hair and a gold chain necklace. He looked like a young lad on the factory assembly line than a 3D printing engineer I usually worked with. It was surreal.

3D printing service is not a simple job. To be a 3D printing engineer, one needs to have the following skills.

- Understanding of the 3D printing technologies: DLP, SLA, and all types of different 3D printing technologies suitable for the projects at hand.
- Familiarities with the material properties: each process

corresponds to a variety of materials, according to customer needs. They need to choose the material that meets the needs at the best cost

- 3D modeling: people do specialized modeling, but printing services often require simple 3D modeling operations. Examples include shelling, drilling, thickening, closing surfaces, cutting, scaling, merging, and more.
- Sales skills: engineering and sales are two jobs in one and require simple business conversation functions to instill trust in the other person.
- Post-processing skills: the direct output from 3D printers needs to be post-processed to make high-quality prototypes. The engineer has to be familiar with scrubbing, sanding, painting, etc.

In my mind, a 3D printing engineer would require at least a bachelor's degree in mechanics and has at least two to three years of working experience. They also need to command a mixed skillset of engineering, design, and art. And with the rapid on-demand requests from the clients, they often work irregular hours and long graveyard shifts. In major cities, the salary of such talents started at RMB 10,000/Month ($USD 1,500). This may not sound much for people working in major urban areas, but labor cost is often a critical and competitive advantage in the world of production.

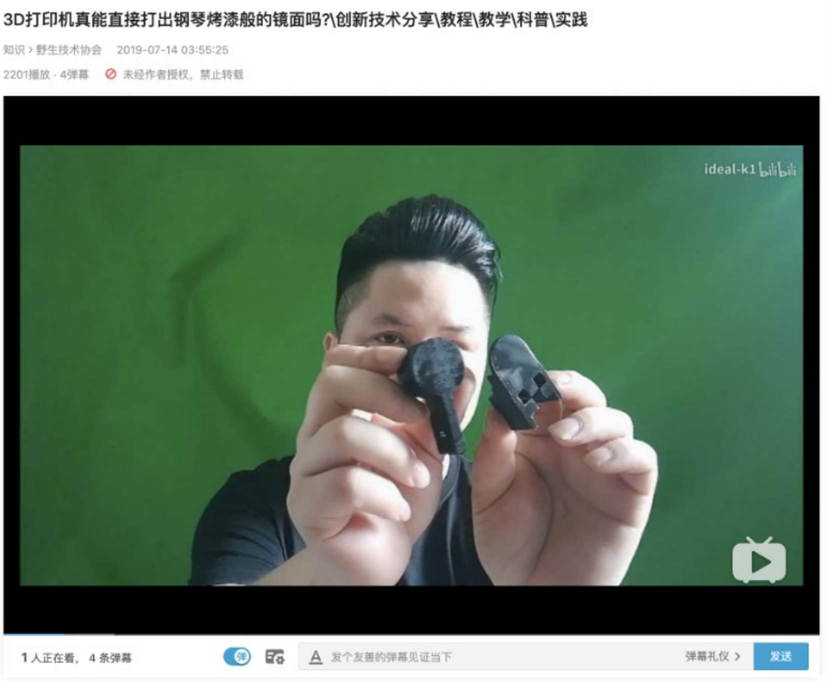
I am curious about how they manage. I sit down with a young supervisor, and here is our Q&A.

Q: Where did you recruit these people?
A: We recruit graduates from junior high schools from the surrounding villages. We had also recruit college graduates, but they were not very good at the jobs. The college graduates asked too much and delivered little.

Q: How did they learn these skills?

A: We have an apprentice program, and they learn on the job. About three out of ten people can master the skills.

Q: What about 3D modeling? They surely need to take some of those courses in college.
A: There are tons of tutorials on the Bilibili site with detailed and step-by-step instructions. Note: Bilibili is a popular entertainment site for Chinese teenagers. It has a lot of fans-generated videos.



Bilibili 3D printing channel ideal-k1 teaches how to make piano varnish finish on 3D printed objects.
Source: ideal-k1 on Bilibili

Q: How much do they cost?
A: We started them with RMB 2000 in salary plus commission on every job completed.

For these young kids, mastering the 3D printing skills through the apprenticeship is not that much different from mastering cooking and crafting. They see 3D printing just as a skill to learn to make a living. They are patient and take the time to master each one of the skill sets.

Q: How do you keep the talents with this kind of salary while you have such intensive and irregular working hours?

A: When they come here, they have opportunities to learn, get paid more as they master new skills, and work a desk job in an air-conditioned office. They are free to play games or watch videos when they are waiting for printing jobs. The alternative is to take a tedious sweatshop job in the factories with little opportunities to advance.

Q: Are you frustrated with long hours and heavy workloads with little time to yourself?
A: We love to work hard and strive for success.

At this point in the interview, I felt like visiting an alternative reality different from the life experience in the major cities. I took a quick break from the meeting to process what I just heard.

A: You guys work longer hours than the infamous 996. Do you feel exploited by the boss?

First, he didn't know what 996 was, so I had to explain it to him that 996 means companies nine am to nine pm and six days a week. A lot of employees in large Internet companies in the cities are fighting against this practice.

After my quick explanation, he replied: we don't have a boss here.

"NO BOSS!" I questioned him. He told me that he has been working for this company for three years with excellent performance. He cut a deal with the company for five industrial 3D printers with no deposit. The company does not set any performance targets and only asks him to pay a percentage of sales. There are many "contractors" like him working with this company and many other similar companies in this town.

For him, this is an opportunity of a lifetime, and he wants to work hard so he can contract more machines in the coming years. He can improve his parents' lives back in the villages and make them happy when he visited them during the Chinese New Year holidays. With this arrangement, the companies can reduce operational labor costs, manage overheads, and work with motivated and entrepreneurial "partners."

He enjoys and treasures the opportunity. The alternative for him is to stay in the village and be a peasant.

Are the hard work and long hours still exploitation when one has no clock to punch at work, no boss, no performance KPI requirements, and no risk of fixed assets like expensive industrial 3D printers and material inventories. For the companies offering partnerships with "contractors," they reduce the operational costs and management overhead. Working with hardworking partners, the companies optimize their fixed-asset investment in printers and material inventories.

Soil for manufacturing innovation

While 3D printing has been promoted globally as advanced next-generation manufacturing, the booming 3D printing industries in Chang'an are still considered low-end manufacturing where unskilled laborers can be trained on the jobs to complete these tasks competitively.

While the advance of the manufacturing industry in the Pearl River Delta and in China cannot rely only on these low-end manufacturing industries, these low-end manufacturings, like seaweed in the sea, are providing rich nutrients to support the innovation in the ecosystem. With their support, PRD companies like DJI drones and BYD Automobile can innovate faster than their global counterparts with their speedy and cost-efficient support.

Even some of the 3D printing works from Toyota and Honda in Japan are now outsourced to the 3D printing industry in the PRD, and the business is increasing. Because even accounting for shipping time and cost, it's still more cost-effective and faster than local processing.

Not just socks and toys

While the 3D printing services in Changan are considered "low-end manufacturing," it is different from the traditional low-end assembly, such as sock knitting or toy making. The industry needs multi-skilled talents that could be trained on the job and also learn from open resources.

Take 3D modeling as an example. Changan has a large pool of junior high school graduates thanks to the nine years of compulsory education that give the students the necessary skills: reading, writing, and mathematics. Bilibili offered open access to learning resources and produced by peers in the industry with step to step learning instructions. Build on top of this, Changan and 3D printing offer large numbers of people a new path of life and professional development. Young kids with poor school scores in rural villages destined to work in assembly lines or agriculture can now find another way.

Humans at the center of 4th Industrial Revolution

3D printing has been promoted as the technology to decouple the world from China as the world's factory. However, Chang'an presents a reality check - it not only counters that narrative but also offers a peek into the future of manufacturing. As the manufacturing machines become smarter, the laborers need to evolve with them.

Let’s ask three questions.

- Is Southeast Asia prepared enough to produce "multi-skilled labors” to take over such "low-end smart manufacturing"?
- Can a 40-year-old unemployed American ex-autoworker be retrained for such multi-skills jobs?
- And the last question, is there any other place in China outside of PRD that could compete with Changan on 3D printing service?

After seeking the answer to the last question, our company sold that industrial 3D printer and depended entirely on our supplier's services. The cooperation is a win-win. Another PRD farmer has the opportunity to teach himself to become a mechanical engineer.

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05

Cosmolocal Explorations

Wind Empowerment, Pico-hydro and Nea Guinea[1]

1 http://neaguinea.org/

The following chapter features excerpts from Kostakis, V., Latoufis, K., Liarokapis, M., & Bauwens, M. (2018). The convergence of digital commons with local manufacturing from a degrowth perspective: Two illustrative cases. *Journal of Cleaner Production, 197: 1684-1693. Doi: 10.1016/j.jclepro.2016.09.077*

Introduction

Small-scale off-grid renewable energy systems, frequently encountered in rural households or village communities, can utilize devices like solar panels, hydroelectric plants and small wind turbines depending on the resource mix of the area.[2] Although a well-sited small wind or hydroelectric turbine may produce much more energy than a solar panel of the same rated power,[3] these technologies have higher capital costs, require significantly more maintenance due to their moving parts[4] and at some point in their lifetime will require the replacement of a component, which might often be difficult to obtain.[5] Locally manufactured small wind turbines and pico-hydroelectric plants aim to address such issues by deploying an alternative process of designing and manufacturing, based on the engagement of the end-users and the support of relevant community networks.

2 Patel, H., Chowdhury, S., (2015). Review of technical and economic challenges for implementing rural microgrids in South Africa. *IEEE PowerTech Eindh*. Conf.
3 Kabalan, M., Anabaraonye, B., (2014). Solar photovoltaic versus micro- hydroelectricity: a framework for assessing the sustainability of community-run rural electrification projects. In: *IEEE Global Humanitarian Technology Conference* (GHTC).
4 Kuhn, P., (2010). Small Wind Turbines: Operating Experience & Yield Assessment. *World Summit for Small Wind*, Husum, Germany.
5 Leary, J., Howell, R., While, A., Chiroque, J., VerKamp, K., Pinedo, C., (2012a). Post-installation analysis of locally manufactured small wind turbines: case studies in Peru. In: *IEEE Third International Conference on Sustainable Energy Technologies (ICSET)*, September 2012. Kathmandu.; Ferrer-Marti, L., Garwood, A., Chiroque, J., Escobar, R., Coello, J., Castro, M., (2010). A community small-scale wind generation project in Peru. *Wind Eng.* 34, 277-288.

Hugh Piggott, a widely acknowledged expert in small wind energy, has been living in the remote off-grid community of Scoraig in Scotland since the mid-1970s. He started experimenting with household wind-energy systems manufactured from parts that could be salvaged from the scrapyard of the nearest town. Gradually he developed a design which could be locally manufactured with simple benchtop tools and techniques, using mostly locally sourced materials. Piggott documented the efficient wind turbine designs he had developed and their manufacturing techniques in a construction book manual that describes the manufacturing process of six small wind turbines of rotor diameters from 1.2 m to 4.2 m (with rated power of 200 W and 3 kW respectively).[6] The construction of such a wind turbine requires a group of five to eight people, without previous experience, to work for about five days to manufacture it from scratch. The wind turbine blades are made out of local varieties of "soft-wood", which are hand-carved with basic woodworking tools. The axial flux permanent magnet generator has a unique disk topology which facilitates simple manufacturing of the stator windings and the rotor magnet disks, while the wind turbine's moving parts are mounted on the wheel-bearing hub of a car that can be recycled from an old vehicle.[7] All materials used in the manufacturing of the wind turbines can be found in the local markets of most medium-sized towns, apart from the magnets, which need to be ordered from specialized online dealers.

The performance characteristics of locally manufactured small wind turbines, such as power curve, annual energy production and wind-electric system efficiency, have been monitored and found to be similar or better when compared to commercial small wind turbines available on the global market.[8] The total cost of manufacturing and installing a wind turbine with a 2.4 m rotor diameter (Fig. 2) would amount to $1700 (including the tower, foundations and electronics).[9] This is a 65% reduction in the purchase cost when compared to a commercial wind turbine system of the same status

6 Piggott, H., (2008). *A Wind Turbine Recipe Book: the Axial Flux* Windmill Plans. Self- publication.

7 Piggott, H., (2008). *A Wind Turbine Recipe Book: the Axial Flux Windmill Plans*. Self- publication; Bartman, D., Fink, D., (2008). *Homebrew Wind Power.* Buckville Publications LLC, Masonville, CO; Latoufis, K., (2012). Open-source hardware small wind turbines as a technology for sustainable degrowth. In: *3rd International Conference on Degrowth Ecological Sustainability and Social Equity*, 19-23 September. Venice, Italy.

8 Latoufis, K., Pazios, T., Hatziargyriou, N., (2015a). Locally manufactured small wind turbines: empowering communities for sustainable rural electrification. *IEEE Electrification Mag.* 3 (1), 68-78; Sumanik-Leary, J., Piggott, H., Howell, R., While, A., (2013). *Locally manufactured small wind turbines: how do they compare to commercial machines?*. In: Proceedings of 9th Ph.D. Seminar on Wind Energy in Europe, September 2013. Uppsala University Campus, Gotland, Sweden.; Mishnaevsky Jr, L., Freere, P., Sinha, R., Acharya, P., Shrestha, R., & Manandhar, P. (2011). Small wind turbines with timber blades for developing countries: Materials choice, development, installation and experiences. *Renewable Energy,* 36(8), 2128-2138.

9 Latoufis, K., Pazios, T., Hatziargyriou, N., (2015a). Locally manufactured small wind turbines: empowering communities for sustainable rural electrification. *IEEE Electrification Mag.* 3 (1), 68-78.

supplied from a low-cost but trustworthy manufacturer.[10]

Fig. 2. A locally manufactured small wind turbine of rated power 600 W at 10 m/s, able to produce energy of 1270 kW h/year at a 5 m/s mean wind-speed location.

Additionally, when the net present cost of a locally manufactured small wind turbine and a commercial equivalent are compared (Fig. 3), it is found that locally manufactured technology can offer savings of 20% over the lifespan of the system.[11] Similarly, the locally manufactured small wind turbine has

10 Christensen, K., (2012). Nordic folkecenter for renewable energy. In: *Catalogue of Small Wind Turbines*, sixth ed. World Wind Energy Association, Chinese Wind Energy Association, Denmark: FC Print.
11 Sumanik-Leary, J., Piggott, H., Howell, R., While, A., (2013). Locally manufactured small wind turbines: how do they compare to commercial machines?. In: *Proceedings of 9th Ph.D. Seminar on Wind Energy in Europe,* September 2013. Uppsala University Campus, Gotland, Sweden.

a significantly lower electricity cost than the commercial turbine, with a Levelized Cost of Energy at 0.95$/kWh, as opposed to 1.23$/kWh of the commercial equivalent.[12] Since locally manufactured small wind turbines can be manufactured by non-experts during training courses, labor costs expressed in monetary terms are usually non- existent, thus enabling low-income communities to access this technology. Furthermore, the locally manufactured small wind turbine produces more power at lower wind speeds, which are more frequent in most sites, consequently making this turbine more compatible with the energy demand of an off-grid system.[13]

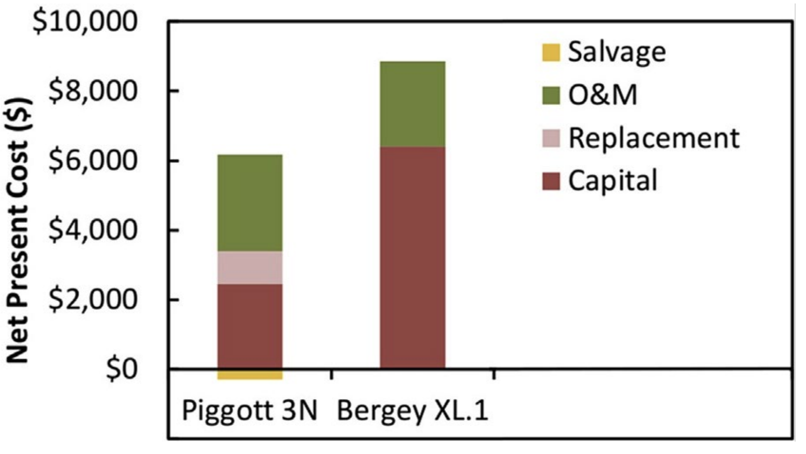

Fig. 3. Net present cost by system component with a used discount rate of 10% (O&M stands for Operation & Maintenance; Piggott 3N is a locally manufactured small wind turbine; Bergey XL.1 is a commercial small wind turbine) (Sumanik-Leary et al., 2013, p. 5).

Piggott's open-source designs have propelled the creation of a global network of designers, manufacturers and users of locally manufactured small wind turbines.

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12 Sumanik-Leary, J., Piggott, H., Howell, R., While, A., (2013). *Locally manufactured small wind turbines: how do they compare to commercial machines?*. In: *Proceedings of 9th Ph.D. Seminar on Wind Energy in Europe*, September 2013. Uppsala University Campus, Gotland, Sweden.

13 Sumanik-Leary, J., Piggott, H., Howell, R., While, A., (2013). *Locally manufactured small wind turbines: how do they compare to commercial machines?*. In: *Proceedings of 9th Ph.D. Seminar on Wind Energy in Europe*, September 2013. Uppsala University Campus, Gotland, Sweden; Latoufis, K., Pazios, T., Hatziargyriou, N., (2015a). Locally manufactured small wind turbines: empowering communities for sustainable rural electrification. *IEEE Electrification Mag.* 3 (1), 68-78.

Fig. 4. A 500 W locally manufactured pico-hydroelectric plant.

Nea Guinea

One such group is Nea Guinea, a Greece-based non-profit organization interested in community resilience and self-sufficiency. The renewable energy workshop of Nea Guinea started building locally manufactured small wind turbines with the aim to provide the back-to-the-land movement in Greece with appropriate knowledge and tools to achieve a transition to a more sustainable lifestyle.[14] Addressing the need of some of these farmers for inexpensive electricity production from pico-hydroelectric plants, Nea Guinea has developed a 500 W pico-hydroelectric plant (Fig. 4) for off-grid systems in cooperation with the Rural Electrification Research Group (RurERG) of the National Technical University of Athens. The latter uses Piggott's (2008) designs for manufacturing the generator, and the openly

14 Latoufis, K. (2014). *Reinforcing resilience and self-reliance of communities in degrowth*. In: The Case Study of the Renewable Energy Workshop of "Nea Guinea". *4th International Conference on Degrowth for Ecological Sustainability and Social Equity*, 2-6 September. Leipzig, Germany.

accessible designs for locally manufactured pico-hydroelectric casings and low-cost turgo runners of Joséph Hartvigsen.[15]

A prototype has successfully been in operation in a rural farm in Greece for the past three years without the requirement of any maintenance or spare parts. The hydroelectric plant uses 20 m of head and 5 l/s flow to produce enough electricity to supply the farmhouse with hot water for bathroom/kitchen use and enough energy for refrigeration, lighting, power tools, communications and a washing machine. So the hydroelectric plant satisfies all energy needs of the residents apart from cooking, for which they use natural gas, and heating, for which they use biomass. Compared to other commercial products of the same power rating, the total cost of this hydroelectric plant has been reduced by 50%.[16] Currently, there is promising experimentation with 3D printers and the use of recycled plastics for locally manufacturing the turgo runner.

Nea Guinea has manufactured three small wind turbines and one pico-hydro plant for different projects with the participation of the end-users. A grid-connected 1.8 m-rotor- diameter small wind turbine was constructed as a student project in collaboration with the National Technical University of Athens, which involved the reconfiguration of the generator in order to comply with a specific grid-tied inverter. The wind turbine was installed in the environmental summer camp of "Meltemi" in the outskirts of Athens as part of a pilot mini-grid. A battery-connected 3 m-rotor-diameter small wind turbine was manufactured in the workshop of Nea Guinea in Athens as part of an adult-education course and was installed in an already existing off-grid renewable-energy system in the eco-community of "Spithari" in Marathonas, after reconfiguring the generator to the appropriate battery voltage. An AC-coupled 2.4 m-rotor-diameter small wind turbine was manufactured in Athens in order to be installed in an organic olive farm in Filiatra as part of an off-grid hybrid system. The generator was reconfigured to operate with the grid-tied inverter used in the system, and the wind turbine rotor was sized according to the mean wind speed of the area. The small wind turbine was once again manufactured as part of a training course for adults in the Nea Guinea workshop. Finally, a pico-hydro plant was designed for a permaculture mountain farm, as the wind and solar resources in the area were not adequate, while the hydro resource was abundant. The wind-turbine generator was recon- figured to operate with a turgo runner for direct battery charging.

The pico-hydro plant was initially part of a student project in collaboration

15 Cobb, B., (2011). *Experimental Study of Impulse Turbines and Permanent Magnet Alternators for Pico-hydropower Generation.* Oregon State University (Master Thesis of Science in Mechanical Engineering).
16 PowerSpout, (2014). Retail Price List. Available at. http://www.powerspout.com/ (accessed on 5.04.16).

with the National Technical University of Athens and a derivative of that design was manufactured in the Nea Guinea workshop as part of a practical adult-education course and then installed on the farm.

Wind Empowerment

Piggott's designs, which have catalyzed the creation of this community-based technological network, are not patented and can be modified, improved, and/or replicated by anyone and for any use.[17] Moreover, the manufacturing process of six small wind turbines is described in his low-cost book manual, while digital copies are available on a donation basis.[18] A derivative design based on Piggott's manufacturing plans is the book manual of Otherpower from the US, which describes a similar manufacturing and design process, but with modifications for more demanding environments.[19] The designs developed by Otherpower are also shared with the Wind Empowerment network and other users through their website and online forum (Fieldlines.com).

All the organizations belonging to the Wind Empowerment network have their own local workshops, which are often open to the public for certain periods of time. During the educational construction courses held in these workshops, wind and hydro turbines are built on the demand of a user community, which provides the necessary funds for purchasing the materials. The end product is installed in the user community and is owned by them. For example, in the workshops of Nea Guinea, one can order a wind turbine by providing the funds for the materials, and it will then be manufactured during the next course. In this way, a global network of workshops can manufacture small wind turbines on-demand with the assistance of local organizations representing the network. This creates a network of spaces where the technology is advanced and better adapted to the local context. Furthermore, new knowledge is generated and then shared on relevant online fora, network events, online seminars and conferences. There are cases, however, when practical courses are held and small wind turbines are built without a specific installation in mind, as it is important to share the manufacturing knowledge and expand the network. Yet, this can create a surplus of small wind turbines which have no place to be installed, and in this case the local organization creates a campaign to find a "home" for these turbines.

In addition, the various educational approaches and scenarios are shared

17 Piggott, H., (2005). *How to Build a Wind Turbine: the Axial Flux Windmill Plans.* Self- publication.
18 Piggott, H., (2008). *A Wind Turbine Recipe Book: the Axial Flux Windmill Plans.* Self- publication.
19 Bartman, D., Fink, D., (2008). *Homebrew Wind Power.* Buckville Publications LLC, Masonville, CO.

through common projects in countries of the global South, where member organizations team up to execute a rural electrification project in a selected region with the aim of creating a regional group. A recent example of such joint educational activities is the Wind Empowerment project in Ethiopia, where V3 Power from the UK, Nea Guinea from Greece and I-Love-Windpower from Tanzania organized training courses in the Somali and Afar regions, in collaboration with the local NGO Mercy Crops.[20] The aim was to train students of local technical colleges, some previously trained as metalsmiths, carpenters or electricians, on wind energy and locally manufactured small wind turbines. The turbines constructed were successfully installed in rural communities in the region and are closely followed up with the support of the Wind Empowerment network. This takes place through the use of an open-access guide for the maintenance and service of locally manufactured small wind turbines and the support of the local NGO that facilitates the process.[21]

In terms of licenses, although the design manuals are technically open-source, they are not available under a particular commons-oriented license. The hardware itself is not patented, so anyone can build and modify the designs, which are in public domain. The level of awareness around the digital-commons discourse has been low within the global network interested in such technologies. It might be argued that the lack of an officially adopted commons-oriented legal framework does not mind engineers and hobbyists who already can freely experiment with the designs and build functional turbines without having to pay patent license fees. At the same time, modifications would be shared through online and offline fora and relevant manuals. However, several emerging commons-oriented hardware projects, which explicitly promote commons-based forms of property (such as the CERN or TAPR open-hardware licenses), have been triggering discussions among an increasing number of engineers and makers. It is currently an open question as to how a collective design and piece of hardware could be produced by the Wind Empowerment network and under what license it could explicitly be provided.

20 Latoufis, K., Pazios, T., Hatziargyriou, N., (2015a). Locally manufactured small wind turbines: empowering communities for sustainable rural electrification. *IEEE Electrification Mag.* 3 (1), 68-78.
21 Wind Empowerment, (2015). *Maintenance and Service Guide for Locally Manufactured Small Wind Turbines* (Version 2.11). Available at. http://windempowerment.org/maintenance-and-service-guide-2/ (accessed on 7.04.16).

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https://farmhack.org/tools

Farm Hack:[1] A Farmer-Driven Platform for Knowledge Exchange

Chris Giotitsas

Black Soldier Fly as a Feed Alternative for Aquaculture

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

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

Organisational Form

A brainstorming session

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

While the community grew, FH acquired a non-profit status in 2013. Having a legal form it managed to receive some funding through grants to make improvements on the platform and provide funds for the short term employment of two of its constituents, who worked on community outreach. After this point the community became more independent and decentralised and relied entirely on the support and time of its constituents as well as its partnerships with other organisations, rather than attempt to secure funding to employ people and acquire resources. This has, inevitably, led to reduced momentum, given the fact that everyone is contributing their time voluntarily. Yet the consensus in the community is that it should keep relying on the constituents' voluntary contribution rather than employ workers for its operations.

FH lacks any formal structure. As a non-profit it has a board of directors, however its role is mostly nominal. Instead, every member of the community is free to contribute to the decision making process. Practically, this means that the constituents most engaged in FH activities end up being the ones most involved in the organisational structure. It is a "do-ocracy" of sorts, as a FH member with a software development background put it. At the same time the platform has been incrementally improved over the years in order to provide a more easy and independent use to the users. Thus making, for instance, the tool documentation process better as well as providing a detailed template for users and affiliated organisations/groups to organise FH events autonomously.

Economic Model

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

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

The FH platform features an "open shops" component where "businesses and organisations invite other users in to see what they have been working on, the events they have hosted or will host, the tools they've worked on, and the conversations they've been involved with". Their ultimate goal with the open shops is to provide a simplified toolset for users or groups to sell their tools or components or even certain services. Commerce is considered important according to the FH ethos as "regionalised manufacturing makes for resilient economies and tools which are customized to a farmer's particular needs". [2]

2 Farm Hack, (2017), http://farmhack.org/wiki/getting-started

Mode of Operation

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

Farm Hack events

As previously mentioned the Farm Hack events were in the early years mostly organised and facilitated by the organisations involved with FH. Over time, as the community grew more independent and decentralised, a detailed guide for events was developed and featured in the platform to enable the constituents and affiliated organisations to host events. Certain requirements should be met for a successful FH event and the guide offers various suggestions to meet them. In general, these events are problem-solving oriented with various specific goals. For instance they may involve conceptual meetings to brainstorm new tools; collaboratively design, build, or document tools; skill and know-how transfer; software hackathons. Documentation of results, despite the type of activity, is always encouraged in order for the entire community to benefit from these events. Further these events are opportunities to attract new adherents and constituents and for existing ones to socialise.

Farm Hack platform

The Farm Hack platform is a software platform developed by community constituents with software development skills and it is based on various other open source tools. The platform serves both as a coordination and collaboration tool for the community and as a tool database for the ones that have been individually or collectively produced. These may not only be operational machinery. It might be a ready commercial product, a prototype, a do-it-yourself fix, a concept design or even an idea submitted for collective brainstorming. While there has been a steady influx of users and tools, the platform has not been very successful as a collaboration tool, with most of the coordination happening "behind the scenes" and the collaborative tool development taking place in physical spaces, like the events, rather than digital. Further, proper documentation of both processes and tools is an issue that the core group is trying to improve, as it is a time and effort consuming process. Updates in the platform are driven by community feedback as well as other content featured, like for instance the FH blog.

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

Note

*originally published as: Giotitsas, C., & Ramos, J. (2017). A New Model of Production for a New Economy. Source Network/New Economics Foundation.

L'atelier Paysan:[1] Peasants Building Their Own Tools

Chris Giotitsas

https://www.latelierpaysan.org/

L'Atelier Paysan literally translates as the "peasant workshop". It emerged in 2009 as a subgroup within an association for the development and promotion of organic agriculture called ADAbio in Rhone-Alpes (a region in the south east of France). It all began when the founders of this project Joséph, an experienced organic farmer and a member of ADAbio, and Fabrice, a very politically aware carpenter, realised that farmers could genuinely benefit from each other's tool-building experience and creativity. So they standardised, documented and disseminated three essential pieces of machinery that had been developed by Joséph along with other farmers and were utilised in permanent beds (one of the basic methods for soil management in organic agriculture). This effort was well-received by the farmers in their network so more tool-building knowledge was accumulated over the next three years from farms in the area. Sixteen farmer-build tools were standardised in total. Their designs were then printed in a comprehensive guide-book complete with blueprints and pictures, in order for more farmers to be able to construct them in their own farm.

Meanwhile, in 2011 the first workshop took place. The tools made by AP are, almost, entirely made of metal. Ten farmers attended the workshop to learn how to work metal (basically cut, drill and weld) and at the same time attempt to assemble some of the aforementioned tools. The workshop was quite successful with the farmers producing eight tools by the end of a week. At this point these farmers along with Joséph and Fabrice established

ADAbio auto-construction, which was basically the branch of ADAbio that was promoting the self-building of machinery by farmers. At the same time, first utilising various internship programs funded by the French state and later through regional state funds they managed to hire people with specific sets of skills to assist in their endeavour, like for instance engineers and political economy graduates.

After that, the first season of workshops began, where farmers learned metal-work and built the first three machines. Initially this activity was exclusive to their region but later expanded to others.

AP workshop participants prototyping a tool

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

Organisational Form

As already mentioned AP was initially conceived by a group of farmers led by Joséph Templier and Fabrice Clerc. Their activity was institutionalised through ADAbio, the organic farming association they were all part of, forming ADAbio Autoconstruction. Within ADAbio they managed to secure funds for paid internships and later regional funding to initially employ an engineer and a development officer. This enabled them to expand their activity and the number of farmers involved. Over the years it became apparent that ADAbio could no longer facilitate this operation so the decision was made to create the not-for-profit cooperative that was named L'Atelier Paysan. The structure of the organisation could be illustrated as an inverted pyramid with the cooperative at the top; the core group in the middle; and the executive team in charge of implementing the action plans at the bottom.

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

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

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

The size of the operational group of the cooperative is considered to be the ideal in order to facilitate the amount of activities decided upon by the cooperative. Should the need for further expansion come up, the group is reluctant to increase the size and complexity of its activities. Instead they propose the creation of more similar groups which would form a network of cooperation and solidarity.

Economic Model

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

At first mostly relying on the assistance of the founding farmers and some regional funds for rural development, over time the workshops became established providing an important source of income for the organisation. Contributions by farmers participating in the workshops form a large percentage of the budget. These contributions finance the development of new technology; the maintenance of AP's equipment; and support the participation of farmers that are unable to make a contribution. However, by tapping into a special mutualised fund for vocational training and skill development, AP manages to reimburse the contribution each farmer makes in most cases. At the same time, they buy raw material and equipment in bulk and then resell them to farmers below market prices but still making a very small profit. However, they do not manufacture or sell any of the machines that they produce.

Further, financial support comes from crowd-funding as well as various solidarity organisations. For instance, more than 20 groups belonging to the CIGALES association (solidarity financing groups from all over France) offer their support to AP. Last, important financial support (about 40% of the budget) comes from national and regional funds for agricultural development that have recognized AP's contribution to the development of agriculture in France. All of the financial activity is made public on the AP website.

Mode of Operation

The activity of AP is two-fold: on one hand they engage in research and development of new technology and on the other they disseminate technological know-how.

An AP workshop

Knowledge transfer

The first of the two main goals of AP is to enable farmers to create their own machines and tools. The AP is based in the region of Rhone-Alpes along with its branch in the Brittany region. However, they own three fully equipped trucks that function as mobile workstations which enable them to transfer their activity all over France. They conduct workshops that last 3 to 5 days in farms and warehouses. The nature, location and time of the workshops are defined by the farmers themselves at the end of each year according to their specific needs and time availability. The workshops are usually conducted by one of the engineers working for AP. There, the farmers are initially instructed on and familiarised with metalworking (basically drilling, cutting and welding). Then they collectively engage in the manufacturing of one or more machines following the comprehensive instructions drawn up by AP. All participants are urged to engage in all stages of the manufacturing process in order to acquire the full skillset required to be able to recreate it and, more importantly, to experiment, modify, improve and maintain their own machinery.

The farmers attending might have some previous experience but often they do not. They usually tend to be engaging in similar agricultural activity so the machines built in each workshop target certain needs of the specific group. The farmers that provide the funds for the materials get to keep the machine(s) at the end of the workshop. Some workshops are for prototyping purposes. In these, a certain piece of machinery is experimented upon and manufactured for the first time by the group of farmers that designed it along with the AP engineer that assisted them. The blueprints for the machine built each time are printed out along with lists of tasks and placed in a prominent position in the work space. These are used as points of reference by the farmers in the manufacturing process of the workshop. The level of detail allows the farmers to carry out the whole process themselves, with the engineer supervising and instructing when needed. Beyond observing and learning from each other, through these workshops, farmers can socialise and share ideas and tips with regards to their farming activity as

AP participant working on a machine part

these workshops are quite intensive and require them to spend several days together sharing meals and possibly lodging.

Technology development and dissemination

As previously mentioned, AP started as an attempt to gather, systematise and disseminate essential farm equipment created by farmers. This is still a primary goal for AP. For this reason, its people travel across the country, meeting with farmers and gathering information on farming equipment and as of recently farm buildings as well. This information is codified and uploaded in the AP forum for anyone to access them. Several groups and individual farmers have been inspired by AP and have created machines that were later uploaded in the forum. For instance the II Charimaraich 1118 is a machine built by a group of small-scale vegetable farmers called ALADEAR which was then featured in the AP forum. The forum post includes the design and pictures of the various versions of the machine. There are over 500 posts in the forum containing instructions and conversations regarding farm machines, methods and buildings.

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

A group of at least 5 farmers with a specific need or idea need to be gathered, since AP will not work with individuals. Then an engineer-facilitator is assigned to the project and the design process begins. After several meetings, feedback and exchanges a design is finalised and the prototyping process begins. The farmers need to be involved in every step of the way and the prototypes are produced after consensus is reached amongst them. The prototyping process is documented and uploaded in the AP forum. The farmers then test the prototypes in the field and, having acquired the necessary skills in the workshop, they make modifications and adjustments. After the testing phase is completed the AP engineer produces a complete and comprehensive blueprint for the machine which is then uploaded in the list of machines of the AP website. Yet AP points out that these designs are not final and it is up to the users to further develop them, according to their needs and knowledge. Indicative machines are the "Dahu" 19 a machine specifically developed for wine-makers with fields in steep slopes which is currently tested by the farmers, and the "Sandwich" 20, a tool for orchard cultivation created in collaboration with an organic agriculture group called GRAB.

**Note*

*Originally Published as: Giotitsas, C., & Ramos, J. (2017). A New Model of Production for a New Economy. *Source Network/New Economy Foundation.*

Open Bionics[1]

1https://openbionics.org/

The following chapter features excerpts from Kostakis, V., Latoufis, K., Liarokapis, M., & Bauwens, M. (2018). The convergence of digital commons with local manufacturing from a degrowth perspective: Two illustrative cases. Journal of Cleaner Production, 197: 1684-1693. Doi: 10.1016/j.jclepro.2016.09.077

Robot hands and prosthetic devices

Nowadays, the robot hands market is dominated by rigid, fully- actuated devices that are equipped with multiple actuators and sophisticated sensing elements (e.g., high-resolution encoders for the joints and tactile force sensors for the fingertips). Moreover, these hands typically require complicated control laws in order to interact with the environment or to execute robust grasping and dexterous, in-hand manipulation tasks. For these reasons, the particular hands cost between $20,000 and $100,000 (see Table 1) and require a lot of effort and expense to be repaired and maintained.[2]

Another important aspect of the current situation in the prosthetics market is the fact that prosthetic devices also require frequent repairs and replacements, which can only be performed by experts. For example, the expected life span of a myoelectric prosthetic arm-hand system (that costs ~$160,000) is five years, while the maintenance may include cable repairs, suspension-liner replacement, harness repair, batteries and other parts that amount to 10% of the cost of each prosthesis.[3] The same study reports that the average annual cost of the prosthetics hardware for an upper-limb amputation exceeds $55,000. Furthermore, a recent study reports that the average lifetime cost for prosthetics and medical care for the loss of a single-

2 McGimpsey, G., Bradford, T., (2010). *Limb Prosthetics Services and Devices*. Bioengineering Institute Center for Neuroprosthetics, Worcester Polytechnic Institution, Worcester, MA.; Yudkoff, M., Dayanim, A., (2013). Developing a life care plan for amputees. In: *14th Annual IARP PA-NJ Conference*. Pennsylvania.

3 Yudkoff, M., Dayanim, A., (2013). Developing a life care plan for amputees. In: *14th Annual IARP PA-NJ Conference*. Pennsylvania.

arm for an amputee in the USA is more than $800,000.[4] Thus, it becomes evident why most amputees express their disappointment at the large cost of buying and maintaining a prosthesis, the increased weight of the device, as well as the difficulties they face with repairs. The fear of damaging the prostheses also causes most amputees to avoid using them in everyday life tasks, instead they use simple hooks or grippers. The situation is far worse for people that are uninsured or for people that have partial insurance that does not cover modern prosthetic devices, the required repairs, or maintenance costs. Moreover, in 2014 in the USA, 9.2% of the population (29 million persons) was completely uninsured.[5] It must also be noted that amputees in countries that are suffering from poverty or wars do not have access even to basic health care.

Table 1

Costs of commercially available prosthetic hands (McGimpsey and Bradford, 2010).

Device type	Cost
"Split-hook" devices	~ $10,000
Open/close cosmetically realistic myoelectric hands	$20,000 e 30,000
Neuroprosthetic hand systems	~ $100,000

All these facts were sources of inspiration for the creation of the OpenBionics project.[6] This initiative produces digital commons of designs, software, and know-how for the development of anthropomorphic, underactuated, modular, adaptive, lightweight, and intrinsically compliant robot and prosthetic hands of low complexity and cost (see Fig. 1).[7] The design was based on a simple idea: to use steady elastomer materials (e.g., silicone or polyurethane sheets) in order to implement the human extensor-tendons counterpart and cables driven through low-friction tubes to replicate the human flexor- tendons analogues. Human-likeness of robot motion and structure is achieved by employing appropriate metrics of

4 Blough, D., Hubbard, S., McFarland, L., Smith, D., Gambel, J., Reiber, G., (2010). Prosthetic cost projections for servicemembers with major limb loss from Vietnam and OIF/OEF. J. *Rehabilitation Res.* Dev. 47, 387-402.

5 Cohen, R., Martinez, M., (2015). *Health Insurance Coverage: Early Release of Estimates from the National Health Interview Survey, January-march 2015*. National Center for Health Statistics. Division of Health Interview Statistics.

6 Liarokapis, M., Zisimatos, A., Mavrogiannis, C., Kyriakopoulos, K., (2014). OpenBionics: an open-source initiative for the creation of affordable, modular, light-weight, underactuated robot hands and prosthetic devices. In: *2nd ASU Rehabilitation Robotics Workshop*. Arizona State University.

7 Kontoudis, G., Liarokapis, M., Zisimatos, A., Mavrogiannis, C., Kyriakopoulos, K., (2015). Open-source, anthropomorphic, underactuated robot hands with a selectively lockable differential mechanism: towards affordable prostheses. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*.

anthropomorphism in the design process. The use of parametric models derived from hand anthropometry studies allows for the creation of personalized devices.

The thumb mechanism can attain nine different configurations, replicating the human thumb opposition to the other fingers, with only one degree of freedom. A selectively lockable differential mechanism employs a set of simple buttons that can block the motion of each finger, allowing the user to intuitively select between 16 distinct index-, middle-, ring- and little-finger combinations. A single actuator combined with the differential mechanism can execute 144 different grasping postures and gestures, facilitating the desired cost and weight reduction. The structure of the hand is extremely robust, and especially the robot fingers can withstand significant torsional forces and impacts.

The proposed hands can be fabricated with low-cost desktop manufacturing technologies, such as 3D printing and computerized numerical control (CNC) machines, using off-the-shelf, low-cost and lightweight materials that can be easily found in hardware stores around the world.[8] The costs and weights of the OpenBionics robot and prosthetic hands, as well as the cost of replacing a damaged finger unit, are reported in Table 2. It must be noted that the presented figures do not include research and development or tools costs. The particular prosthetic hands are as functional as the commercially available solutions,[9] and they cost only a fraction (i.e. 0.1e1%) of their price.[10] The OpenBionics robot and prosthetic hands can be created within 4-6 working hours. Although it is hard to collect the production times of other commercially available prosthetic hands, a particular amount of time is considered small and minimizes the labor cost.

The OpenBionics website (www.openbionics.org) serves as an online repository of videos, codes, designs and tutorials. A variety of designs is provided, and website visitors are able to request the files needed to develop a personalized prosthesis by filling out an appropriate form. Further, the initiative has partnered with the OpenRobotHardware.org project, which is intended to serve as a resource for efforts focusing on open-source mechanical and electrical hardware, with a particular focus on projects that

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8 Zisimatos, A.G., Liarokapis, M.V., Mavrogiannis, C.I., Kyriakopoulos, K.J., (2014). Opensource, affordable, modular, light-weight, underactuated robot hands. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 3207-3212.

9 Kontoudis, G., Liarokapis, M., Zisimatos, A., Mavrogiannis, C., Kyriakopoulos, K., (2015). Open-source, anthropomorphic, underactuated robot hands with a selectively lockable differential mechanism: towards affordable prostheses. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*.

10 McGimpsey, G., Bradford, T., (2010). *Limb Prosthetics Services and Devices. Bioengineering Institute Center for Neuroprosthetics*, Worcester Polytechnic Institution, Worcester, MA.; Yudkoff, M., Dayanim, A., (2013). Developing a life care plan for amputees. In: *14th Annual IARP PA-NJ Conference*. Pennsylvania.

may be useful in robotics applications, research and education. Thus far, the OpenBionics and the OpenRobotHardware initiatives have attracted more than 50,000 unique visitors from 157 countries and the designs have been downloaded thousands of times.

Design-embedded sustainability

The OpenBionics initiative is currently represented by the Control Systems Laboratory of the National Technical University of Athens (a public, non-profit higher education institution) and does not follow a planned obsolescence strategy. The sustainability and democratization aspects are indeed evident in the designs, as the focus is on providing robust, modular, reusable and easily maintainable solutions that will facilitate cooperation and replication by others. For example, the OpenBionics robot and prosthetic hands share the same modular finger structure, so as to enable a potential user of the devices (e.g., an amputee, a technology enthusiast, a researcher or even a company) to use a minimum set of tools and units (e.g., developed fingers) and devote a minimum amount of time to getting familiarized with

Table 2
The costs and weights of the OpenBionics devices (Zisimatos et al., 2014; Kontoudis et al., 2015).

Device	Cost	Weight
Robot hand	\$60 - 100	~200 gr
Prosthetic hand	~\$200	~300 gr
Modular finger unit	~\$10	15-20 gr

Fig. 1. The OpenBionics prosthetic and robot hands.

the required construction procedures or repairing and maintaining a damaged or old device. It must be noted that the easier it is for the user to repair the prosthesis, the less likely it is that he/she will seek help from a professional/expert, minimizing the maintenance costs (all repairs can be made by a non-expert).

Moreover, as has already been mentioned, the proposed robot and prosthetic hands are significantly robust, do not require frequent repairs, and the cost of their replacement units is very low (e.g., \$10 for each broken finger), when compared with the commercially available prostheses that require up to ~$17,000 annually.[11] In addition, the modular basis of the OpenBionics robot hands allows for the replication of multiple robot-hand models with the same wrist module. Such a basis also facilitates repairs and robot-hand maintenance, since damaged fingers can easily be replaced with new units. These hands can be used in industrial automation scenarios by companies that cannot afford robotic production-line solutions that cost hundreds of thousands or even millions of USD.

It must be noted, though, that the OpenBionics devices require for their replication certain desktop manufacturing technologies (e.g., 3D printers or laser cutters) that are not yet readily available in every house. Thus, a strategic plan of the OpenBionics initiative is to establish a global network of makerspaces where the OpenBionics designs could be built on-demand or where the potential user could seek assistance for repairs. Finally, the software code that has been written for the control of the different actuators, or for data collection from the various sensing elements, is also shared among the robot and the prosthetic devices, minimizing the required development effort.

The aforementioned characteristics provide OpenBionics devices with a strategic advantage over competitors and commercially available solutions. In 2015, the OpenBionics initiative won the Robotdalen International Innovation award and has now initiated a collaboration with Robotdalen to perform clinical trials and commercialize affordable prosthetic devices. Among the future plans of the OpenBionics initiative is the creation of a spin-off/start- up company for the commercialization of the derivative designs without compromising their open dissemination and licensing.

On-demand production

The OpenBionics initiative uses open designs, local makerspaces and shared desktop manufacturing equipment in order to contribute to the creation of a new on-demand production system. By relocalizing the production of the OpenBionics prosthetic hands into the aforementioned network, the transportation costs, the advertising/dissemination costs and the environmental impact of their production are minimized, since materials travel less and the required infrastructure and technical expertise is shared.[12]

11 Yudkoff, M., Dayanim, A., (2013). Developing a life care plan for amputees. In: *14th Annual IARP PA-NJ Conference*. Pennsylvania.

12 King, D., Babasola, A., Rozario, J., Pearce, J., (2014). Mobile open-source solar-powered 3-D printers for distributed manufacturing in off-grid communities. *Challenges Sustain*. 2 (1), 18-27; Kostakis, V., Fountouklis, M., Drechsler, W., (2013). Peer production and desktop manufacturing: the case of the Helix_T wind turbine project. *Sci. Techno*l. *Hum. Values* 38 (6), 773-800.
Values 38 (6), 773-800; Kohtala, C., Hyysalo, S., 2015. *Anticipated environmental sustainability of personal fabrication*. J. Clean. Prod. 99, 333-344.

All the designs are freely available to everyone to replicate, modify and customize according to their preferences, and of course to ameliorate them, proposing derivative solutions that are aesthetically or functionally better. Moreover, the OpenBionics prosthetic hands can be personalized to meet the specific needs of each patient, or they can even be developed for specific tasks (e.g., prostheses for sports activities or for heavy-duty tasks).[13] All hand designs have been developed accordingly to allow their replication by non-experts. This demand-driven production paradigm accelerates innovation and leads to advanced, personalized prosthetics that cost a fraction of the price of the currently commercially available solutions, requiring also lower maintenance costs.

Sharing

As said, OpenBionics has a global-commons orientation in sharing its designs, software and know-how. In this respect, the initiative has initiated international cooperation with various commons-oriented maker spaces and maker communities through participation in related conferences, exhibitions and competitions and through the organization of workshops and seminars. These communities are often based on open spaces of cooperation and innovation and range from hackerspaces to fab labs and creativity studios. The motivation behind these spaces is that everyone can take advantage or contribute to the shared infrastructure (e.g., 3D printers, laser cutters, CNC machines, PC systems, sound and photo studios), facilitating a mutualization of the means of production and propelling the emergence of a genuine “sharing economy” with more and direct human connections (Helfrich and Bollier, 2014). For example, in order to develop the required hand electronics (e.g. printed circuit boards), the OpenBionics initiative used the infrastructure of the Greece-based Athens Hackerspace.gr, a physical space dedicated to creative code and hardware hacking. For research purposes and for the development of the OpenBionics devices, the team uses the infrastructure of the Control Systems Laboratory of the National Technical University of Athens. The OpenBionics research was initially supported by the European Commission with the Integrated Project no. 248587, “THE Hand Embodied”, within the FP7-ICT-2009-4-2-1 program “Cognitive Systems and Robotics” (€560,000, 2010-14).

13 Kontoudis, G., Liarokapis, M., Zisimatos, A., Mavrogiannis, C., Kyriakopoulos, K., (2015). Open-source, anthropomorphic, underactuated robot hands with a selectively lockable differential mechanism: towards affordable prostheses. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*

The OpenBionics designs are available under a Creative Commons license that allows people to share, copy and redistribute the related material in any medium or format and adapt, remix, transform and build upon the material for any purpose (even for commercial purposes). Such a license was selected in order to empower grassroots innovation, since the more people that modify and work on the OpenBionics hand designs, the more efficient and dexterous they arguably become. Through their participation in the Hackaday.io and other commons-oriented communities, the OpenBionics team members have supported the replication of their prosthetic and robotic hand designs by others, while many different groups around the world have started working on derivative versions of the designs that maintain the same commons-oriented license. For example, the robot and prosthetic hands' GitHub repositories of the OpenBionics initiative have been copied/forked numerous times, enabling new users to freely experiment with the provided designs and create new customized versions. Moreover, the OpenBionics designs have been acquired by a community of researchers, makers, hobbyists and professionals currently spread over 174 countries and 7500 cities around the world.

All the OpenBionics designs were initially developed by a cross-institutional team of roboticists but are nowadays maintained and modified by a community of makers, researchers and hobbyists. More precisely, the OpenBionics team initially focuses on the preparation and prototyping of new innovative designs using their expertise in robot-hand design, robot grasping and manipulation and brain-machine interfaces. The prototypes are thoroughly tested with extensive experimental paradigms, and their CAD files are openly distributed through appropriate dissemination channels (e.g., GitHub repository). Furthermore, the CAD files are supplemented with comprehensive tutorials that allow the replication of the proposed designs by non-experts. Subsequently, the worldwide community of makers, researchers, hobbyists and hardware hackers provides feedback on the proposed solutions, modifies the designs, proposes new solutions and possible alternatives and develops derivative versions. Thus, progress and innovation can be accelerated via synergistic cooperation of experts and non- experts.

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Sensorica[1]

1https://www.sensorica.co/

Michel Bauwens and Vasilis Niaros

Sensorica is an open collaborative network committed to the design and deployment of sensors and sensemaking systems, utilizing open source software and hardware solutions. It was officially launched in February 2011 in Montreal, Canada with the vision to empower 'communities to optimize interactions with our physical environment and realize our full human potential'.2 Until 2015, Sensorica was focusing most of its energy into developing its own products and services, while developing the infrastructure to sustain its decentralized operations. At the end of 2015 Sensorica undertook the development of an open source sensor network for

2 Sensorica (2016a). About us.

the heavy industry. Through this project, called Sensor Network, people at Sensorica realized that open networks can work in synergy with traditional institutions, in a way that benefits both parties, as well as the society as a whole.[3]

Sensorica is partially a commons-based community and partially a market-oriented entity. On one hand, individuals and organizations are mutualize resources to initiate projects, driven primarily by intrinsic motivations, as opposed to financial rewards. On the other hand, the innovative solutions developed in Sensorica can be exchanged in the market to generate income. It is basically an informal structure, legally represented as a non- registered association,[4] with which all the affiliates (i.e. affiliated individuals and organizations) are linked.[5] A non-profit organization6 acts as a custodian, holding all assets and liabilities of the network as commons, based on a 'non-dominium' agreement.[7] 'Non-dominium'[8] reflects the fact that no country or combination of countries has the power of dominant control over the relevant territory and resources.

As regards the market-oriented operations, Sensorica uses independent exchange firms to interface between the informal network and the market.[9] The exchange firms are neutral entities, which serve to exchange the products co-developed by the network in the market. For this purpose the exchange firms take over all the relevant operations, such as marketing, sales and logistics, while they hold legal liability for the products. Their operation is fully transparent to the community and in trust that they serve the benefit of the network as a whole. The exchange firms are the exclusive carriers of the Sensorica brand in the market and are responsible for assuring the quality and ethical standards of the products.[10] At the time of the writing Sensorica operates with two exchange firms,11 one related with prototyping and digital fabrication services[12] and one with blockchain services.[13]

As an organization, Sensorica is inspired by open source design and commons-based peer production. It is fully decentralized, featuring

3 Brastaviceanu, T., Laughlin, S. & Anastassiou, J. (2016). *Interfaces between open networks and classical institutions: The Sensorica experience.*
4 Based on CCQ-1991 - Code civil du Québec: http://legisquebec.gouv.qc.ca/fr/ShowDoc/cs/CCQ-1991.
5 OVN Space (2016a). Legal structure; Siddiqui, Y. & Brastaviceanu, T. (2013). *Open value network: A framework for many-to-many innovation.*
6 Sensorica's custodian is ACES-CAKE. For more see: http://aces-cake.org/cake-english-homepage.
7 Brastaviceanu T., Bergeron F., Bosserman, S. & Shanks, B. (2013). *Business model 3.0.*
8 Here 'non-dominium' is referred as a new form of property and management of common resources. For more see: https://wiki.p2pfoundation.net/Nondominium
9 OVN Space (2016b). Exchange firm; *Sensorica* (2016b). Q&A.
10 Brastaviceanu, T., Laughlin, S. & Anastassiou, J. (2016). *Interfaces between open networks and classical institutions: The Sensorica experience.*
11 Sensorica (2016b). *Q&A.*
12 BDan concepts, see: http://www.bdanconcepts.com
13 Blocksense, see: http://blocksense.io

distributed decision-making processes and bottom-up resource allocation. Its structure is multilayered and polycentric, designed to facilitate co- creation and exchange of value. It is a dynamic structure, highly adaptive to its ever-changing internal and external environment. Participation in Sensorica is open, with very low barriers of entry. It empowers permissionless individual action through open knowledge and transparent processes.

Sensorica identifies itself as a new type of organization tuned for P2P organization; an expanding type of open enterprise or, as it is referred, an Open Value Network (OVN).[14] An OVN is a generic organizational and business model, apt to enhance and support commons-based peer production. It can take various forms and can be adapted according to each context.[15] OVNs allow individuals and organizations to create common value in an open environment, while keeping account of the different contributions in a common ledger system. All assets are commonly held by the network and the co-created value is distributed equitably within and beyond the network.

Its economic dynamics are based on flat and large scale coordination, cooperation and collaboration. It builds on mass-customization of shared resources, in contrast to mass-production. It thus relies on economies of scope instead of economies of scale to increase returns, which are distributed amongst the contributors in proportion to their contributions.

The aspiration of the OVN model has been to create an ethical structure that could harness the flexibility of open collaboration and sharing, while addressing the challenges of open source projects, related to governance and sustainability. The OVN model provides solutions for open source software and hardware projects, so that they can effectively capture, manage and distribute financial rewards to the contributors; deal with issues related to trust; retain and protect a formal legal structure and brand; and formulate and execute a business strategy.

An OVN comprises of separate business entities (open-enterprises), with relevant flexibility with their legal and ownership arrangements, that can perform all the traditional business functions, including R&D, coordination, production, distribution, marketing, sales, distribution of profits, legal liability, etc. Simultaneously, an OVN utilizes the productive dynamics of peer production and mass-collaboration, observed in numerous open source projects, where a significant proportion of the produced value comes from multiple small contributions. This way a unique innovation potential

14 Sensorica (2016a). About us.
15 Siddiqui, Y. & Brastaviceanu, T. (2013). *Open value network: A framework for many-to-many innovation.*

is created through openness and variety, while the linked business entities deploy this potential to become viable and competitive in the market.

The OVN is characterized by three fundamental principles, which guide the various relations within and without the network, namely, open membership; transparency and variety of contributions. These are briefly presented below:[16]

Open membership. In an OVN all members can at any time join or leave the network and form, join or acquire an open-enterprise. An OVN can consist of individuals or organizations, including nonprofits, government entities, open-enterprises or even other open-value networks.

Transparency and open-access. Transparency enables the open source communities to gain access the information, knowledge and the processes in an OVN. Nevertheless, certain restrictions may apply according to the nature of the resources and the respective expertise of the contributors (e.g. dangerous chemicals may be restricted to chemists, etc.).

Variety of contributions. As a contribution is understood any tangible and intangible input, including a product or a service; an idea or a prototype; time spent on tasks or projects; physical space offered for activities; data or information; but also financial investments; social connections; manufacturing and distribution channels; as well as any type of provision or entitlement, such as liability acquisition, insurance, certification or evaluation. In other words, any effort that is a part of the use value is a contribution. This broad spectrum of contributions, which spans across all levels of the production, finance and governance of the OVN are evaluated and rewarded under the same terms.

The Sensorica OVN rests on a techno-social infrastructure in order to reinforce decentralized self-organization and render the network creative and productive. This infrastructure comprises three main interlocking systems:[17]

- **Value Accounting System (VAS)**, which records and evaluates every member's input and calculates revenues in proportion to each contribution;
- **A reputation system**,[18] which determines the behavior

16 Siddiqui, Y. & Brastaviceanu, T. (2013). *Open value network: A framework for many-to-many innovation.*
17 Sensorica (2016c). Value reputation roles.
18 For details see: http://www.sensorica.co/home/working-space/value-reputation-roles/reputation and http://valuenetwork.referata.com/wiki/Reputation_system

within the community and attributes merit in accordance with the collective interest; and

- **A role system**,[19] which allocates the arrangement and interrelation of the different activities among the agents, based on their skills and interests.

These systems enable the OVN to track and evaluate the contributions and redistribute revenue. The Sensorica VAS constitutes a contribution-based reward mechanism, which fairly redistributes revenues in proportion to each contribution to the related projects. The aggregated data generated by the VAS are fed into the other two systems, which in turn support the VAS. In the following paragraphs we provide a more detailed presentation of the Sensorica VAS.

Sensorica provides a platform for people to share resources and create common value. In turn, revenue is generated through either market-oriented entities, which build on the common value to exchange products and services, or through project-related grants. As a result a broad spectrum of different contributions are employed in this process, including material contributions (e.g. resources, tools, consumables, etc.), immaterial (e.g. time, effort, etc.) or capital (e.g. space, equipment, infrastructure, etc.). In order to ensure a fair redistribution of revenue in accordance with the contributed value a VAS is necessary to record the various contributions for every different project.[20]

The VAS is a contribution-based reward system, which incentivizes interaction and collaboration, by keeping a permanent quantitative and qualitative record of all contributions. The recorded contributions are evaluated, based on a metrics system, as well as participatory evaluations of the members.[21] The VAS integrates the function of the other two systems mentioned previously, i.e. the reputation and role systems: it keeps a permanent record of who is doing what (role); how well (reputation) and how much (value) in a particular project.

The different dimensions of value are made commensurate using a value equation system, which attributes a percentage of the total revenue to every participant, in the form of 'fluid equity'.[22] The fluid equity of every contributor in a certain project is visually represented in the form of a pie-chart, illustrating its share of the potential revenue related to the project.

19 For details see: http://www.sensorica.co/home/working-space/value-reputation-roles/roles and http://valuenetwork.referata.com/wiki/Role_system
20 Brastaviceanu, T. (2014). *Why do we need a value accounting system?*. Multitude Project.
21 OVN Space (2011). Value accounting system.
22 OVN Space (2016c). Fluid equity.

That is, if exchange value is created in the market, the VAS guides the redistribution of the revenue to the contributors.

Furthermore, as the OVN is a dynamic structure, certain types of contributions are simultaneously associated with the creation of new resources.[23] For example, a design or a prototype which had been contributed to one project, represents a resource that can be used in a different context. Therefore, in order to facilitate this interoperability of the resources in different contexts (e.g. different projects), the VAS is complemented by a Network Resource Planning (NRP) system, which matches resources with a certain value stream. Similar to the function of an Enterprise Resource Planning (ERP) software, the NRP collects, stores and interprets data from all the different types of activities in the network and attaches them to specific resources, to keep track of the contributed value on resource level.

The NRP integrates the function of the VAS in Sensorica, by allowing the re-use of resources in different contexts, enabling exponential network effects. Especially in the case of digital commons, like open source software, open knowledge and open designs, further utilization of the associated resources results in further increase in the aggregated use-value for the network. At the same time, the NRP-VAS[24] supports the expansion of the OVN, by attributing equity to resources generated by external sources and integrating them to the network.[25] For example, a piece of open source software code, which has been developed by someone who is not a member of Sensorica, can be used within a Sensorica project to compile a final product that is then exchanged in the market. Through the NRP-VAS system, the external developer will be given a percentage of fluid equity in the project and, as a result, revenue will be distributed to him/her. This way, the OVN can create bridges with other creative communities in mutually beneficial terms.

The main objective of the NRP-VAS is to separate the various forms of income generation, either through the market or through grants, from the actual distribution of revenue. It thus effectively 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 personal gain. The system allows the identification and evaluation of the different qualities of contributions, through a combination of self-logging and peer review. The social contract is that all external revenue shall flow back to all contributors, not just those directly connected to the market or government partners.

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23 Brastaviceanu, T. (2014). Why do we need a value accounting system?. Multitude Project.
24 From 2015 onwards the terms NRP and VAS have been conjoined (NRP-VAS), as the two systems function inseparable. Nevertheless, in older Sensorica documentation separate references may be found of either NRP or VAS.
25 Brastaviceanu, T. (2014). Why do we need a value accounting system?. Multitude Project.

The NRP-VAS infrastructure supports the distribution of rewards according to the recorded economic activity. The OVN model sits on top of the NRP-VAS infrastructure, which keeps track of economic activity within and without the network in real time and in a transparent manner.[26] Furthermore, qualitative characteristics of economic contributions and behavior are also taken into consideration, based on different dimensions of reputation of the contributor, as perceived by the community. All this is integrated into an techno-social infrastructure, which, on one hand, redistributes benefits to the contributors and, on the other hand, reinforces a certain state of affairs that represents a common sense of fairness among them. Building on this, additional layers can be attached on the top, with relevance to various perceptions of ethics, sustainability or any other subjective systems of value.[27]

Nevertheless, as the distribution of rewards is based on past economic activity, the accumulated data comprise a public socioeconomic profile related to a particular person or organization. There is a significant amount of power that this type of information can potentially provide if it gets appropriated and centrally controlled. For this reason, Sensorica is exploring the deployment of the NRP-VAS infrastructure on the blockchain, to maximize transparency and security.[28]

26 Brastaviceanu, T. (2015a). On redistribution of resources.
27 Brastaviceanu, T. (2015b). E-mail communication, July 2015. Retrieved from: http://wiki.p2pfoundation.net/Sensorica
28 OVN Space (2016b). Exchange firm.

*Note

This case was originally published in: Bauwens, M., & Niaros, V. (2017). *Value in the commons economy: Developments in open and contributory value accounting.* Heinrich Böll Stiftung, P2P Foundation.

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Picture 1: A cosmolocal manufacturing workshop in the rural makerspace of Tzoumakers, Epirus, Greece, source Nicolas Garnier

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

This is one of the reasons that the farmers and makers of the Tzoumakers community[2] (Picture 2) (named so by combining the terms "makers" and the "Tzoumerka" region) got together.

Picture 2: The Tzoumakers space (Source: Nicolas Garnier).

They first discussed the problems they faced and then mapped and prioritized their needs. Then, they proposed a set of solutions that they use, know or have heard about and started sharing their experience. At the same time, the members more familiar with modern technologies searched the web looking for open source solutions to their pressing local problems that people or groups like l'Atelier Paysan[3] might have solved before them.

The appropriate solution for the fencing problem finally emerged from within the local community: a beekeeper and an owner of a nearby mountain shelter had used in the past a simple tool for hammering fencing poles. The tool does the job without acrobatic and risky moves being necessary, making it possible for only one person to hammer the poles while standing

2 http://www.tzoumakers.gr/english/
3 https://www.latelierpaysan.org/English

firmly on the ground (picture 3). They explained the logic of this tool to the rest of the Tzoumakers community and altogether set up a plan to build one.

Picture 3: Testing the newly constructed tool for hammering fencing-poles from the Tzoumakers group (Source: Alekos Pantazis).

A workshop was therefore organized. The first preparatory step for the workshop was taken within the informal "core" community: a group chat and a coordination document was created and shared between eight people. After a face-to-face meeting and chat discussions, the group created a list of tools and raw materials that would be needed to build the tool and each of the core members got the responsibility of bringing some of them to the workshop (such as metal welding tools, angle grinders, metal tubes, pieces of solid metal, etc.). After this list was established, the workshop was communicated more widely via Tzoumaker's Facebook group,[4] emails and phone calls to specific members of the mapped community that might be interested, and via a poster placed in nearby villages and local agricultural associations.

At the workshop, a number of explanations were provided to the participants, including: the underlying logic of the tool; why it is more practical than a "traditional" one; why a solid tube is placed at the edge of the tool in order to create a use similar to that of a hammer; and how the total weight of the tool can be calculated. Moreover, in an effort to ensure that the making process could be reproduced easily, participants kept records of various elements on a whiteboard (picture 4): the sequence of the steps needed for constructing

4 https://www.facebook.com/groups/430246720759962

the tool; the points to be welded; the required tools, materials and their prices; and some other useful details and observations. In addition, a device that helped the parallel alignment of the two grips during the welding of the tool was made and photographed. In other terms, the whiteboard functioned as a material representation, user guide and reminder of the “ingredients” and the temporality of the workshop.

Picture 4: Presenting, explaining and recording key information to make the pole hammering tool at the Tzoumakers makerspace (Source: Alekos Pantazis).

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

While the set aim was to build the tool, during the workshop, there was an element that surprised the organisers. At some point, the participants said that they wanted to inscribe "Tzoumakers" on the tool. In other words, they showed that they cared not only about building a tool but also about the collective identity that enabled them to create this tool. The inscription 'Tzoumakers' became a means to make explicit a sense of collective and common identity. By providing the means for building a tool for hammering fencing poles and inscribing a signature on it, the workshop enabled a close entanglement between the Tzoumakers and a tool: it became their tool. This 'ownership' became also evident at the end of the workshop, when a funny video was spontaneously made by one of the participants. The participant played a salesperson who praised the tool as if it was part of an advertising spot, saying for instance that "with this tool, I was saved! I fenced the whole village and now I can sleep peacefully". After the sales pitch, another participant underlined that the tool was produced by Tzoumakers, while another one added that it is a "clever tool". Even if this anecdote mobilises fiction and humour, it nonetheless reveals pride and a sense of achievement in a moment of collective enjoyment. This sense of community was also established on a more serious level by developing an ethics of contribution and reciprocity in the use of the tool. For example, while discussing about the lending process of the tool with anyone who might need it, regardless of whether he/she participated in the construction process, the idea of asking for a small donation in the form of makerspace consumables gained ground. In this way "free" as "free beer" is to be avoided while "free" as "free speech" empowered.[5]

It is important to note that several versions of the tool were created: a light version of 9 kilos and a heavier version of 12 kilos. This had to do with both the size of the pole to be hammered and the body type of the user, thus inclusivity was embedded in the tool design process. Women users, who are often excluded from design processes, were taken into account in the design and production of an agrarian tool. Another adjustment was discussed two months after the workshop: an idea for improvement was to place the handles of the tool vertically rather than horizontally so that the movement made by the user gets more ergonomic and less painful. This adjustment is to be implemented in the next version of the tool. The coexistence of several versions shows that what is at stake is not only the reproduction of a tool but more importantly experimentation with a tool by its users, which includes testing, improving, adjusting. During these phases of experimentation, the tool has to go through certain 'tests' in the field. For instance, the tool not only needed to be able to accomplish a certain task, but it also had to pass an "ergonomy and physiology test". The tools need to be built in such a fashion that they can be used smoothly, naturally, taking into account the variability and contingencies of human bodies. This represents, for the Tzoumakers, a form of inclusivity and conviviality, and the stated aim is thus to create a sort of "library" of different models both physically and digitally.

5 Phrase by Richard Stallman, 2015.

At the time of writing, the two pole-hammering tools that have been built at the workshop are in the hands of farmers of the Tzoumakers community. One tool, for instance, was used for the construction of raized-beds that was funded by a state subsidy for young farmers (Picture 5).


Picture 4: The Tzoumakers space (Source: Sotiris Tsoukarelis).

Moreover, pictures and videos of the workshop have been uploaded, and a designer is willing to produce detailed documentation of the tool (including ideally also filming). So, the next phase, after the prototyping of the tool, will be the design of a booklet that will include a detailed presentation, an explanation of the usefulness of the tool, a list of all the equipment and material needed, instructions for building the tool (and the risks thereof), drawings and pictures. To sum up, we see that the open sourcing of a tool not only involves experimentation and construction but technologies need to be documented, transformed, translated, immersed into the local context and imaginary, represented and adjusted. This opening up is both a technical practice and a social endeavour. Connectivity, accessibility, adaptability and conviviality of technology is a manifold issue that requires specific practices supported by specific social forms and processes, as well as political reinforcement. Our stories are thus not only about the practices of rendering agricultural tools convivial, but also about the (geo)politics, ethics, aesthetics and collective dimensions thereof.[6]

6 Update: https://drive.google.com/file/d/1sWen_GwYBVWYQK2bPFwVoRR4U9w8wbh7/view?usp=sharing"

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Originally published as:
Pantazis, A., Meyer, M. (2020). Tools from Below: Making Agricultural Machines Convivial. The Greek Review of Social Research, (forthcoming, link).

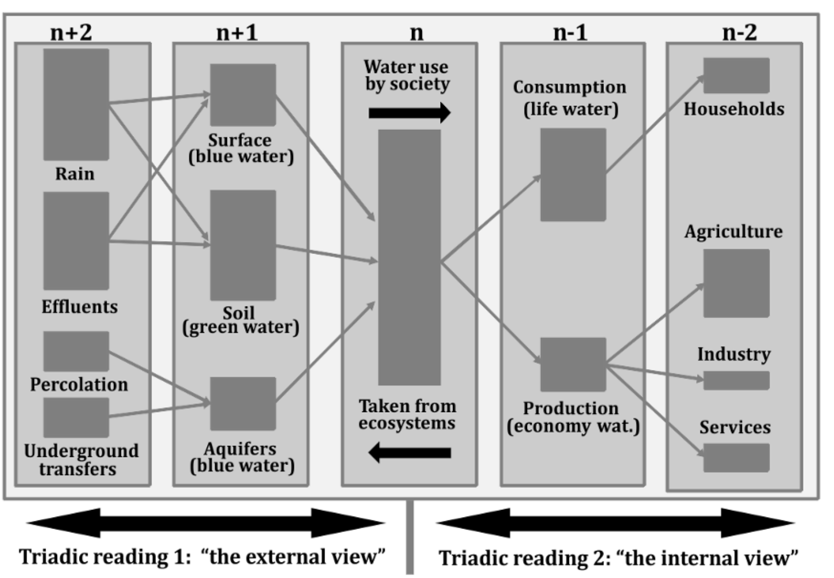
*Alekos Pantazis acknowledges financial support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 802512). Morgan Meyer acknowledges financial support from the project L'innovation par les usages, un moteur pour l'agroécologie et les dynamiques rurales (MCDR, 2015-2018).

MuSIASEM[1]

https://magic-nexus.eu/tags/musiasem

Accounting for material/energy flows and their limits

Bauwens, M. and Pazaitis, A. (2019). P2P Accounting for planetary survival: Towards a P2P infrastructure for a socially-just circular society. A joint publication between the P2P Foundation, Guerrilla Foundation and Schoepflin Foundation. Available at: https://commonstransition.org/p2p-accounting-for-planetary-survival/ with additions from James Gien Wong



From http://societalmetabolism.org/wp-content/uploads/Biosci_12-0072_Fig1.png

MuSIASEM, standing for "Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism,"[2] is an important set of tools for biophysical accountability. As current price signals do not reflect the need to conserve resources for long-term sustainability, regions, corporate entities or networks of cooperation need direct access to the flows of matter and

2 See also the treatment here at https://wiki.P2Pfoundation.net/Multi-Scale_Integrated_Analysis_of_Societal_and_Ecosystem_Metabolism

energy that they require for operating, and to the possible limits of that use in view of sustainability. To answer this challenge, the project has developed systemic tools that can be utilized for maintaining sustainable production.

MuSIASEM is an accounting method aiming to analyze socio-ecosystems and simulate certain possible or required patterns of development. It integrates biophysical and socioeconomic variables to establish a link between the metabolism of socio-economic systems, i.e., the processes of energy and material transformation that are necessary for the continued existence; sustainability and reproduction of those systems; and the potential constraints imposed by the natural environment in which they are embedded.

MuSIASEM integrates data from various levels (e.g., national, regional, local and household); from various issues such as time use, land use and energy consumption; and from various activities and production sectors. An in-depth analysis of the MuSIASEM framework exceeds the confines of the current article, as this would require a fundamental explanation of several concepts from different scientific domains, including Complex Systems Theory and Bioeconomics. Nevertheless, it serves the purposes of the current research to briefly present some of the main features.

MuSIASEM focuses on the patterns that make socio-economic systems work, and enables a deeper understanding and an assessment of their sustainability. Two fundamental categories in this process are funds and flows. Flows are the elements that come into or out the system, e.g., energy, food, or water, whereas funds are the agents that are preserved in the system and transform input flows into output flows, e.g., capital, people, or land. In other words, flows are the elements that keep the society alive, while funds are the elements that have to be sustained and reproduced in the process.

Two other useful categories are those of endosomatic and exosomatic metabolism. Endosomatic metabolism is related to food, i.e., energy transformation that takes place inside the human body to maintain its activity and development. Exosomatic metabolism refers to energy converted outside of the human body, that will be converted to applied power under human control, in order to facilitate work associated with human activity.

Using these categories MuSIASEM enables the connection of two non-equivalent views of the metabolic pattern of a given society: a) the external view, which concerns potential environmental constraints, such as the availability of resources, waste generation and absorption capacity; and b) the internal view, which deals with potential technical and economic constraints, such as the technical coefficients and the requirement of production factors. In other words, the first view assesses the feasibility of the metabolic pattern according to the characteristics of processes that lie outside of human control, whereas the second view focuses on the viability of the metabolic pattern according to the characteristics of human-controlled processes.

The MuSIASEM approach can be used to analyze environmental constraints of a socio-economic system by generating an Environmental Impact Matrix. To this end, the flows metabolized by a society are mapped in spatial terms (using GIS) in order to study their impact on the metabolic pattern of the embedding ecosystems. Mapping flows against ecological funds in spatial terms allows us to check whether the density of the metabolized flows is harmful for the stability of environmental processes.

Respectively, MuSIASEM can be used to analyse socio-economic constraints. In this case, biophysical variables are combined with monetary ones to characterize the different activities that constitute the economy. This provides a biophysical overview of economic processes through quantitative representations of society's metabolic patterns. These patterns are then described in relation to the profile of allocation of human activity in the different compartments of society.

This analysis shows the interrelationships between demographic, economic and environmental constraints. In this direction, MuSIASEM can be used to integrate data referring to different levels of organization and scales (national, regional, local and household) and different dimensions of analysis.

This combination of biophysical and monetary variables generate a record of time use and exosomatic energy consumption in the different activities that make up the economy. This provides a biophysical overview of the economic process in the form of a quantitative representation of a metabolic pattern, showing the interrelationships between demographic, economic and environmental constraints.

MuSIASEM is a unique framework that can be applied in different contexts and under various assumptions. It enables the development of tools that can analyze patterns of energy consumption on different levels and create linkages with social and economic indicators, such as monetary flows, employment and output. It may be used to compare the performance in relation to specific desired outcomes across different countries, sectors or regions on various levels of analysis, and to study the effects of these outcomes. It holds great potential in the design of socio-economic systems, either communities, organizations or supply systems, that are socially and environmentally embedded.

Relationship with Cosmolocalism

Cosmolocalism implies a type of scenario where there are clear local impacts (e.g. a material production initiative will have dimensions of flows and funds). The design solutions offered in an Open Knowledge Commons cannot be simply downloaded and implemented in isolation to their context. MuSIASEM provides a tool to deal with the complexity of which suite of solutions one might attempt to implement, given a contextual understanding of what sustainability means. Local communities could randomly "download" solutions and implement them, but what would their collective impact be on the other dimensions outside of the specific solution focus area? As a species we are notorious for creating solutions that generate more problems. MuSIASEM can help answer those questions.

MuSIASEM treats human societies as complex metabolic systems. If we change the metabolism, which inputs flow into the system and out, we would want to avoid unintended consequences. If we are trying to balance economic needs with ecological ones to stay within planetary boundaries (e.g. "Doughnut Economics"), you need a tool like this that looks across all dimensions and scales to make sure that your solution at one scale and dimension doesn't unintentionally pull a harmful string at other scales or dimensions.

MuSIASEM, and tools like it, are necessary for a pragmatic implementation of cosmolocalism, due to the complexity of the transition we are collectively engaging in. Communities are microcosms of society and changing their metabolism has to be done with great care as there are many moving parts. Cosmolocalism acts at the community scale and open knowledge scale, while MuSIASEM can be a powerful tool to mitigate unintended consequences of cosmolocal community transformation.[3]

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3 There are 3 case studies to illustrate the application of MuSIASEM from this FAO report http://www.fao.org/3/i3468e/i3468e.pdf Table 1 on page 12 is the multi-level MuSIASEM Matrix table for the case of Mauritius that summarizes many other tables from other dimensions in the country such as food, water, energy (usually MuSIASEM deals with WEF - Water Energy Food nexus). Page 39 discusses this table's usage. From that table, you can see how decisions in one specialized domain can ripple across to affect other domains. This is done in the simulations shown on page 41, which offers three different scenarios and their ripple effects.

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FabChain[1]

1 https://fablabbcn.org/news/2018/07/16/fab14.html

Linking advanced research to urban metabolisms and mainstream production and manufacturing

Bauwens, M. and Pazaitis, A. (2019). P2P Accounting for planetary survival: Towards a P2P infrastructure for a socially-just circular society. A joint publication between the P2P Foundation, Guerrilla Foundation and Schoepflin Foundation. Available at: https://commonstransition.org/p2p-accounting-for-planetary-survival/

FabChain is uniquely positioned to correlate the advances of the pioneering Fab Lab ecosystem, which is focused on 3D printing and relocalized manufacturing, as R&D laboratories connected with both a league of engaged cities as well as manufacturing organizations.

FabChain[2] is envisioned as a token-based system to solve the problems of fragmentation and value flows among local distributed, commons-oriented design and manufacturing capacities. It builds upon the vibrant community of Fab Labs, a global network of digital fabrication laboratories with over 1300 members extending to more than 100 countries. Simultaneously, it advances the idea of the Fab Cities, a concept scaling the Fab Lab culture on city level, promoting a model for urban transformation based on the sustainable use of local resources and materials and the sharing of cultures.

The specific importance of FabChain is that it aims to connect an existing network of advanced research laboratories, with an alliance of cities and with the existing logistical networks of industry.

The main goal of FabChain is to engage stakeholders in sustainable and (opensource) circular economy production practices, including the recycling,

2 At the time of writing the FabChain initiative is still on the initial stages of preparation. All the information reflects the instigators' intentions at this particular point.

reuse and relocalization of supply chains at a city level, while enabling interaction and synchronization with other cities. This would need a confederated blockchain infrastructure that could facilitate the trans-local allocation of knowledge and productive capacities, while monitoring material flows in local, transparent supply chains. In this process, local makerspaces would be instrumental in mobilizing and allocating material resources and means of production. These relations would be agreed upon and enforced through smart contracts that would secure the automatic execution of the terms with the distribution of tokens.

The design of FabChain tokens encapsulates various functions for different stakeholders across the supply chain. They can provide certification; ensure transparency and alignment to ethical conditions (e.g., fair trade, provenance, organic production); stimulate cooperation and synergy among different stakeholders; incentivize circular economic activities; distribute rewards to contributors; regulate the use of mutualized resources and facilities; support the network's sustainability by creating links with the external market economy; encourage participation; and establish reputation-based decision making.

The token model of FabChain is intended to offer two different types of tokens: a) a non-transferable reputation token (FabRep); and b) a transferable utility token (FabCoin). The reputation token will represent the value that an agent, either an individual, a group or an organization, has contributed to the network, as perceived within their respective communities. Each community is allowed to determine its own rules to attribute reputation, as it also affects the power relations in its decision-making.

FabCoins may be transferred among entities in the ecosystem to reward or encourage contributions, promote localized production and incentivize collaboration among different actors. Furthermore, different actors may provide products and services in exchange of either FabCoins or other currency. The value of the tokens will reflect their usability in these relations and their recognition as a mechanism of reciprocity. In principle, FabCoins could be used for the remuneration of contributions in the network, insofar as they provide access to useful services in the global FabChain community or eventually the possibility to be exchanged for fiat currency.

Additionally, FabChain aims to issue a series of ad-hoc certification tokens to determine the level of skills and competences for individuals or groups; the quality of services, tools and learning, as well as security standards for Fab Labs; the quality of designs and other relevant uses. Finally, FabChain also foresees proper attribution to the designers and their creations.

The FabChain model makes significant contributions in the development of accountability systems apt for sustainable and inclusive production. It illustrates an employment of distributed ledger technology to simultaneously coordinate social production on a global level, while keeping local material flows in check. This can be crucial especially at the city level, where a critical capacity for circular economic activities is concentrated, due to population density, the existence of diverse skills and capabilities and available materials for reuse. It has been argued before[3] that cities offer a favorable context for commons transitions. The FabChain confederated infrastructure could be instrumental in supporting the generalization of this potential at the global level by creating trans-local bridges of knowledge sharing and political organization.

3 Bauwens, M., & Niaros, V. (2018). Changing Societies Through Urban Commons Transitions. Berlin: Heinrich Böll Foundation. Available at:
https://www.boell.de/en/2018/02/08/changing-societies-through-urban-commons-transitions.

FairCoin and FairCoop[1]

1 https://fair-coin.org/es

Tools for a cosmo-local, open cooperative ecosystem

Bauwens, M. and Pazaitis, A. (2019). P2P Accounting for planetary survival: Towards a P2P infrastructure for a socially-just circular society. A joint publication between the P2P Foundation, Guerrilla Foundation and Schoepflin Foundation. Available at: https://commonstransition.org/p2p-accounting-for-planetary-survival/

FairCoin, FairCoop, and the larger ecosystem of which it is a part of, aims to be an open cooperative ecosystem for the exchange of value between communities both locally and on a global scale. It is driven by the ideas of an 'integral revolution' championed by the Catalan Integral Cooperative[2] and is already being used by various local communities mainly in Spain and Greece. It is much more than simply a new and more 'fair' currency, within an ecosystem that is democratically governed. Rather, it aims to offer a total solution for post-capitalist practices.

FairCoin is a currency created by FairCoop, the global open cooperative ecosystem. The motivation behind FairCoin has been the creation of a medium of value for the FairCoop economic system that would be controlled by its global community. FairCoin was initiated by an anonymous developer who distributed the first 50 million units for free to people that had expressed their interest, but the currency was then grandfathered by the FairCoop system as a means of payment.

In line with the FairCoop values, FairCoin is premised on the principle that value is generated by cooperation, in contrast to the broadly applied methods of minting or mining that generate and escalate inequalities in the user community. The first version of FairCoin experimented with a hybrid

2 For more on the Catalan Integral Cooperative see our extensive report, authored by George Dafermos: https://P2Pfoundation.net/wp-content/uploads/2017/10/The-Catalan-Integral-Cooperative.pdf

consensus protocol between proof-of-work and proof-of-stake, aiming for a more ecologically friendly model; some additional units were generated as well. However, it was soon realized that a completely different approach had to be developed.

This led to the second version of FairCoin, which implemented a unique consensus algorithm called proof-of-cooperation. This protocol is not meant to create any additional units, rather it relies on a network of trusted Cooperatively Validated Nodes (CVN) to validate transactions and generate blocks. CNV operators are appointed and approved by the FairCoop general assembly. A new block is created every three minutes and the process is coordinated among the CVNs by a round-robin system. A small transaction fee is charged on the users by the CVN that generates a block at any given time, which mainly serves to avoid spam activity and also covers the operational costs of the system.

The design of the FairCoin system allows it to run efficiently with very low requirements in processing and energy use. FairCoop claims that a network of up to 30 computers with regular processing capacity suffices to cover its operation, requiring the equivalent of a 4-member household in annual energy consumption.[3] Furthermore, FairCoin is substantially less prone to speculation, thereby tying its value to real productive activity that takes place in the global FairCoop economic system. Its exchange rate is regulated through democratic procedures by the FairCoop general assembly, rather than free- market operations. Only a small fraction of FairCoins are held by people not directly involved in FairCoop, while the majority of the units are circulated within a community of people sharing its common values.

FairCoin is a very specific case of a currency that has been created to serve a specific purpose by a specific community. Nevertheless, its relevance arguably stretches beyond the FairCoop ecosystem, being a medium of value explicitly designed to embed rules for social and ecological sustainability. Furthermore, the fact that it is based on the original bitcoin client eloquently exemplifies the potential of blockchain technology in enabling different socio-institutional outcomes, despite its original underpinnings. Regardless of its limited scope, it showcases how small-group dynamics of high-trust communities can be scaled on a global level, facilitated by a technological infrastructure that embodies their shared values and aspirations.

3 https://fair-coin.org/en/faircoin-2-revision-one-most-promising-cryptocurrencies.

ENVIENTA[1]

Gabor Kiss[2]

1 Chttps://sto.envienta.com/
2 Chairman and CEO of ENVIENTA Association & Ltd.

Some years ago a friend of mine Peter visited me from Belfast and told me that he would like to move to a small farm with his partner where they could build a small cottage with a garden in the soft embrace of nature. I was intrigued after he mentioned that they would like to create a completely self-sustaining living space.

I had planned to become an architect during my adolescence. I drew countless imaginary buildings, despite the fact that I knew it would require a lot of time and experience for my ideas to ever become reality. However, over the next 15-20 years after school I gained exposure to many software tools that can take anything that pops out of your mind and portray them in photorealistic ways.

So then I decided to draw up plans for a small 45m2 cottage for Peter. I envisioned that the main structural frame of the cottage would be constructed out of recycled shipping containers. Then we would place a solar panel system on the roof, which would power all the electrical devices. Some of the furnishings in the cottage would be made by 3D printers. The drinking water, which is also used for cleaning, would be recycled and then used in the toilet. After the remaining water is treated through various chemical procedures it would be turned into greywater, which could then can be used to water plants. Since physical space and water usage would be limited, we decided that a vertical garden system for food production would be most optimal. We would recycle a large percentage of the waste and the materials used in the household. Finally, all the physical processes of the cottage, such as electricity usage, water usage, or food production would be monitored on a daily basis. All this data would be embedded into a "smart home" system, which would then provide continuous feedback and visibility through a touch screen and smart phone app. This totally modular and turnkey solution would translate into a comfortable and sustainable home with minimal cost and zero emission.

Four years ago, in 2015, the blueprints of this cottage were finished, and then the question emerged… what if this concept could be duplicated and scaled up to meet the needs of the masses? What would this do for the sustainability of the planet? This lead to the creation of the ENVIENTA project. The name ENVIENTA is derived from the words "ENvisioning and ENcouraging Technological Alternatives".

In 2015, ENVIENTA started publishing blog articles to determine if our solutions would be interesting for other people besides ourselves. We were excited to learn that yes indeed, they were. In a short period of time thousands of enthusiasts joined our social media sites, and other groups shared content about our project. The idea that was seeded in Hungary and Spain soon sprouted all over the world. As of today in 2019, the prototype called "ECOHOUSE" is completed and the concept has been proven. It is ready to roll out to individuals and eco-villages around the world.

What Problem Does the ENVIENTA Solution Solve?

Affordable housing is a global systemic problem today, not to mention access to ecologically sustainable technological solutions. While none in the ENVIENTA community were experts in the fields of ecology or economics in the early years, it became clear that a collective shift in consciousness was necessary to recognize that the origins of these problems are economic in nature.

Furthermore, we have to think differently about almost everything: the nature of innovation, our ideas of ownership, intellectual property, and means of production. It is time to start thinking differently about who owns the means of production and start operating at a local level, facilitating peer-to-peer production, open access and sharing of the goods people need.

This shift will inherently create a solution to not only the affordable, sustainable housing problem, but in all sectors of society. It opens up possibilities for businesses everywhere, both small and large, to participate in the process of satisfying local needs in an ecologically, socially and economically sustainable way, while also meeting global needs. This vision which emerged in 2015 has since gained popularity in public awareness and has come to be known as a "Circular Economy".

A holistic approach is critical for resolving the challenges we face, in which we begin recognizing that currently we have everything backwards. Let's just think about one main systemic problem today, the focus on continuous economic growth (GDP) doesn't recognize the carrying capacity of our planet and resources. This growth-based socio-economic system puts all of our resources and needs of the planet and people in service to continually grow our economy.

However, if we can flip this around and put our economy in service to our environment and needs of society, then we can create innovations and a new economy that keeps us within the planetary boundaries. This shift in awareness and consciousness will automatically start shifting our economy away from an infinite growth paradigm towards a sustainable, regenerative one.

A major problem today is that, due to centralization of production and the markets inability to calculate actual supply and demand based on price mechanisms, there is a great amount of overproduction and overstock, to the point where products that aren't needed or wanted end up being sold at rock-bottom prices, or are merely destroyed and disposed of.

Another important factor is connected to consumerism. Today we get everything as a finished product and have no idea of how things are made, or what externalities went into the production of those goods. But as technology becomes more accessible to everyone, many individuals may become interested in making products by themselves, for themselves. This is the origination of what has become known as the "Maker Movement".

Instead of being mindless consumers, we can become artists and creatives. We can have fun while producing sustainable products in just the right quantities that meet demand, while minimizing wasteful overproduction. The production of goods shifts into the realm of creative arts, where different makers (of artists) can collaborate with others through a common platform using easily accessible tools.

Instead of frustration when we have a product idea that is too complex to build and take to market ourselves, we can find help from other experts and makers in the field. An idea can quickly and easily be turned into a concept which can then be shared with other makers and people in the community who can provide feedback, offer suggestions, and add their own contributions.

As an example, let's look at the problem of water shortages. If a maker comes up with an innovative technological solution to the problem of accessing drinkable water, then the question arises, how can we share that solution with others around the world. Let's imagine that due to drought there is a shortage of water in South Africa. The interesting thing is that the humidity in the air there is much higher in the summer months than the winter. What actually happened is that some makers from Europe came up with an apparatus to harvest water from the air. The makers provided access to the blueprints to a local entrepreneur and manufacturer in South Africa and they were able to deliver the right number of devices to the public, customized for local needs.

Water shortage is not unique to South Africa. According to forecasts 12 metropolitan areas already face similar problems. In the age of climate change a 20 year lag in providing technological innovations to people is simply unacceptable. We do not have that much time. The free access to technology does not only reduce the time of problem solving, but due to enhanced feedback it influences the speed of innovations as well, resulting in much faster problem solving and exponential increasing technological development. If we provide continuous access to technological developments, we can quickly build a new world that is sustainable and regenerative.

The ENVIENTA Platform Solution

ENVIENTA is an open-source project that has developed an application for inventors and product developers to collaborate and openly share their ideas. The declared goal is to speed up product development and the creation of local circular economies by providing access to crowdfunding, decentralized manufacturing and localized distribution to consumers. ENVIENTA is an innovation supporting platform that connects everyone with everyone on a global scale, so we achieve social and economic collaboration that surpasses borders.

A Tool for Measuring Means and Resources

It is only logical to create a quantifiable system which ensures the exchange of values between the distant partners through a digital platform. ENVIENTA is not only about moving ideas, solutions, information and files back and forth, but also the resource management as well. Accordingly we can create an agreement through the use of blockchain ledger to account for the provided resources in real time, which can also serve as a currency for value. Such a cryptocurrency can serve as the blood for circulation within a digital ecosystem in order to exchange value between local innovation and manufacturing hubs, masterminds, makers, investors, manufacturers, distributors, and customers.

New Systems of Education

At the same time that we are sharing information and creating sustainable technologies, we are also educating future generations in ways our traditional school systems cannot do. The distribution of education can happen simultaneously through the internet (MOOC's - Massive Open Online Courses), joined together with the local facilities and community spaces. Hands-on access to modern technological equipment, taught by open-minded mentors who actively participate in the work of the community will radically disseminate knowledge both locally and globally.

While these educational community spaces can be thought of as the workplaces of the future, they are also facilities designed for local digital manufacturing using the ENVIENTA platform, which will welcome curious and creative people of all ages and backgrounds. If we build on the concepts of collaborative commons, openness and a willingness to experiment, we will also build more and more innovative facilities. Since these facilities would make launching local initiatives more possible and engaging within the local communities that young people are a part of, they may be less interested in leaving their homeland or moving into big cities.

Recognition of interconnectivity

To achieve all this we have to prove – especially to ourselves – that by joining forces as creative makers, we are able to build an efficient and sustainable collaborative commons to meet everyone's needs in a very short period of time. This will ultimately create a positive feedback loop of mutual aid that continues to improve the conditions of humanity.

As the level of personal responsibility grows from involved and engaged citizens, we realize that the solutions to global problems always happen locally, but with global consciousness and collaboration. We really begin to embody the principle that, when we help others, we also help ourselves.

So next time – just like Peter in the beginning of the story – if you plan your own cottage, or you have an astonishing idea or a solution which can make the world a better place, there is no reason for holding back. Come and join our creative global community on *envienta.org* and getting involved with on our social media channels.

Holochain[1]

An alternative to a global distributed ledger, based on biomimicry

Bauwens, M. and Pazaitis, A. (2019). P2P Accounting for planetary survival: Towards a P2P infrastructure for a socially-just circular society. A joint publication between the P2P Foundation, Guerrilla Foundation and Schoepflin Foundation. Available at: https://commonstransition.org/p2p-accounting-for-planetary-survival/

1 https://holochain.org/

Holochain stands for "holographic storage for distributed applications." As the name implies, it is a framework for the development and hosting of distributed applications. Holochain can be described as an alternative to a distributed ledger comprising a significantly "lighter" architecture. Instead of storing a copy of the whole ledger on every node of the network and enforcing its validation, Holochain takes an agent-centric approach and splits the data to many different nodes and ensures access only to the data that are useful or relevant for every node. This means that every agent generates and holds on to their own data on their own device. The only types of data that are transferred to – and are readable by – other agents are the ones to which they need access or are authored in a "shared space." In Holochain there is no global view on all data, unless specifically and consciously designed to be.

Subsequently, data integrity in Holochain is ensured through a P2P validation system. It doesn't entail resource-intensive processes like "mining," which allows Holochain to be easier to deploy on less powerful devices, such as mobile phones. Holochain rather relies on its peers to ensure the integrity of the data shared among them. The peers of the network hold part of the data and validate it against a set of shared validation rules, which are specific to the protocol or an application (hApp). In other words, users audit each other's actions to see whether they have been authored in accordance with their common validation rules.

The validation rules may vary among different applications, as some may require stricter rules than others. For instance, a cryptocurrency can have different validation rules from those of a social network. Hence users in the Holochain system do not interact directly with the data shared among the peers of the network. All interaction is rather effectuated through the code of applications, so that they enforce their own rules, restrictions and objectives. The very concept of an application in Holochain begins to break down. Thanks to the level of composability of functionality and because of the loose UI coupling, the ecosystem rather evolves as a collection of micro services arranged in intricate relationships with each other tailored for the user.

Much like Ethereum, Holochain was developed to support the functionality of applications, based on sets of agreements among the people that use them, from social media and messaging applications to shared logistics management and cryptocurrencies. In the old client-server model, the existence of a central node served to maintain the integrity of the data and ensure the enforcement of the agreed-upon rules. With distributed ledger systems, this central node is replaced with a network of nodes synchronizing to a common state. Holochain enables this function without the need of a central node, to which everyone is accountable and should report. It does so by requiring each node to agree to the shared set of rules, cryptographically verify it with a hash function as the initial entry in their own record, and require every subsequent action to be validated against the same set of rules. Simultaneously, it solves some of the main scalability issues associated with blockchain technology. Holochain does not require every node to update a unique database held by everyone on every interaction in the network. Instead, nodes validate each other based on the information that is mutually relevant and on rules that are context-specific. This way, the system becomes more efficient with the addition of new nodes, which allows for network effects to be harnessed.

Ultimately, the type of interaction enabled by Holochain will be determined by the applications that will eventually run on top of it. However, we do not suggest that Holochain, as, in fact, every technological infrastructure, is neutral. Bitcoin, and to a large extent most blockchain-based infrastructures, was imbued with the principles that were of importance to their designers: anonymity, immutability, and the by-passing of human trust. Conversely, the design of Holochain has several characteristics that are relevant to the commons. This can form the basis of a new economic reality that is more democratic, more inclusive, more open and better informed on the local and global environmental thresholds.

More specifically, *Holochain creates the conditions that may allow diverse economic entities to mutualize and share resources more freely and agree on common rules of conduct that can be enforced in a P2P fashion.* This can accommodate a more even distribution of power among the participating agents and increase transparency. Holochain alone is not a protocol for social cooperation, but it can support the creation and enforcement of such shared protocols. Combined with the possibility to issue and distribute crypto-tokens, communities may create fairer reward systems and new media to interface with the market while maintaining their integrity to their values and principles. Furthermore, Holochain goes beyond crypto-tokens, by enabling and favoring forms of mutual credit crypto-accounting, which have a much greater expressive capacity than tokens. Finally, the Holochain framework can produce massive efficiency gains by unlocking unused processing and storage capacities, as well as shared information, to allow for more sustainable use of vital computation resources and increased trust among collaborating agents.

AbilityMade: Producing Open Assistive Devices for People with Disabilities

José Ramos and Melissa Fuller

AbilityMade is a Sydney (Australia) based social enterprise whose mission is to help people with disabilities access the equipment they need. Their vision starts by making custom-made 3D printed Ankle Foot Orthoses (AFOs) available to Australian children! The enterprise's approach is to use 3D scanning & printing technology to fabricate customised designs for AFOs. They are developing 3D scanning equipment and are making it widely accessible on the World Wide Web in 2018. The enterprise was founded by Melissa Fuller and Johan du Plessis.

3D printed Ankle Foot Orthoses (AFOs)

Development up to 2017
(written by José Ramos)

AbilityMate initially started by running design jams and projects at community makerspaces. The aim was to help people with disabilities by developing custom made 3D printed devices. In this early phase the AbilityMate community would work directly with people with disabilities to assess their needs and 3D print the devices that made them more independent. This has been exploratory and the AbilityMate community has co-created a number of different designs for people in need of assistive devices. These designs have been made available online.

Hack-a-Home Project

A more recent collaborative research project which is still ongoing seeks to test "what happens when you put the means of production in the hands of those who need it", whether the production of custom made assistive devices could be moved to the community requiring them. The project entailed conducting trainings at various residences where people with disabilities live. People with disabilities and their carers were trained to do various aspects of the design and production of assistive devices, from body scanning to 3d modelling and 3D printing. Overall, this project seems to have had a low general impact, as coordination has been challenging and production has only happened when AbilityMate makers have been present. However, the impact is large for individuals when they experience the power of being able to produce assistive devices to cover their own needs.

Open Source 3D scanner

The Magic Shoes project

In mid 2016 AbilityMate started receiving many request form families in the Cerebral Palsy community who saw 3D printing as solution to the challenges they face. Members from this community requested that they have a go at 3D printing Ankle Foot Orthoses (AFOs). AFOs are customised leg braces worn to support posture and mobility of kids and are used for corrective therapy. Currently AFOs are prescribed and hand fabricated by a medical specialist called an Orthotist. After looking into how AFOs are currently made they realised that their approach of using 3D scanning and 3D printing could potentially create a more pleasant experience for children and reduce the turnaround times and wait times experienced by these families. Because of the large amount of work and investment required to make this a reality, AbilityMate was joined by 6 other impact driven organisations. The project includes regulatory affairs, a clinical study with 20-30 children, development of an open source 3D scanner, the establishment of 2 orthotics clinics to make 3D printed AFOs available and the release of an open source package including blueprints of the 3D scanner and findings from the clinical study. A considerable financial investment of $600,000 is required for a project of this size. With a strong collaboration in place and a successful proof of concept AbilityMate has raised $400,000 through crowdfunding and philanthropic donations and still needs to raise $200,00 to complete the project.

Magic Shoes project team

The AbilityMate model

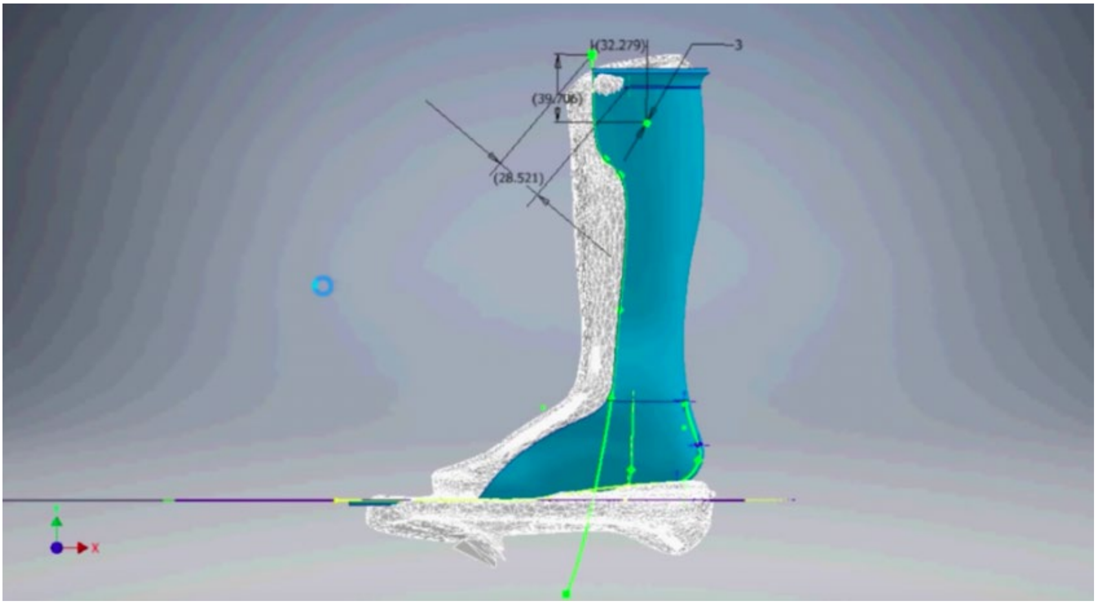
Having explored the production of a number of assistive and medical devices, AbilityMate came to the realization that it needed to create a viable business model. Once it has done this, it will be able to apply the same model to other types of customised assistive and medical devices. The current focus of AbilityMate is therefore to establish this new enterprise model around the customisation and production of AFOs. They've started with "The Magic Shoes Project" and now have now begun to set up a sustainable social business.

AbilityMate are a For Purpose technology start-up that's incorporated as a Proprietary Limited Company. They have modified their constitution in line with a Social Benefit Company. It permits and requires Directors to act to deliver the purpose and to consider wider impacts of their decisions. AbilityMate will be engaged in the customisation and digital manufacture of custom-made assistive devices. AbilityMate's products help orthotists achieve the clinical results they expect and deliver effective, cutting-edge options and better experienced to their patients.

In their experience the interaction with orthotists is critical to the safe delivery of 3D printed AFOs because these devices are corrective by nature not augmented like a prosthetic hand for example. AFOs are traditionally prescribed and made by Orthotists, after careful evaluation of biomechanical needs.

Moreover, many devices that are normally prescribed by health care providers have been subjected to clinical trials. Simply having a repository of open source templates for assistive and medical devices does not really suit a large percentage of the market. AbilityMate has learned that it has needed to create a model which incorporates the medical profession and clinicians that prescribe the devices. The new model has three basic aspects:

1. Open source body scanning devices;
2. A customisation and fabrication service (CFS);
3. A network of localised 3D printing facilities



Customization of AFO

The first barrier to overcome is the way in which orthotists develop AFOs in the first place. For things like AFOs, orthotists have traditionally used plaster casting which children tend to dislike. The first problem to solve is to find a way in which orthotists can digitize the production process. There are many types of body scanners, but they have not been widley adopted by the profession. Good scanners can cost between $20,000 to $30,000, and may not be made for scanning the legs of wriggly children. AbilityMate is therefore working on an open source scanner that will be available to anyone to make at a much lower cost.

Secondly, orthotists are not digital designers, they work with their hands, and do not normally have knowledge and experience with CAD and 3D printing. AbilityMate believe it is not realistic to expect orthotists to become experts at these. AbilityMate's strategy is therefore to set up a customisation and fabrication service (CFS). This is currently the model used for orthodontics and other medical devices that require a high degree of customisation. The CFS would be an online platform set up and run by AbilityMate. AbilityMate would receive orders from orthotists based on digitised body scans and their prescriptions. AbilityMate will make arrangements to have the leg brace printed at a 3D printing facility located closest to the orthotist who placed the order. Before onboarding a 3D printing facility to join the platform, AbilityMate will ensure the facility has all the required quality control and regulation requirements in place.

Thirdly, to fund and protect users this model requires there are elements of open source IP and closed IP. By opening the IP of the 3D scanner they reduce barriers to 3D printing. It will also enable AbilityMate to reach kids in remote communities. They will also have to keep some IP closed. AbilityMate has received genuine concern from the medical profession about open sourcing templates and 3D designs for AFOs. Because AFOs are corrective devices there is a major risk in having an unqualified person designing and printing AFOs for already vulnerable members of the community. AbilityMate is also in the process of raising seed investment from impact investors. For them it doesn't make sense to open the IP surrounding how to customise an AFO in CAD modelling. These barriers have really challenged their thinking about open design and cosmo localisation because their vision started out with ambitions to keep everything open! In reality this approach could have negative consequences on children and on AbilityMates' ability to raise capital. As the business model evolves, they hope that the tensions between the vision for cosmo-localization and the practical considerations of AFOs and seed investors can be resolved and integrated.

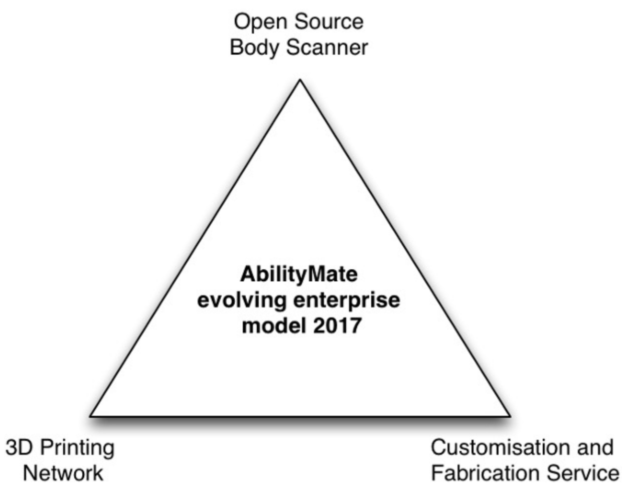


Image: José Ramos

Based on this three-part model their plan been to support the development of AbilityMate "Pods". Pods would be localized operations that can support a number of territories in instantiating the model (a little bit like a franchise but using open source principles). AbilityMate would package as a service how to set up a full-fledged operation, which would include how to conduct 3D printing as a CFS, how to produce and use the scanners and upgrade orthotics clinics to digital workflows, and how to draw on an open design commons. AbilityMate would help people set up their own operations in different parts of the world to service their local areas.

Open clinical trials and university collaboration

AbilityMate have also learned that the production of medical devices based on open designs needs to be coupled with clinical trials and the validation of models and technologies of medical devices. In Australia, for example, clinicians/orthotists will not normally prescribe an medical devices that has not been validated through clinical trial. This means that from a medical profession point of view, there is no real value in having hundreds of innovative open source designs for medical devices if none of them have been trialled and validated. In addition to this, medical trials are very hard to do, they cost a lot of money because of the research costs involved. In their opinion, they believe that certain contexts warrant a more liberal approach to this. For AFOs, for example, it is better that kids have them than not. For other types of devices where there is higher risk, they feel clinical trials need to be strictly applied.

Therefore, the challenge is not just to cultivate an open design commons for assistive devices and medical devices, but to build an approach to prototyping, testing and trialling assistive devices and medical devices in conjunction with this design commons. This requires open data on clinical trials that others can build on, which allows for people to build on and create subsequent design optimizations. In essence there is a need to create a commons around clinical trial data and the validation of devices. AbilityMate have only just begun to have conversations with universities about this.

Values and principles and the role of the maker movement

AbilityMate is an expression of deep personal connections with the experience and challenges for people who are disadvantaged by disabilities. Johan's grandfather, for example, had polio, which left him with an impaired limb. The social stigma of being cripple haunted his grandfather's entire life, impacting his work opportunities, and had an impact on three generations of his family. Melissa has a cousin who was struck by a car and acquired a spine and brain injury, losing the ability to walk and speak. The state insurance, which was meant to last his whole life was quickly exhausted by medical costs for equipment, and she saw how her cousin's family constantly improvised to figure out how to solve basic problems.

The maker movement has also had a big impact on the values and thinking of AbilityMate. Before starting on this journey, Melissa did a tour of 40 makerspaces / tech shops / Fab labs across the United States. Realizing the massive impact of producing material things, and the possibility this new model could have has been a motivation as well. The way in which the maker movement merges the idea of the user with the designer and the consumer has been significant. In 2014 Melissa started a community makerspace in Sydney which is where she and Johan met.

Fairness is also a key concept. AbilityMate do not want to do charity, but rather create a more fair and equitable system. They feel that the emergence of a global design commons levels the playing field and creates fairer opportunities for people to have access to assistive devices and equipment. Fairness also means the price of assistive devices. The current high costs of assistive devices adds yet another burden to people with disabilities. The global design localized production model provides a way to lessen that cost burden.

Overall, they feel four words help to express their values and principles:

4. authentic-ness;
5. transparency / openness;
6. courage;
7. fairness.

Team, skills and decision making

Melissa comes from a design and manufacturing background, and Johan comes from a computer science and startup background. There are 4-5 other people they work with. Their backgrounds include industrial engineering, marketing and product management, CAD modelling and UX design. There are also volunteers that are connected with local maker spaces, and some interns with a biomedical background. Overall engineering with a scientific approach is valued, the ability to test hypotheses and conduct rapid prototyping, engage in user centric design, entrepreneurial skills and fund-raising. Areas where they may need future support include legal, fund-raising and finance. But the intangibles are critical in their opinion. They feel that people must have a personal connection with the area, and they are always looking for people who understand the “why” behind why they want to be involved. Often there is a personal story or connection with the disability area.

In terms of work style they prefer to cultivate a culture of co-learning rather than hierarchy. Decisions are made in different ways depending on the context. Most the time there is a team conversation which is open. Meetings are weekly. If there are more urgent decisions to make then less people may be involved in a decision. They use Loomio’s method of working groups and ensure decision-making is transparent, documented and as open as possible. Overall they try to be as organic, open and inclusive in their decision making as they can. While Melissa and Johan are the driving force, they try and distribute this as much as possible, for example by trying to rotate pitching for money or when applying for competitions.

Strengths and weaknesses of open design logic and the future

One of the biggest challenges that they face is in articulating the benefits of an open design business model. There has been lots of scepticism on the part of potential impact investors and it has been hard for people to understand why they would want to give away their “IP”, a constant need to explain and educate people on the benefits of equity fundraising. Alternatively, the benefits of working within the open design business model is the clear resonance it has with many people, associated with its altruistic dimension and potential for social impact. People have been very attracted to the model and have wanted to help, which has made it easier to establish strong partnerships. This has also helped attract talent which has become part of the team.

They feel the open design business model is a critical strategy in addressing the many challenges that we have. They do not feel approaches that rely on patents and tight intellectual property will make enough of a difference. They feel the future of open source hardware is bright if people take the

open design pathway. They are optimistic and feel the changes will come from the bottom up.
They see the outlines of a virtuous cycle developing across the open design distributed manufacturing development space. There needs to be ways to circulate value from users and clinicians back through designers and platform developers. As well, learning from other open design enterprises is critical, as the verification of such models helps to create knowledge and legitimacy. They feel it is a bit like social bootstrapping. When there are not a lot of cases it is hard to articulate the benefits of such a model and harder to get resources and people behind it.

At a social level they see an economic virtuous cycle emerging. When a valuable design is added to the global design commons and the benefits of that design begin flowing into the local community, then it frees up people and their time to do others things, and people can apply yet more open source strategies, in a virtuous cycle of economic benefits. As open design enterprises get on their feet and produce results, they capacitate communities to do more. This can include strategies for building circular economies into this model. Finally without a global design commons, local production is not possible, and without local design production then the global commons is not possible. Creating suåΩch virtuous cycles is key.

Everything discussed thus far represents the thinking and activity up to 2017.

Developments 2018-Present (written by Melissa Fuller and AbilityMade team)

Over the past four years, AbilityMade's achievements have not come without a fair share of complex problems to solve: grit, creativity and humility have continually proved to be indispensable characteristics of our company culture.

Our key theme for 2021 is - Scaling growth to break-even. To break even we must meet demand by increasing our production capacity and releasing new 3D scanning & printing enhancements. Meeting our goals will require additional partnerships with orthotics practises and close collaboration with early adopters.

The orthotics & prosthetics workforce is small but growing with 410 practitioners nation-wide. Many of these practitioners travel long distances to service regional/remote communities in Australia and also the Pacific Islands. AbilityMade has conducted several trials of a digital telehealth solution for the delivery of localised services in remote Australia.

For many years the Orthotics & Prosthetics (O&P) profession has been undervalued by state-based funding bodies. With the introduction of the National Disability Insurance Scheme consumers now have clout when it comes to choice and control. In 2017 AbilityMade was only scratching the surface in understanding why children with disability face such unreasonable barriers in accessing comfortably fitting AFOs or AFOs at all!

People & Culture (ownership, teams, and people)

Most of AbilityMade's people are based in NSW, with parts of the team living in regional NSW or interstate in South Australia or Victoria. Remote work is currently the most common form of collaboration at AbilityMade as the main office in Sydney attracts people less frequently than pre-Covid 19 times. Our technology footprint traces across Australia with orthotics practises located on the east and west coast.

The AbilityMade team has grown from 5 members to 16, and shifted from an entire company focus on R&D and fundraising, to teams focused on; social impact, strategic partnerships, design, engineers , production and people & culture

Previously owned wholly by co-founders, AbilityMade is currently rolling out an Employee Shared Ownership Plan.

In this image are only some of the people behind AbilityMade

Comparison of AbilityMade's ownership, organisation, governance and legal Structure from 2018 to 2021

	2018	Now (April 2021)
Legal Structure	Pty Ltd with special constitution - Benefit corporation	Remains the same
Shareholders/Ownership	Wholly owned by co-founders	AbilityMade has seven investor shareholders. The group is made up of philanthropists, charitable trusts and high net worth. Currently rolling out an Employee Shared Ownership Plan
Board	Not applicable	One non-executive director and two executive directors
High Level Priority Team	Not applicable	Leadership Team made of seven representatives from various areas of the business
Teams	Entire company focused on R&D and fundraising	Business Development Finance and Funding Product & Software Development Production People & Culture
Team Members	Five	Sixteen

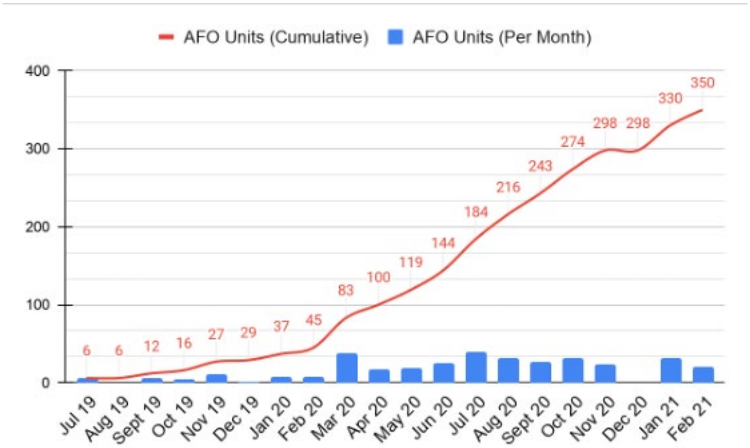
Over the last two years AbilityMade has taken on seven impact-investor shareholders. The group is made up of philanthropists, family foundations and charitable trusts
This is allowing us to drive innovation through an impact funding model. Previously involving no impact investment, our funding journey over the last two years has involved:

- **2018 - $500K Seed Round**

  Using a Simple Agreement for Future Equity (SAFE Note)
- **2019 $1Mil Seed round**

  Priced Equity Round
- **2021 - Impact Debt in-progress**

  Our focus is to raise the next round of funding through an impact debt instrument which has similar parameters to the BOLD contract created by Impact Investment Group for XCeptional in 2019



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Social Impact

In the 2020 calendar year our social impact grew by approximately 438% year-on-year!!! Toward the end of the year customer demand for our service exceeded our capacity to supply.

Technologies, products & digital fabrication services

2019 was the year our products and services became commercially available to partner clinics and beneficiaries. Over the 2020 christmas break our development team knuckled down, automated many processes and increased our throughput significantly. The Covid-19 pandemic presented us with problematic supply chain and logistic issues, but once again the AbilityMade team rose above and did everything we could to get our much needed products on the feet of Australian kids.

We now offer a stack of digital services and as well as custom-made orthoses. These products range from instantaneous scanning, anatomical alignment, 3D modelling, 3D printing, personalisation and fulfilment. The final product is a 3D printed custom made orthosis which is design and fitted by Orthotists who cannot keep up with the needs of their communities. Our customers are busy, overloaded clinicians who gain satisfaction from helping people. We provide an innovative, clinically proven and scalable solution for expanding their businesses. We focus on creating an experience that is intuitive & reliable.

This set of technologies forms the AbilityMade Digital Fabrication Platform. Our platform is web-based, allowing for universal accessibility and global scalability!

We also intend to drive innovation into this sector to help our end clients - the kids that need our AFOs, whilst continuing to work with our orthotist partners to grow the marketplace for our solution. People living in Melbourne and Adelaide can now have their limb scanned on an iPhone and two weeks later return to try on their AbilityMade device. Practices in Newcastle, Wollongong and Parramatta employ our instantaneous 3D scanner to gain time back in their clinics and respond to the community demand.

How the platform works:

- The orthotist takes a contactless, 3D scan in seconds
- Then uses our app to upload it with their prescription
- We do the 3D modelling, send them a 3D preview to accept
- The device is 3D printed at a microfactory and delivered in as little as 72 hours

Comparison of AbilityMade's technology 2018 to 2021

	2018	Now (April 2021)
3D Scanning	Photogrammetry Prototyping • 2 x in the field working prototypes deployed • AbilityMade workflow not compatible with other scanning solutions • Early makerathon building a photogrammetry scanning rig - Timelapse at a Sydney makerspace	AbilityMade Scanner Supplied Service Model • Monthly rental feel + Installation • Maintenance and support • Clinician operator training • Clinical profiling & design BYO Scanner Model • Clinician uses their own scanner such as iPhone • Clinician preforms their own modelling for internal AFO surface • Clinician then provides AbilityMade with a 3D file and we manage the rest
Digital Platform	In Development / Pre Launch	We now offer a cloud-based software used to: • Operate AbilityMade's scanner • Select image set • Live stream/preview limb in alignment • Create desired shank angle, with automated heel posting • Order digital fabrication • Pre-print preview and feedback • Monitor the status of orders
3D Modelling	Capacity Then • 3D modelling took approximately > 6 hours per unit • Unit economics not viable unless investments in automation could be made	Capacity Now • With significant investments in automation 3D modelling now takes <1 hour
3D Printed Custom-Made Ankle Foot Orthoses (AFOs) Product Mix	• Manufactured only for clinical trial users • Minimal features • Registered as a manufacturer with the Australian Therapeutic Goods Administration (TGA)	Custom-made AFO Range • Standard AFOs - Static, articulated and SMO (supra malloea orthosis) High Performance AFOs • Modularity
		• Compatible to various components such as carbon fibre struts Optional Custom AFO Features • Trimlines • Clearances • Flexible foot plate • Arches • Heel Posting • Material volume reduction • Variable thickness • Personalisation • Various housing designs for joint systems
3D Printing Network & Technology	**Additive Process**: Selective Laser Sintering (SLS) **Material**: PA 12 (White Nylon) **Print Microfactory**: Sydney **Material cost**: $2.2 cm3	**Additive Process**: Machine Jet Fusion (MJP) **Material**: PA 11 (Grey Nylon) **Print bureau location**: Melbourne (Microfactory) **Material cost**: $1.54 cm3
Finishing, decoration and delivery	**Finishing & Decoration Process**: No suitable solution for finishing and decoration discovered **Finishing micro factory**: Only in house testing **Delivery**: Turnaround time: 48 hours min and 18 days max	**Finishing & Decoration Process**: Retired Process - Hydrographic dipping Current process - High quality spray painting, multiple colour options & 3D printed embossing

		• Compatible to various components such as carbon fibre struts Optional Custom AFO Features • Trimlines • Clearances • Flexible foot plate • Arches • Heel Posting • Material volume reduction • Variable thickness • Personalisation • Various housing designs for joint systems
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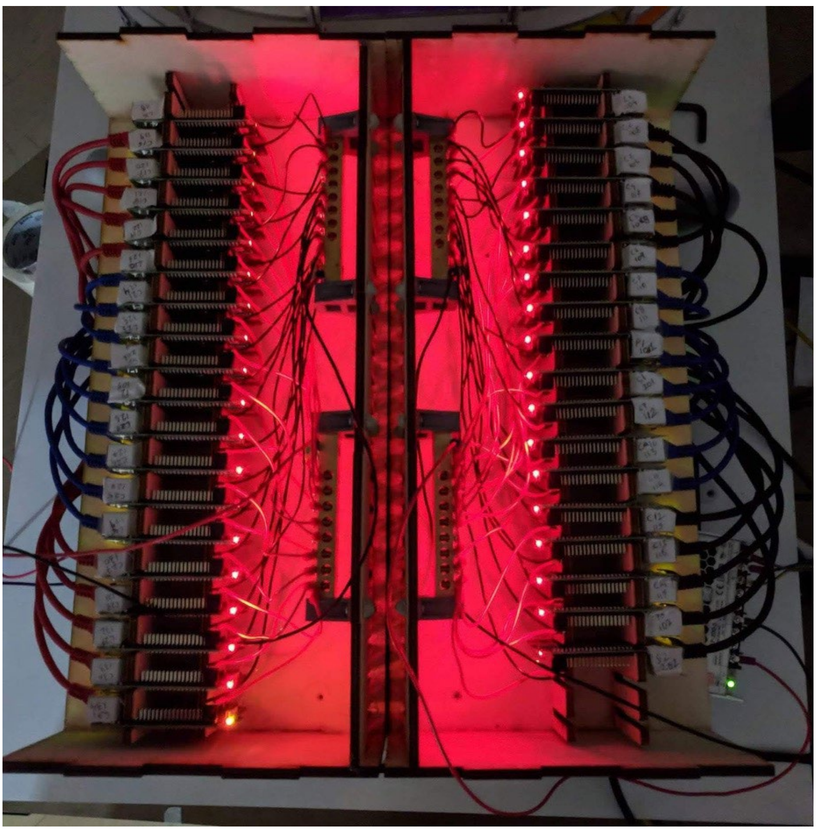
Finishing, decoration and delivery	**Finishing & Decoration Process**: No suitable solution for finishing and decoration discovered **Finishing micro factory**: Only in house testing **Delivery**: Turnaround time: 48 hours min and 18 days max	**Finishing & Decoration Process**: Retired Process - Hydrographic dipping Current process - High quality spray painting, multiple colour options & 3D printed embossing
		• Trauma informed orthotic care New Impact Projects Coming Soon! 1. Increasing Access to AFOs Project • A project to support disadvantaged groups of children that are unable to access funding for their AFOs through the NDIS 2. Localised Orthotic Care Project • This project is strategically very significant as it lays the foundations for us to provide services to other parts of Australia (and eventually other parts of the world) that we could not service to date • Innovations in telehealth applications for allied health professions where telehealth isn't widely adopted currently.

Client being scanned in AbilityMades instantaneous 3D photogrammetry scanner



The inner workings of early prototype of AbilityMade's 3dScanner

Industrial grade design - latest version of 3d scanner

Intellectual property and open design

We now have the following IP protocols in place:

- Trade mark registration
- Quarterly patent watching service - to stop companies patenting designs which already exist in our workflow or within the open sources design commons.
- NDAs and confidentiality SOPs - the magic is in our 3D modelling! We have created templates and CAD automation processes that we keep as trade-secrets. Orthotists are not CAD modellers and most do not want to be CAD modellers. Even if they do invest in CAD software & skills, they cannot do modelling in a scalable way. Digital workflows allow us to

automate CAD templates, increasing our capacity and quality repeatability.

As we did back in 2017 we've found it challenging to validate the potential social impact and business case of open-sourcing our hardware and software stack. Since 2018, we've considered open-source for all the products in our offering at the early stages of development. For our AFO range an open source strategy does not make economical sense. The two primary reasons for this is that:

- AFOs are regulated medical devices, and provision requires the supervision of a certified-clinician.
- The 3D printers which produce our AFOs to an acceptable quality and safety standard cost > $600,000 and are not widely available.

While it does not make ethical and economic sense to open source our AFO designs we're still committed to open sourcing the design of our scanning inventions. Establishing a community around the scanner makes strategic sense, as the more scanners available to Orthotists means more children will get access to services and less will undergo the distressing process of plaster casting. We also see open-sourcing of our scanner as a way to decrease product development and sales cost, shorten go-to-market time, and incubate the community with knowledge, experience and resources to help us solve this major global problem. This open-sourcing initiative will take place once AbilityMade has the resources to manage the project sufficiently. Another regulatory review will need to be completed before we can legally, ethically and safely endow people with disability with opportunities traditionally reserved for for-profit med-tech companies. Hopefully, together we will democratise the design & manufacturing of a scanning technology formed from necessity and activated by many in the AbilityMade network. AbilityMade's scanner is an asset we believe belongs in the commons.

Client Story

"Today we picked up Emily's new AFO's & so far they are brilliant! Her stride & foot placement were much more consistent, when turning her feet were better positioned & she did the best running we've ever seen. Also they look fabulous!"

Kylie, mom of Emily H

As part of this project we had to complete rigorous mechanical testing to ensure the 3D Printed AFO can withstand the forces it will be subjected to without fatiguing over time.
We completed the prescribed 500,000 cycles using our mechanical testing setup that was developed in collaboration with Sydney University, and validated as clinically accurate by our partner orthotist Paul. The setup measured forces and deflection of every cycle,

New Product Line - High Performance Carbon Fiber Equivalent AFOs After 2 years of development we are in the final stages of trialing the new range of high performance AFOs.

*Note

This report on AbilityMate was conducted by José Ramos in the context of the Open Design & Manufacturing project, co-funded by the Erasmus+ programme of the European Commission

06

Cosmolocal Q&A

bHive Cooperative[1]

www.bhive.coop

Ian McBurney, in response to questions by José Ramos

José Ramos: How did it start? What was the inspiration?

Ian McBurney: Our Board has spent our working lives on ecological sustainability, leadership and governance, social justice, business strategy and systems, community development, cooperatives, environmental education and web development. We got our heads together on bHive at Synergize Coworking Hub in Bendigo, where we were working at the time.

Our inspiration came from many conversations about the need to solve our economic, ecological and social problems together and locally. It also came from the failure of the investor owned global sharing economy platforms: they began at the turn of the century with such promise. They were going to build community, create an access economy, reduce consumption and create local work. What they actually did was the opposite, on all counts.

We began with a pitch night at a local bar in Bendigo at the end of 2016. Our local community donated $35,000 to get the coop off the ground.

José Ramos: How do you see bHive fitting into the transformations happening in the world today? How does bHive participate in these great challenges, transitions and transformations?

Ian McBurney: At bHive, we see ourselves as a part of the Platform Cooperativism Movement, the Sharing Cities movement, the Open Cooperatives movement, the Local Economies movement, the New Economy movement and the Commons movement.

bHive is a model that aims to help enable a local, networked, decentralised, democratic economy that provides access to goods and services. We aim to build community, localise work, localise ownership, localise spending and help to fund the restoration of the local ecology and the eradication of local poverty.

Together, these aims are a direct response to climate collapse, ecological collapse, economic inequity, political fear and social breakdown, all of which are global challenges we must meet in coming years.

José Ramos: What is the purpose of bHive, what does it exist to do?

Ian McBurney:

Vision
We own our local digital sharing economy together

First mission
Create a digital platform that allows Bendigo people to create, own and run sharing enterprises, providing access to shared local goods and services.

Purpose
Build local Enterprises: bHive is an economic development driver that will enable local people to build the cooperative sharing enterprises that will operate using the bHive reputation, identity and payments tools.

Create meaningful work: bHive will create work and income in peer to peer services including energy, food, stuff, transport, skills, money, logistics, space, business and personal services and more sectors.

Localise spending: Currently, households in Bendigo spend $2.5 billion annually, with a high percentage of this leaving Bendigo. Our modelling indicates that by 2030, bHive sharing enterprises will be keeping a projected $71 million annually in the local economy.

Locally owned: bHive users will own the platform under our cooperative structure. As a non-distributing cooperative, any surplus made is reinvested in the bHive platform and local charities. Sharing enterprise cooperatives will be owned by the users of each and profits will be distributed amongst member owners.

Belonging: bHive is a community building tool that brings people together to create real human connections. Neighbours can communicate and share local ideas, produce, tools, run events and projects.

Eradicate poverty and restore the ecology: 4% of all spending on bHive sharing enterprises will be invested in local charitable projects that aim to eradicate poverty and restore the ecology. By 2030 this is projected to be over $3m annually.

José Ramos: What are some examples of projects or events that bHive has done that exemplified it?

Ian McBurney: bHive Cooperative has been fundraising, planning, strategising and building our entity since the end of 2016. We will launch its first application, called "Villages" in October 2020 and we are finalising our business plan for Australia's first Car Sharing Cooperative.

Villages will connect groups of neighbours together to build community, run events, communicate with each other and share stuff and skills. Villages is real sharing. It's gifting, not consumption. You can share stuff and skills, like tools, furniture, veggies, fruit, time, babysitting, advice and meals.

Villages aims to create an epidemic of belonging. It is a digital tool that brings us face to face. This is important because our modern society is socially isolated and lonely, which is having a huge impact on our health and wellbeing. The early 2000s research of Professor Lisa Berkman showed that having strong connections in our local community is better for our health than giving up smoking, alcohol and fat and adds ten years to lifespan. Relationships built over the side fence and up the street can last a lifetime. We need to be together.

When you create your Village you can become a member and an owner of bHive Cooperative. You have the same ownership share as every other member. With bHive, there will be no advertising, no selling of data and no bots.

Over the last 18 months bHive Directors have been involved in numerous international and local conversations with developers and platform co-operative specialists to source a reliable and flexible software solution that will support bHive Villages.

Villages is a foundational element of bHive that once in place can be built upon. Future applications that will plug into Villages will include cooperative sharing enterprises like car sharing, stuff sharing, skills sharing, power sharing and more.

José Ramos: How does bHive express the logic of open source design and production / cosmo-localism?

Ian McBurney: bHive Cooperative Bendigo is creating sharing enterprise applications that will be put into practice in Bendigo only. Our model for scale is that other places will work with us to replicate the model for their local place. In each local bHive, spending, work and ownership will be local. Software, IP, ideas, plans, policies and procedures, the business model and more will be shared between independant, networked bHive Cooperatives.

bHive will also partner with existing cooperatives.

José Ramos: How does bHive "bend" technology into a social - ethical context of application?

Ian McBurney: bHive members will have Villages as their central application, connecting them with others locally to share access to goods and services. Villages enables human connection and reduced consumption. But it also acts as a member owned identity and reputation engine. Members must be a real person on bHive Villages who lives in your town. Members subscribe to Villages and there will be no advertising on the platform, so members will not "be the product" as is the case on other platforms.

Around Villages will be local sharing enterprises such as car sharing, food sharing, stuff sharing and more. These will be local independent cooperatives in their own right, that deliver services for their local town only. Members will access these services using their Villages Identity and Reputation. Their Reputation will thus cycle through these cooperatives, changing over time depending on how they treat people and property.

4% of all spending in bHive will go to local projects that aim to eradicate poverty and restore the ecology locally. In this way, a member's spending on local goods and services will also be helping to fund a social and ecological bottom line.

The Cooperative entity of bHive will ensure that ownership of these "platform cooperatives" will be local, work will be local and spending will circulate locally. bHive cooperative will grow to the size of the local place and will not need to "grow" beyond that point. It will be replicated in other places.

As the number of members grows in a local place, we envisage participatory democracy applications that encourage bHive members to become active citizens in their town.

José Ramos: What is the operating / business model of bHive? How does it sustain itself, grow and provide value to the community?

Ian McBurney: Users subscribe to the Villages platform for $5/month and Members buy a $10 share upon joining the cooperative.

Members will then subscribe to and pay to access the services of other local sharing economy enterprises, such as car sharing. 1% of turnover from these cooperatives will go back to the bHive cooperative.

bHive will then be an incubator for the next sharing enterprise cooperatives to join the network. The more local cooperatives that form, the stronger the network will be.

José Ramos: What is the governance model? Who owns it and has operating rights?

Ian McBurney: bHive is a cooperative, so owned by its members, with democratic one member, one vote governance and a board elected from its members. It is non distributing, meaning that excess funds will be reinvested in the platform and the community.

When people sign up to our Villages Software, they can also sign up as a member of the cooperative.

Other sharing cooperative enterprises like car sharing will be distributing cooperatives that share profits amongst members.

José Ramos: What is the ecosystem for the enterprise? Who are the communities that drive the value and receive the value?

Ian McBurney: The bHive Villages platform puts everyone at the centre. Everyone has their own local Village that enables them to connect with others who live near them and to share access to stuff and skills locally. Everyone can then join communities of interest across town.

Sharing enterprises will be built around Villages at the town or city scale, enabling members to access shared transport, energy, food, skills and more. Members will also create, work for and own these sharing enterprise coops.

The value will be created locally by members and will stay locally with members. bHive is an economic development engine for local communities. Currently the 40,000 homes in Bendigo spend $2.5billion annually. Most of that money leaves town. What if we could reverse that trend and localise a large percentage of that money?

José Ramos: Methodologically, how does bHive participate in addressing these great challenges, transitions and transformations?

Ian McBurney: bHive has participated in and been inspired by the movements above over the last five years.

Currently bHive is building the Villages software and completing a car sharing coop feasibility study. The next step is to launch and trial Villages and the car sharing coop. The bHive team is also talking to other places who might be keen to work with us to replicate the model for their local place. If your local place is keen, we'd love to talk to you!

Open Motors[1]

1 https://www.openmotors.co/

Yuki Liu, in response to questions by José Ramos

José Ramos: How did Open Motors start and what was the inspiration for it?

Yuki Liu: My brother Tin and I, were born and raised in Turin, Italy, one of the very central key automotive industry cities in the world. Modern Turin was built and evolved around the large-scale manufacturing of cars, compliant with the toughest regulations on the globe.

Our father, Francisco Liu, has been working for renowned Italian motorcycle and automobile design and engineering companies since the 1980s. We literally grew up with Nutella and automotive!

Once grown, we had the opportunity to join our father in several automotive related projects, coordinating teams of engineers and designers to develop complete vehicles, purchasing parts from Tier 1 suppliers, and managing external contractors. We started participating in the development of electric vehicles over 15 years ago in 2003 at Giugiaro, as an internal project.
After some years in this industry, we realized that we were just building beautiful cars, not really innovative projects, so my brother decided to move to the Silicon Valley in search of real innovation in 2008, while I moved to Shenzhen, China for market strategy and manufacturing related projects.

We learned about open source hardware, and were exposed to many inspiring new modes of business such as one-room factories, assembly and manufacturing ecosystems, districts, and alternative guerrilla-like modus operandi in production. We witnessed the beginning of new trends like IT merging with cars and experienced the unsustainability of the traditional automotive industry and its negative impact on cities and citizens. We got to know new players leaping forward, familiarized with the rise of ride-hailing services and new technologies such as self-driving AI and connected cars.

We realized that the market needed new types of vehicles specifically engineered for new mobility and services. We combined all these experiences into Open Motors with the mission to accelerate Mobility as a Service (MaaS)'s transition to first profitability at scale with an open and sustainable approach.

José Ramos: What is the operating / business model of OM? How does it sustain itself, grow and provide value to the community?

Yuki Ḷiu: Our Business Model is very simple

- sell Open Source EV platforms, add-on modules and external R&D services
- sell or lease complete highly-upgradable EVs
- lease batteries / and soon a revolutionary new charging system
- resell green energy

We have been shipping to target customers since 2015 our open and modular hardware platform for EVs, called TABBY EVO. Currently, we are finalizing the development of EDIT, the first self-driving vehicle designed & engineered specifically for Mobility as a Service: again, we are applying the advanced modularity and open approach this time to an entire vehicle. Fleets can last 10 times more thanks to easy repairability & hardware/ software upgradeability.

EDIT is a data-driven project, the result of crunching crucial feedback and data we received.

We are now integrating a revolutionary battery swapping technology and charging station that will allow instant hot-swapping of batteries, extending the range of EVs, saving batteries from highly destructive fast-charging, lowering the running costs as well as the costs of new infrastructure and impact on the grid.

Open Motors is introducing to the automotive industry a more open approach enabling the growth of startups and serial entrepreneurs to join the sector. The creation of an open framework as a chassis to build vehicles is possible, creating a true open ecosystem. That's where TABBY EVO comes into play: free to use, and available to everyone.

The TABBY EVO platform can be used to bootstrap new businesses creating their own vehicles, run services, tech development for education purposes, and much more. By using it they can save millions of dollars and years of R&D. All the plans and blueprints are downloadable for free from our website. They can improve and customize the designs, and upload them to share their ideas with the community through the ecosystem.

Despite its simplicity, TABBY EVO started a revolution, empowering entrepreneurs to start their own companies, brands and EVs.

The revenue generated by our sales, still in its test-market infancy, is not covering our investments yet. Open Motors is mainly self-funded and is still considered a pre-revenue company, currently working through the stage of product development and market validation.

José Ramos: What is the governance model of Open Motors? Who owns it and has operating rights?

Yuki Liu: Tin and myself, have the majority share and hold the total control of the company.

José Ramos: What is the ecosystem for the enterprise? Who are the communities that drive the value and receive the value?

Yuki Liu: We are creating an open ecosystem. Everyone from traditional automotive suppliers and manufacturers, to new players in self-driving and connected cars from all over the world are enabled to deploy, repair, adapt and upgrade software and hardware components and technologies faster and easier thanks to an open, modular, ready-to-use starting point.

What we provide to the ecosystem:

1. **The Network:** design and innovation partners are key to the Open Motors ecosystem. Thanks to these partners, ranging from design to production, we can support developers from the initial stages through the whole industrialization process.
2. **Communities:**
    - assemblers
    - designers
    - makers
    - manufacturers
    - part suppliers

We don't believe we can do everything by ourselves with a closed approach, that's why we believe in the partnership with parts manufacturers & new startups that develop technologies that can be integrated as a module in our complete vehicle EDIT and our TABBY EVO platform.

Partnerships with Tier 1 suppliers are fundamental to obtaining the most reliable parts. These most advanced parts can be developed in a variety of modes inside of our system for the ability to upgrade highly evolving technologies such as self-driving and connected vehicles. This technology is typically changing form factors and position every two years.

José Ramos: What have been OM biggest challenges in making the enterprise successful?

Yuki Liu: New leaders in the Mobility as a Service (MaaS) market such as DiDi, tend to play it safe. They're using a mainstream approach with traditional automakers even though it is not profitable to strengthen their position.

Newer challengers like Meituan may try something different.

Innovation adaptation can be a challenge in breaking business model barriers using new ideas and technology in the sector, opening to new possibilities that were not accepted before.

Another problem is industry standards. To develop new markets with new technology and new business models, we need new standards that reflect the changes in the industry.

We also need funding to invest in the production to lower the cost/unit and attract a larger client base and enable more and more new entrants in the EV market from the global south and emerging countries.

José Ramos: How does OM express the logic of open source design and distributed production?

Yuki Liu: For the past 100 years, entering in the automotive industry has been impossible due to the high barriers. Companies wishing to enter the market with a new vehicle have to invest millions of dollars in production facilities, hire thousands of employees, spend around five years of R&D and deploy huge resources into marketing and sales.

In order to accelerate the transition to advanced technology in mobility, we introduced open, modular Electric Vehicles solutions, ready-to-use and in white label, to allow new and existing car manufacturers to develop their own models bypassing these entry barriers.

We wanted to enable other companies to develop seamlessly integrating modules into an open and versatile fleet vehicle.

How are we doing this?

1. We are bringing Open Data, Open Innovation, Open Source, and Open API into the automotive industry. We also rebranded to Open Motors from OSVehicle to highlight a more inclusive and less radical approach to these technologies.
2. By applying advanced modularity to our platforms, we are profoundly changing the relationship with the public, cities, ecosystem, and core business model in the auto industry. We are offering complete vehicles and battery technologies with easy repairability, refurbishment and hardware/software upgradeability.The main advantages are a longer lifetime of the product, a lower TCO (total cost of ownership) and recyclability, which can save up to 70% of logistics costs. On top of this, we can hack import taxes in many countries: in Nepal for instance, taxes go from 238% for a complete vehicle to 2-3% for components. It's a huge saving, more than 230%! Then, our technologies can be easily assembled and maintained locally.
3. By taking a different approach from traditional auto OEMs and the big/giga factory model, we believe in distributed manufacturing and distributed assembly, relying on a consolidated network of manufacturers and distributors of car & electronic components in Europe, US and Asia, we developed during 30 years of direct supplier relationships and a top-level automotive engineering team from Italy.
4. By enabling co-creation and a participative approach to development and customization of the projects, the experimentation of new technical solutions and new paths to more sustainable fabrication are accelerated while massively reducing overall costs and logistics. Our platform is fully compatible with 3D printing and digital manufacturing amongst the manufacturing techniques we're adopting.
5. By enabling new players to enter the EV (Electric Vehicle) industry solving specific needs in their country or industries

and by sharing common technologies, we are contributing to define the new mobility standards.

6. By organizing initiatives and training sessions on site to enable the participation in the assembly/manufacturing of platforms and complete electric vehicles, involving also local government and municipalities.

José Ramos: How does OM "bend" technology into a social - ethical context of application?

Yuki Liu: By responding to social and economical needs, distributed manufacturing enables a more flexible production chain, satisfying local markets and economic demands in a more sustainable way.

That's why we made a very complex product like a vehicle super simple: simplicity is the key for social sustainability.

So it's way easier to create local jobs and give new work and vitality to existing small and medium businesses and skilled workers that may have lost competitiveness or have been left behind for the crisis.

The hardest task of our engineers was to simplify the vehicle, make it modular and keep safety as the prior objective. Even if it's simpler and modular our platform is designed and engineered to be road legal Worldwide (Asia, USA, Europe, etc..) .

Economic development, employment programs and policies, including the reuse of existing infrastructure and competences is one of the key goals of governments in the upcoming years. Local manufacturing is not only creating jobs but also facilitating new economic models based on innovative mobility related services.

José Ramos: How do you see OM fitting into the transformations happening in the world today?

Yuki Liu:

3. **Traditional car** sales are plummeting world wide, including in new high growth markets such as China. It has become apparent that the current petroleum based auto industry's business model is terrible for most of its users who can no longer afford cars made to rapidly decay, insurance, expensive parking costs, documents, repairs, wear-parts and the ever

climbing price of petroleum based fuels. Younger generations are more interested in getting from point A to point B without having to own anything and succumb to these expenses.

4. At the same time there is a rapid growth in the use of car sharing, ride-hailing services, micro-mobility and public transportation where it is available. It has become clear that the future of the automobile is all about Mobility as a Service (MaaS) as a business model. We are making the first car designed and engineered for exactly this from the ground up. It will be a profound shift of balance for the advantage of growing local economies, maintaining ecologies while scaling with global populations and these important trends.

5. MOST IMPORTANTLY this is a bottom up, democratized systematic network of localized micro-manufacturing. Each point of manufacturing can optimise, scale, and customize according to the cultural, logistics, and economic needs of each region with the full ability to take advantage of small as well as large leaps in technology now on the horizon. It's a win-win-win for everyone.

6. Modular vehicles were already popular ideas from designers and engineers from Turin, like the Capsula vehicle from Giugiaro back in 1982. In those years, Mobility as a Service providers were so scarce and practically limited to taxi fleets. Now, ride-hailing companies, such as Uber and Didi, became so popular and moving huge fleets of vehicles and they will most likely become the major form of transportation sooner than expected. Right now, they're operating with traditional vehicles designed and engineered for ownership use, used to be parked +95% of their lifetime. Instead the vehicles for Mobility as a Service could be operating 24h 7days. Some of the most successful car sharing fleets already don't last longer than 2 years under heavy usage! The business model based on ownership, is clearly too expensive even for companies like Uber who are throwing away thousands of vehicles, and buying thousands of new ones every 2 years. After graduating from Y Combinator in 2016, we collected data directly from those ride-hailing companies and mobility main players, and developed EDIT, our complete modular EV, which is extending the advanced modularity, to the exterior and interior body of the vehicle, to enable easy repairability and upgradeability

allowing fleets to last 10 times more under heavy usage. This makes services WAY more sustainable financially and environmentally over throwing away thousands of vehicles every 2 years and buying thousands of new ones again.

7. We integrated into our solutions, an affordable battery swapping system and charging station to lower the **cost of infrastructure** and **impact on the grid,** which are still key barriers for the dissemination of more sustainable mobility such as Electric Vehicles in less infrastructured contexts such as the global south and emerging countries. **Swapping battery** technology is solving the problem of battery deterioration and high costs both in the Total Cost of Ownership (TCO) and **charging station**. Fast charging is not sustainable for longer lifespan of batteries and service providers' needs. Our technology allows a full energy charge in less than 5 minutes and has the lowest cost of infrastructure for swapping and charging stations (>10 times more efficient than BetterPlace, Tesla, NIO Swapping battery)

8. **New Mobility** companies struggle with reverse engineering and to cost-effectively integrate new technology into the closed design of the traditional car. All technologies in a traditional car are locked: same as for an iPhone if you want a better and more performant one you have to buy the next version. Basically, you need to hack the current vehicles and invest time and money in lots of reverse engineering. By adding non-integratable hardware to existing production vehicles, the interior and exterior designs of these vehicles are compromised. That's why we applied advanced modularity to our fleets: EDIT is a production vehicle, future-proofed and designed specifically to be modular and always upgradeable.

9. Our world is moving towards a **technocracy** system willing or not. A world where who invests and embraces new technologies quicker is going to lead and influence in the future, while all others will be only followers. Our non-proprietary approach is a contribution towards a universal distributed knowledge and democratized access to technology.

José Ramos: What are some examples of projects or events that OM has done?

Yuki Liu: We are a B2B company and have been serving companies, research centers, academic and governmental institutions from several countries since 2015. Most of these projects are under strict NDAs and we are not able to share their current status of development. The majority of our customers are developing on top of our platforms connected car and self-driving solutions and new electric vehicles for specific applications and geographical areas.

An early example of our open and participative development is the FabCar, back in 2014. It's the first vehicle based on one of our platforms that can be built entirely in a FabLab. It represents the first stage of a collaboration with Hewlett-Packard, Open Motors (formerly OSVehicle) and 5 FabLabs around the world (Garagem FabLab – SP. Brasil, FabLab San Diego, FabCafe Tokyo, FabLab Manchester, and Vigyam Ashram in India) along with FabLab Barcelona to design a concept car based on the needs and desires of the FabLab and Maker communities.

We also enable active participation by local institutions in the co-creation of mobility solutions for specific areas such as ASLAN, the first utility vehicle built on our platform's technology, unveiled for the first time at COP22 (Climate Change Summit by United Nations) in Marrakesh in November 2016. It is a modular utility pickup (100% electric) - the first EV ever developed in Morocco by the state-owned company which manages all the fleets of the country. [2]

Since 2017 Open Motors became a member of the CE100, as Emerging Innovators. The Ellen MacArthur Foundation's Circular Economy Innovation Programme chose Open Motors as a globally unique, innovative business, in order to help unlock barriers to the circular economy's progress.

This programme also includes remarkable companies, organizations and governments such as Google, Renault, IKEA, DHL, the Mayor of London and the City of Phoenix.

In the same year, Open Motors was selected to represent the innovation progress in the transport and infrastructure sector during the G7 Transport Ministers' Meeting. The platform TABBY EVO and the Self-Driving Car 'EDIT' have been presented as one of the best practices and solutions focused on environmental, economic and social sustainability. Both products were showcased at the G7allery in front of the Ministers of the 7 Member States, delegations and citizens during the G7 Transport Ministers' Meeting.

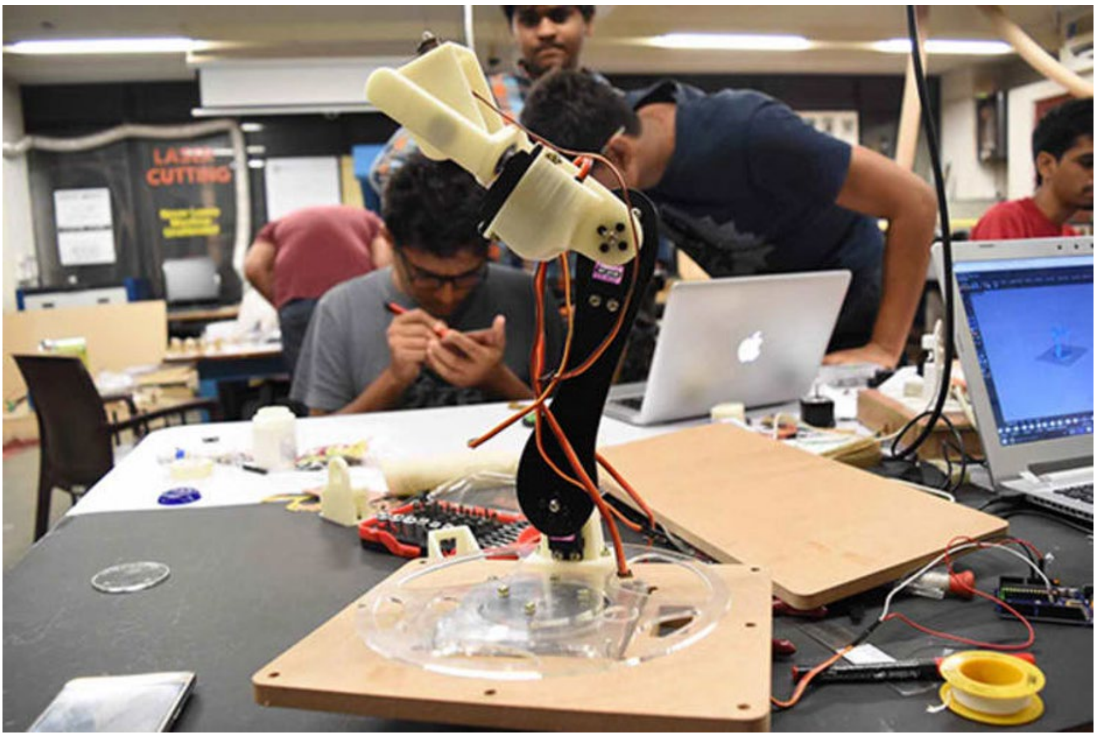
2 video: https://vimeo.com/190801012 info: https://www.openmotors.co/projects/aslan-ev-pickup-morocco/ documentary: at minute 47:23 https://vimeo.com/265562182 pw: P1l0t2018!

The same week that Open Motors was ambassador of innovation at the G7 Transport event, Open Motors was also awarded entrance to participate in the IMPACT Growth Smart Cities Program in Madrid, Spain. IMPACT is an accelerator for startups focused on solving the challenges of urbanization by optimizing resource consumption and improving services through better management of supply and demand. Open Motors has been chosen as an innovative solution in transport management and mobility.

Wikifactory[1]

https://wikifactory.com/

Carolina Portugal in response to questions by José Ramos



Source: Wikifactory

José Ramos: What is the purpose of wikifactory, what does it exist to do?

Carolina Portugal: Wikifactory is a social platform for collaborative product development. We connect product developers with each other and the tools to accelerate their work. Our platform has been inspired by the best practices of software and product development, and have built our platform from the ground up.

We are where ideas get worked on collaboratively and become hardware products. Think a social Github for stuff meets an Alibaba for new hardware products.

We want to let you turn the ideas in designer head into open and closed source hardware products.

We want to be a place where communities can gather and work together on your products.

We want teams to be able to co-create and innovate in private or public with open source or closed source products.

We want people to be able to view, annotate, work on, give feedback on 3D files, assemblies, products, versions, and parts.

Teams are everywhere, partners are all over the place, everyone uses different software, but all can't effectively work together on versioning, annotating and giving feedback on your projects in an inexpensive, natural way.

We are disrupting the PLM software industry by making a spare, easy to use, cloud-based solution that works for small, agile teams.

Teams need a scale-free manufacturing partner that will let them make a prototype, a series of a 100 3D printed parts, then 500 assembled products and later on a series of 1000 products a week.

With one (private) upload, teams can connect you to the right vendors for the project.

No hassle with file types, language issues, many different emails.

With deep manufacturing and China experience, we can connect teams to the right partners for every stage of the process.

We aim to drastically reduce the cost, and massively accelerating the speed at which innovative products can be brought to market.

We are a critical tool for a future where starting a product company is as accessible, and low-risk as beginning a publishing, video production or software company is today.

José Ramos: How did it start? What was the inspiration?

Carolina Portugal: Products are becoming more complex, often comprising mechanical parts, electronic components, and software. In short, modern products require collaboration amongst people with a wide range of skill sets and specific production processes for each part of the product.

However, hardware teams today are still using tools like Dropbox to share files and Microsoft Excel to manage complex workflows. The result is higher costs, slower product development, and error-prone sourcing.

What underpins that collaboration in the first place? How do distributed online communities and teams develop software together? These are the core questions that Wikifactory asked as a team when we came together in 2016.

Inspired by the proven collaboration methodologies from the open source software, we believe we can finally make access to agile PLM tools affordable for small and medium sized product companies.

José Ramos: What are some examples of projects or events that wikifactory has done that exemplified it?

Carolina Portugal: We created the white label for the whole community of Fablab community (https://projects.fablabs.io/). A Fablab can now use Wikifactory to have an open source file repository for the vast number of projects from the network. Fabbers can now showcase and make available their project developed at a FabLab to the world and welcome contribution.

We've visited many FabLabs, Makerspaces and Hackerspaces. Time and time again we've noticed just how much truly stunning work was kept locked up behind closed doors. FabLab members share, teach and work together locally to make more things makable. But, even though works are often displayed they tend to remain behind the door of the FabLab.

Wikifactory was made to change this. That way FabLab can spread their inventions, innovations and projects around the world. We hope that through Wikifactory's versioning, exploded file view and easy collaboration open source hardware projects are empowered, spread and most importantly documented.

Another interesting project we have is the the Shaji Open Market Platform. One feedback we get quite often is about how could one earn on open source design and hardware. Driven by this idea, we've had an eye out for creative opportunities that make it possible for our community to make money out of their projects.

Thanks to our collaboration with Shenzhen Open Innovation Lab, we have the chance to do an amazing experiment that could earn you a bit of income:

SZOIL is friends with the Shaji 'Taobao' town that pretty much manufactures and sells most of the furniture sold on the Taobao e-commerce website, which is the equivalent of an Amazon in China just that it is powered by small vendors.

This is what it is interesting about the Chinese economy compared to Europe or the US, that most online purchases are from small sellers than big brands. Having built roots into the hardware and maker scene in Shenzhen and China too, we saw a real open source movement happening on the ground that isn't really known.

That's why furniture manufacturers of Shaji can sell the furniture designs they produce directly on Taobao as a small vendor, using quality CNC machines in facilities that are as or more advanced than the workshops in Europe.

The Shaji community have asked us whether we could connect them to genuine European or American furniture designs that they could produce with their CNCs and sell to the Chinese market. Authenticity is important to them so they want to pay for a proper License. Ideally each product can have a QR code (which is ubiquitous in China) and the customer can scan it to learn more about the designer and where it comes from. Maybe even give feedback and rate the manufacturer.

We could help them source proprietary international designs who would do with the typical supplier route, but we think there is a chance to give open source design a chance here.

José Ramos: How does wikifactory express the logic of open source design and production / cosmo-localism?

Carolina Portugal: Building community and social networking both online and offline is absolutely vital for the distributed design to take off. From wind turbines for clean energy, water filtration systems for clean water, agricultural systems for biodiversity - product development teams are tackling the world's most pressing social and environmental problems. We should continue to make it possible for this community to come together in events, conferences, faires, workshops of all kinds and locations as have done by many cited in the book, and we should foster that.
At a more fundamental level, distributed design calls for universal access to

creation. Where the access to tools of design and fabrication are distributed, making it possible for someone in a remote location with flexible, digital production tools to freely source designs for the things that s/he could make for his/her community. Where the materials used for fabrication are sourced locally too, turning waste into value. Ultimately, a future where anyone that faces a problem to solve in their lives, can have the productive tools to fabricate, test and iterate quickly to arrive at a solution.

José Ramos: How does wikifactory "bend" technology into a social - ethical context of application?

Carolina Portugal: Our goal is to empower all communities, regardless of their gender, ethnicity or (dis)ability to take part in innovative problem-solving. All efforts in that direction are fundamentally new and to be tested, which makes it an incredible opportunity for further research and development for distributed design. We believe in the creative problem solving potential of people.

José Ramos: What is the operating / business model of wikifactory? How does it sustain itself, grow and provide value to the community?

Carolina Portugal: Our business model essentially is and will always be free for open source and public projects, whilst private projects will require a subscription. We were inspired one more time by the Github model. We also offer a custom whitelabel our site with an upfront fee.

José Ramos: What is the governance model? Who owns it and has operating rights?

Carolina Portugal: Wikifactory is a startup founded by 4 cofounders:

> Tom Salfield
>
> Tom is the co-founder of Wikifactory and has been a thought-leader and entrepreneur within various fields, all to do with socio-economic transformation. He is also a co-founder of the Hub, no known as Impact Hub.
>
> Nicolai Peitersen
>
> Nicolai is the co-founder of Wikifactory and entrepreneur within various fields, all to do with socio-economic transformation. He is the co-author of The Ethical Economy

book.

Chirstina Rebel

Co-Founder and Chief Growth Officer at Wikifactory. Motivated to deliver social innovation by harnessing my abilities in research, business development, community development, web development and communications design.

Maximilian Kampik

Technologist & Interaction Designer fusing pixels, bits and atoms. Co-founder and CXO at Wikifactory.

We have raised $1.5 m to date in investment from a series of angel investors from around the world that concord with our vision and that consider themselves as social impact investors. We are governed by a Board of Directors of 3, but managed by an Executive Team comprising of the co-founders and a COO.

José Ramos: What is the ecosystem for the enterprise? Who are the communities that drive the value and receive the value?

Carolina Portugal: Wikifactory is home to a diverse community of designers, engineers, makers, technologists and other creative problem solvers keen to grow their skills and learn new things by contributing to open source and private projects. From robotics to prosthetics, furniture to agri-tech, bio-tech to drones - the applications developed on Wikifactory are very broad and range and therefore reaching out to product developer communities from across the maker/product innovation network.

José Ramos: How do you see wikifactory fitting into the transformations happening in the world today? How does wikifactory participate in these great challenges, transitions and transformations?

Carolina Portugal: Much like we've seen the internet disrupt industries from news media, music and video, to commerce and financial services we now expect to see disruption of product development and manufacturing industries.

A new era of collaborative design and production engineering is emerging, which involves communities of designers, software companies and developers, manufacturers in new and more flexible economic relationships to deliver increasingly customised products and compete with large corporations in smaller more agile groupings.

3 key trends are set to disrupt the way the next generation of physical products are designed, manufactured, and distributed.

Product design is going online. 3D models.
Increasingly flexible machines such as 3d printers, CNC, robotics.
Open, internet-enabled, supply chains.

We believe wikifactory will be able to provide open standards and infrastructure for:

The way product designers share and work with files online.
Interoperability between all the software services necessary to do design to production (CAD-CAM, Simulation, Industrial IOT, Quality Testing data).
Internet connected production capacity of flexible digital fabrication machines

José Ramos: Methodologically, how does wikifactory participate in addressing these great challenges, transitions and transformations?

Carolina Portugal: Setting up collaboration infrastructure around open source project for things like sharing files, documentation, or getting feedback is a time consuming, costly task. Wikifactory takes the hassle out of this by providing a free, elegant and user-friendly experience so teams can invest their time and resources in what you care about most - the product and community.

07

Cosmolocal Snapshots

Appropedia[1]

1 www.appropedia.org/Welcome_to_Appropedia

Sharon Ede

Hexayurt at Strong Angel 3, San Diego, California. Source: appropedia.org

Why?

Transitioning to a more sustainable way of living requires new, rediscovered, or reinvigorated ways of being in the world. By sharing existing knowledge bases with others, more time and effort can be invested into building on or improving existing ideas and methods, rather than many different communities reinventing a similar wheel.

Appropedia is a 'sustainability wiki', and an online 'knowledge commons' directory/encyclopaedia of sustainable living. It's objective is to build the infrastructure that enables many contributors to curate and share the content that can assist communities and individuals to pursue sustainable ways of living.

What?

Appropedia is an open platform for knowledge-sharing about sustainable living in the form of a wiki (that works in a similar way to Wikipedia) - anyone can add their knowledge and contribute. It's development is underpinned by the Appropedia Foundation, a collective of individuals and organisations who share the ethos of making sustainable living knowledge freely available.

How?

Appropedia exists online in wiki format, and while it does not undertake physical activities in and of itself, it's content is open source, which means any of the information can be freely downloaded and reproduced in any location which wants to make use of it.

Appropedia is also available for 'service learning' approaches, where academic instruction is combined with community service. Those working on such projects are encouraged to make the learnings and designs available to others by adding the content to the wiki. One example from Mexico is the instructions for building a vaccination refrigeration device powered by photovoltaics.

Impact

Appropedia has 8,800 articles across categories from Design (including sub topics like Green Manufacturing) to Construction to Health. A recent update on Appropedia's reach revealed it has 65,000+ pages, over 400,000 edits have been made by users, it receives over 1 million visits every year, has had over 34,000 files uploaded, and has been referenced in academia over 850 times.

There are also testimonials from users of the site eg. an inventor from the Philippines who created a biogas digester had increased exposure for his design, which has been viewed 90,000 times, and has been contacted by people who used his plans to build their own version.

COSMOLOCALISM[1]

Vasilis Kostakis

Image: Research group, source https://www.cosmolocalism.eu

1 https://www.cosmolocalism.eu

In the midst of a systemic crisis, it is imperative to create evidence-informed awareness of new capitalist and post-capitalist futures. COSMOLOCALISM is an action research project, funded by the European Research Council, which aims to advance our understanding of how to create a sustainable economy through the commons. COSMOLOCALISM thus studies the convergence of the digital commons (e.g., open knowledge and design) with local manufacturing technologies (from 3D printing and CNC machines to low-tech tools and crafts). This convergence could catalyze the transition to new inclusive and circular production models, such as the "design global, manufacture local" (DGML) model.

DGML describes the processes through which design is developed as a global digital commons, whereas the manufacturing takes place locally, through shared infrastructures and with local biophysical conditions in check. DGML seems to form economies of scope that promote sustainability and open innovation while celebrating new ways of cooperation. However, such claims rest on thin conceptual and empirical foundations.

COSMOLOCALISM is a pilot-driven investigation of the DGML phenomenon that seeks to understand relevant organizational models, their evolution, and their broader political economy/ecology and policy implications. Through the lens of diverse case studies and participatory action research, the conditions under which the DGML model thrives are explored.

COSMOLOCALISM has three concurrent modules: democratization; innovation; and sustainability. First, DGML governance practices are studied, patterns are recognized, and their form, function, cultural values, and structure are determined. Second, the relevant commons-based innovation ecosystems and their potential to reorient design and manufacturing practices are examined. Third, selected DGML products are evaluated from an environmental sustainability perspective, involving both qualitative and quantitative methods.

*Note

Vasilis Kostakis is the Principal Investigator. The core team also includes Chris Giotitsas, Ifigeneia Douvitsa, Kaire Holts, Mina Kouvara, Indra Lal Acharja, Lucas Lemos, Alekos Pantazis, Alex Pazaitis, San Pisith, Christina Priavolou, Alícia Trepat Pont and Katerina Troullaki. Wolfgang Drechsler, Karin Kruup, Vasilis Niaros, Maro Pantazidou, Ben Robra, Nikiforos Tsiouris and Tonia Vita serve as Project Associates.

FarmBot[1]

1 https://farm.bot/pages/research

Michel Bauwens and José Ramos

FarmBot is an open-source automated farming machine. Rory Aronson, the founder of the project writes: "Picture it as a giant 3D printer outfitted with a seed injector, sprayer, plow, and sensors."

The mission of the project is to produce free and open-source hardware plans, software, data, and documentation such that anyone can build and operate a farming "robot". Aronson created the FarmBot to harness economies of scale and modern technologies. The machine comes equipped with a web-based software package that can be easily modified. Users simply design their farm (graphically) and upload their numerical specifications to the hardware. The hardware functions as a completely automated food production machine, with the capability for sensing (e.g. soil moisture), planting (seeds), irrigation (water spraying) and other functions.

Models range from 3.6 m^2 to 18 m^2 for a raised garden bed that can be used in backyards, but the aim of the project is to be able to scale. While the project is both commercial, as an "out of the box" farmbot can be purchased, it is also a research and prototyping project. Research is being done on FarmBot's yields, life cycle analysis and carbon footprint, and return on investment. It can be seen in the context of other efforts such as FarmHack, L'atelier Paysans and even Open Source Ecology.

The project has extensive research partners around the world, applying farmbot for different contexts, such as NASA, and UC Berkeley. As well, over 500 educational institutions have integrated FarmBot into their curriculum.

Field Ready[1]

1 www.fieldready.org

Sharon Ede

Image from: https://3dstartpoint.com/wp-content/uploads/2017/09/wtfff-490-banner.jpg

Why?

When humanitarian aid is required, especially in the context of disaster response, accessing an open design repository of items that can be fabricated closer to where they are needed is not only faster and more cost effective than the inefficiency, slowness and expense of long and complex supply chains - it saves lives.

Research by Griffith University into the logistics of humanitarian aid has shown that up to 80% of the expenditure of the world's aid agencies goes to buying supplies and moving them around the globe, at a cost of $US15–20 billion a year.

Field Ready is a non-profit organisation which works to shorten the supply chains of humanitarian aid and disaster response through local fabrication using open, shared designs.

What?

Field Ready contributes to humanitarian needs and international disaster relief efforts, including making humanitarian aid supplies in the field, using open design and innovative logistical and local manufacturing methods.

Field Ready's pursuit of approaches like local production and repair, driven by necessity and cost in the humanitarian aid sector rather than carbon emissions or waste policy, shows how revolutionising approaches to disaster response and resilience is at the vanguard of a broader application and learnings around how we make and move things in industrial economies.

How?

Field Ready fabricates, and equips and trains local communities to fabricate, supplies in the area where they are needed. Often the damage, loss or breakage of one small part can immobilise a key piece of equipment or an entire operation in remote or dangerous areas where there is no express shipping, and where the only transportation options may be boat, helicopter or yak. In these scenarios, local production from available materials can make all the difference in securing a water supply, keeping a medical clinic operating, and keeping people alive.

Field Ready have been active in humanitarian aid response and disaster preparedness in Nepal, Syria, Haiti, Iraq, The Sudan, Kenya and the South Pacific. These efforts have included establishing and supporting makerspaces, developing designs for and fabricating search and rescue equipment, medical equipment, mentoring/training and capacity building.

Impact

According to its 2017 Annual Report, Field Ready trained 572 people and made 78 unique designs across six countries. Four of Field Ready's innovations (an otoscope, a connector, an antenna and a rescue airbag) have been assessed as providing cost savings of between 50% - 90% according to independent research. Field Ready's 'rescue airbag', designed to lift up to 5 tonnes of rubble in search and rescue operations, is being made locally due to the prohibitive cost and difficulty in shipping supplies to crisis areas like Syria. Built to meet British standards, and representing a 90% reduction in cost compared to importing, the airbag was designed and tested in London and Istanbul, before being manufactured from local materials, then deployed for use with the 'White Helmets', the Syria Civil Defence. The only shipping associated with this device was emailing the design, which has been made open source and shared with others who may need it.

In 2017, Field Ready was part of the consortium (through World Vision) of the Australian Humanitarian Partnership, a five year, $50 million commitment by the Department of Foreign Affairs and Trade (DFAT) to deliver programs across the Pacific region. Field Ready, with the support of DFAT, opened a makerspace in Suva, Fiji in 2019, and have previously established a makerspace in the Kurdistan region of Iraq with the support of the German government.

GLIA[1]

1 glia.org

José Ramos

Source: glia.org

Glia is an open-access research, development and distribution project to create high-quality low-cost medical devices that are then clinically validated. They believe in creating and sharing hardware that is easily accessible and can be manufactured in low-resource settings. Hundreds of their devices are already in use around the world. The project was founded by Dr. Tarek Loubani. According to their website, GLIA:

"...want[s] to change the way people interact with their devices. Providing communities with open-access low-cost medical devices fosters a culture of self-reliance and sustainability. If low-resource communities can access the equipment they need via an open-access model, they are empowered to troubleshoot problems, customize designs to meet their needs and share their findings with others. The ability to share successes in an open-access environment allows medical and technical communities to work together and avoid duplication of work and long feedback cycles. This model allows off-patent devices to exist as high-quality low-cost generic models, which also exerts downward pressure on prices for high-quality premium brands."

GLIA has run healthcare projects in Gaza (Palestine), supplying 3D printed medical devices, such as stethoscopes, face shields, and tourniquets, and most recently in the fight against Covid-19. They are also developing an Aerosol-Reducing NIV Mask and otoscope.

Hexayurt[1]

1 http://hexayurt.com/

Christina Priavolou

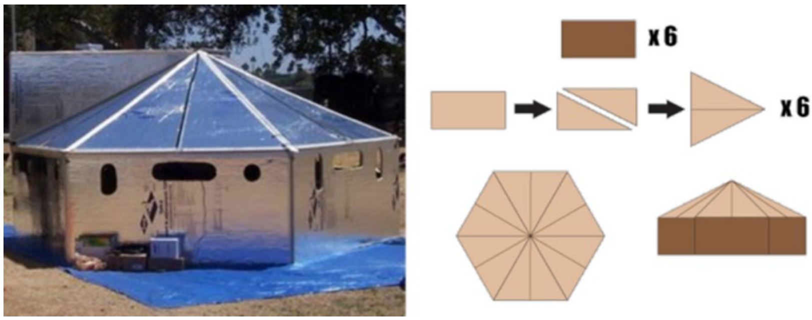
Source: http://hexayurt.com/

Geodesic domes are spherical building structures composed of triangular elements. Utilising the most efficient shape of nature, several geodesic domes have been developed through digital fabrication technologies.[2] Nevertheless, issues related to the geodesic structure were traced—including high amounts of unused material and the need for specialised skills.[3]

In an endeavour to overcome these problems, the Hexayurt project was introduced by Vinay Gupta in 2002 as a modified geodesic dome. Hexayurt is an open-source construction set made of environmentally friendly building materials (like plywood, Oriented Strand Board, Hexacomb cardboard, etc.). It was developed as a simple disaster relief shelter for areas prone to tropical storms, earthquakes, and tsunamis, like Haiti. Classic, semi-folding and fully-folding Hexayurts can be built with simple tools, such as table saws.[4]

2 Buron, J., & Sánchez, M. (2015). An Open-source, Low-cost & Digitally Fabricated Geodesic Dome System. *Iterations*, 01, 24-29.
3 Harriss, E. (2017). Zero Waste Nearodesic Domes. http://www.tilings.org.uk/Hexayurt_Family.pdf.
4 Appropedia. (2017, September 25). Hexayurt playa. Retrieved from http://www.appropedia.org/Hexayurt_playa

Moving to the core of the Hexayurt construction system, a synthesis of triangle and rectangle combinations is observed; triangles are formed by cutting standardised sheets along the diagonal, minimising unused material (see figure). Detailed documentation of the construction process—including information associated with common insulating materials (e.g., R+ Heatshield, thermax, and tuff-R), various types of tape (e.g., foil, bi-filament and vinyl), tie-down techniques (e.g., rope halo and tape-anchors) and the creation of paper models—is available online.



The Hexayurt project and its cutting models
Source: Adapted from Hexayurt, 2018

Hexayurts are lightweight, fast and easy to build under the supervision of one coordinator, while the most straightforward cardboard-made structure costs approximately $100.[5] These factors rendered Hexayurts quite popular, as indicated at the annual Burning Man festival.[6] Moreover, their geometry induced the interest of educators, who used it to organise collaborative learning activities for geometry.[7]

The Hexayurt prototypes are being developed by volunteers who perpetually improve the designs. For example, being a variation of a previous prototype, H13 Hexayurt was introduced to solve the problem of low door height. There are 13 Hexayurt design structures freely available to download, replicate and improve worldwide. The Hexayurt utilities package was developed as a transportable, autonomous infrastructure, including composting toilets, drinking water purification, solar electric lighting and fuel-efficient stoves.[8]

5 Hexayurt. (2018). *The Hexayurt Project: Free Hardware Housing for the World*. http://hexayurt.com/#500

6 Hexayurt. (2018). *The Hexayurt Project: Free Hardware Housing for the World*. http://hexayurt.com/#500

7 Banks, T., Wallace, S., Searcy, J., Sedas, M., & Peppler, K. (2017). Design Math: A Design and Project-based Effort to Learn Geometry in Middle School through Fabric-Based Yurts. Proceedings of the *7th Annual FabLearn Conference*. Palo Alto, US: Stanford University.

8 Appropedia. (2017, September 25). Hexayurt playa. Retrieved from http://www.appropedia.org/Hexayurt_playa

Concerning future directions of the Hexayurt project, recent attempts focus on the use of more durable and recyclable materials, such as honeycomb polypropylene.[9] Innovations in the development of its construction system have also been made.[10] Moreover, additive manufacturing technologies have been applied in the structure, taking the form of 3D printed wall brackets as a way to facilitate the assembly.[11] Finally, concerns about the structural performance of the Hexayurt and its vulnerability to high winds have led to the materialisation of model tests.[12]

9 Hexayurt. (2018). *The Hexayurt Project: Free Hardware Housing for the World.* http://hexayurt.com/#500

10 Erkelens, P. A., Akkerman, M. S. K., Cox, M. G. D. M., Egmond - de Wilde De Ligny, E. L. C. van, Haas, T. C. A. de, & Brouwer, E. R. P. (2010). Innovative shelter for disasters. Proceedings of the *CIB world congress* (pp. 97-110). Manchester, UK: CIB.

11 Eplaya, (2015, August 15). Hexayurt 3D-Printed Wall Brackets. Retrieved from https://eplaya.burningman.org/viewtopic.php?t=75034

12 Maxwell, A., Suskin, T., & Yang., Y. (2012). The Analysis and Construction of a Nearodesic Tri-Dome. http://files.howtolivewiki.com/hexayurt.com/Nearodesic_TriDome_Report.pdf

*Note

*This article was originally published as: Priavolou, C. (2018). The Emergence of Open Construction Systems: A Sustainable Paradigm in the Construction Sector?. *Journal of Futures Studies*, 23(2), 67-84.

Christina Priavolou acknowledges financial support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 802512)

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Eplaya, (2015, August 15). Hexayurt 3D-Printed Wall Brackets. Retrieved from https://eplaya.burningman.org/viewtopic.php?t=75034.

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Maxwell, A., Suskin, T., & Yang., Y. (2012). The Analysis and Construction of a Nearodesic Tri-Dome. http://files.howtolivewiki.com/hexayurt.com/Nearodesic_TriDome_Report.pdf.

LEKA Restaurant[1]

1 https://restauranteleka.com/open-source/

www.archdaily.com/868172/leka-open-source-restaurant-iaac-fab-lab-barcelona

Sharon Ede

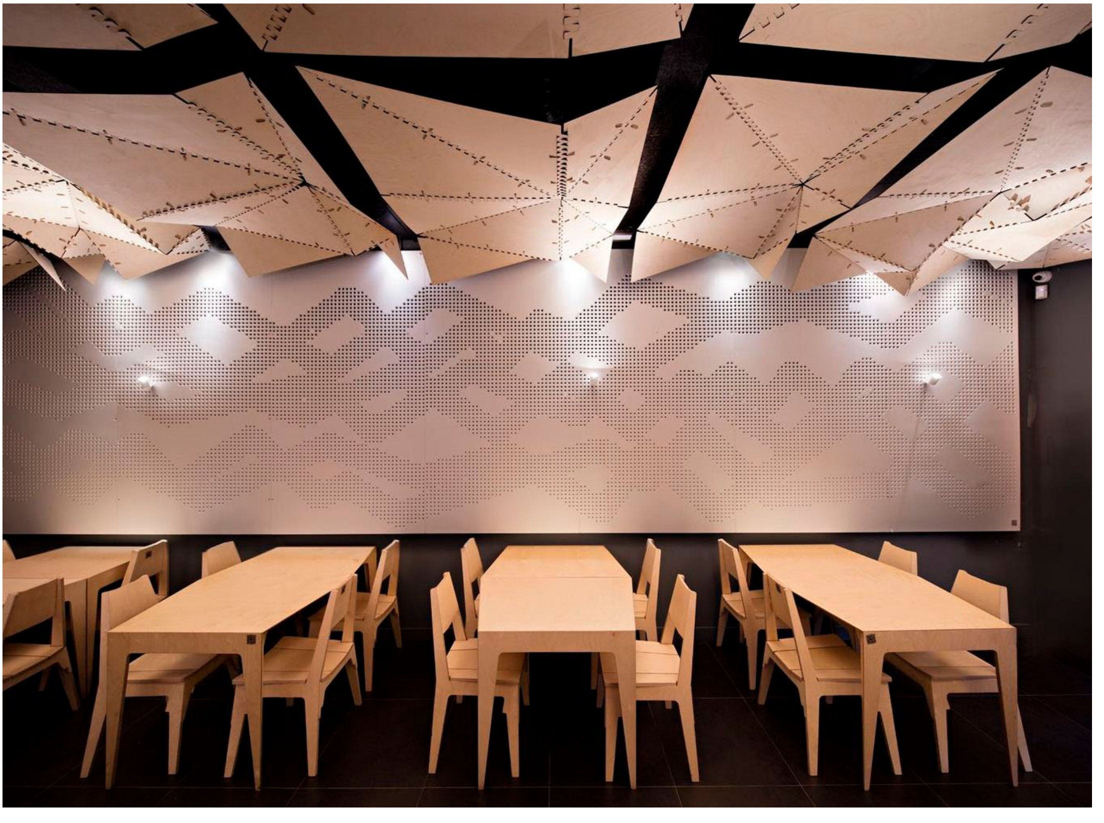


Photo: Javier Callejas for Achidaily

Why?

The things we buy to fit out or create a space are often purchased from retail outlets, who in turn bring in product that has been shipped over great distances after being assembled from components sourced through complex supply chains.

LEKA is a restaurant in Barcelona, Spain, which sought not only to source the food and drink for its menu locally, but also the fabrication of the interior. Both the designs for the fit out of the restaurant, as well as the recipes for the food on its menu, are available for download on the restaurant's website. This means anyone can replicate the furniture in the restaurant, or its menu items - depending on their fabrication and culinary skills! Just as 'design' is a set of instructions, like a recipe, LEKA Restaurant shows how one form of cosmolocalism (where the information of a recipe travels, but the cooking happens close to where the food is consumed) can be applied to new areas such as manufacturing.

What?

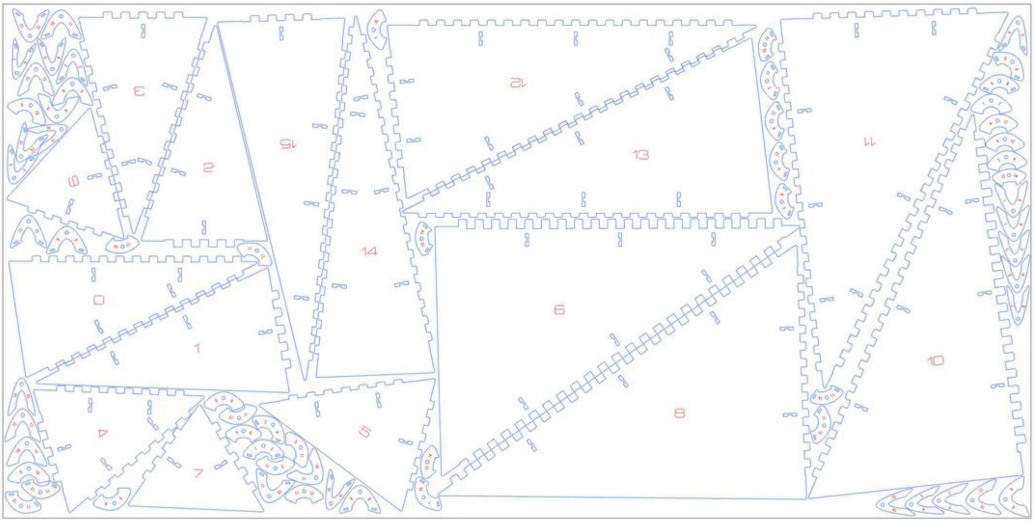
The fitout of the 100m square restaurant in the Poble Nou district of Barcelona was part of a 2015 local fabrication partnership with Fab Lab Barcelona. All of the modular furniture and fittings, from tables and chairs, to the ceiling, wine rack and sign, were designed in collaboration with the restaurant, and manufactured in the Fab Lab.

Fab Labs (fabrication laboratories) are a global network of shared fabrication workshops which emerged from MIT in Boston, and the Lab in Barcelona is part of the Institute for Advanced Architecture of Catalonia (IAAC).

How?

The restaurant fitout for LEKA was made in the Fab Lab, then all the parts were walked from the Lab a few hundred metres up the road to the restaurant, and assembled on-site. The making of the elements occurred in the very same district the fitout was to be installed, which would have radically reduced transport-related carbon emissions associated with production and sourcing from elsewhere. An interesting study would be to quantify emissions from a typical restaurant fitout and compare it to emissions from the LEKA fitout.

The use of digital fabrication technologies also results in minimisation of waste, as the design can be planned and cut to maximise use of material as much as possible:



Design Element. LEKA Restaurant

Impact

LEKA Restaurant shows what is possible in terms of hyper-local production from a shared design commons. Although it is unclear whether reclaimed materials were used in the fabrication of the fitout - which would make it a true example of circular economy - LEKA Restaurant demonstrates how fitouts can utilise local labour and expertise to manufacture what is needed, where it is needed, rather than shipping it thousands of kilometres across the globe.

In accordance with its overall commitment to sustainability, LEKA has also reduced its consumption of plastics, glass and aluminium by 70-80%, and sources most of the food on its menu locally, including their vegetables from a garden planted at the 'Green Fab Lab' at Valldaura.

Multifactory[1]

1 https://multifactory.eu/

Michel Bauwens


R84 Multifactory


Risma11 Multifactory


Biassono Multifactory

Photo: Multifactory

Multifactories create collaborative economies out of co-manufacturing workspaces. They aim to remould buildings no longer in use by setting up a community of enterpreneurs, small factories, artists and craftsmen to support individual activities as well as promoting synergies. The multifactories create dynamic economic activity within the co-manufacturing workspace, enhances the local economy and creates connections with other multifactories in different regions.

What distinguishes a multifactory from a fablab or makerspace is an explicit productive and commercial vocation, but coupled with cooperative and open source modalities of cooperation. Typically a multifactory is a project by associated craftspeople working with various materials, for example iron, wood, textiles but also 3D printing. It is often located in former industrial buildings. Here is the description of an sample site, i.e. the MAGE project in Milan:

"MAGE in Sesto San Giovanni (Milan), also known in Italy as the "Town of Factories". MAGE is an industrial building of 1700 square meters, formerly used as warehouses. At MAGE now you can find 17 small companies and/or associations: crafts makers, sewers, dressmakers, two bag factories, a bikefactory, laser cutting, 3D printing, photographers, architects, jewellers, filmmakers, and artists. We produce goods, ideas and culture since 2010."[2]

Each member works autonomously for their clients but can also cooperate with the other members. The governance of the building and its mutualized services is cooperative and open source principles are adhered to. According to a 2018 report by Lorenza Victoria Salati and Giulio Focardi, there were already 120 multifactories in Europe by that time writing.[3]

This is how the report describes the cooperative aspects:

"In a multifactory, each company keeps its own operational in-dependence and private spaces and is responsible together with all the others for the common parts and strategic choices concerning territorial development (calls, institutional relations, common events).

The three key principles of the multi-factory model are:

- to be a community project,
- have diversity and
- a productive vocation.

A multifactory is a community project since all the companies that are part of it are also members of the managing body of the multifactory itself. All companies are responsible for the decisions and performance of the multifactory.[4]

The multifactory model is explicitly cosmo-local as it combines both being anchored in a place for local production, but the "Invisible Factory" is their common space of mutualized resources, where members of the whole network can share designs and can decide to work together independently of the locality of the site.

Here is how the report describes the Invisible Factory:

"The invisible factory is based on the idea of defining other

2 See: https://wiki.p2pfoundation.net/Multifactory_Models_for_the_Community_Economy

3 Salati, L. V., & Focardi, G. (2018).*v* Sarajevo: Akcija Sarajevo.

4 https://wiki.p2pfoundation.net/Multifactory_Models_for_the_Community_Economy

> *economic subjects in the same working environment as possible resources. There are peer resources that carry out their own individual activity, but that can be activated in case of need in order to plan demanding projects, on the basis of a structure of pre-debated and pre-accepted agreements within the system of the multi-factories. Always available buffet of resources, of which everyone is part, and from which everyone can get the necessary skills when required. One of the advantages of the Invisible Factory is to enable a group of small companies to tackle large projects by supporting a low initial investment and taking on a low business risk, unlike what happens when a small company acquires a large order and finds itself in a financial and resource crisis as it is highly exposed as a prime contractor or has to incorporate human resources which, once the project is completed, are then difficult to fully employ."*[5]

5 Salati, L. V., & Focardi, G. (2018). *The Rise of Community Economy: From coworking spaces to the multifactory model.* Sarajevo: Akcija Sarajevo.

The report mentioned above also stresses the common sociological patterns found in the different places, quite independently from the local territorial culture. There is a broad agreement on values. It is quite significant that this model, which is rarely subsidized, has been able to grow so significantly across the European continent.

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Salati, L. V., & Focardi, G. (2018). *The Rise of Community Economy: From coworking spaces to the multifactory model.* Sarajevo: Akcija Sarajevo.

Open Source COVID-19 Medical Supplies[1]

Sharon Ede

1 https://opensourcemedicalsupplies.org

Image from: www.facebook.com/photo.
php?fbid=118633783162096&set=p.118633783162096&type=1&theater

Why?

As COVID19 became a pandemic and began to rapidly spread in many countries, concern about shortages of PPE (Personal Protective Equipment) came to the fore. Rather than stockpile large amounts of face shields, masks, ventilators and gloves, health agencies assumed they could be ordered and supplied quickly. However the shutdowns of workplaces and transport associated with containing the pandemic hampered this approach, especially as every country needed the PPE at once.

Open Source COVID Medical Supplies (OSCMS) is an international community of over 73,000 members convened in a Facebook group which works to harness the making skills of citizen fabricators to make supplies and PPE, a grassroots initiative to complement government and market response to needs.

What?

OSCMS facilitates the crowdsourcing and collaboration on designs of faceshields, masks, ventilators and other requirements of frontline and second tier staff, so that critically needed supplies could be made and dispatched quickly by local makers and businesses. Iterations on improvements to design so that they are in accordance with health and safety requirements can happen very quickly, offers of product can be made visible to communities who need it, and urgent needs are also flagged directly with the community by frontline staff putting a call out for help.

How?

OSCMS enables designers and makers to collaborate virtually on design and production, and for others to be involved according to what they can contribute, which may be developing outreach materials, liaising with hospitals, delivery or more. The group includes medical professionals who have detailed knowledge of health professional and patient needs. This curation process means that the best designs are identified and shared across the world, and included in the Medical Supply Guide (https://osms.li/guide) which has been developed as a repository for local makers.

The OSCMS group has also developed a Local Response Guide (https://osms.li/localresponse) to help communities organise, including identifying what to produce, what to consider in terms of standards and sterilisation, and how to engage public officials who are responsible for procuring supplies.

Impact

Each week, OSCMS asks its members to update their production tally by submitting their details (name of group, what they produced in what quantity). In just 18 weeks, members of the open source community have shipped over 15.2 million units of medical supplies.

OSCMS also provides a valuable example of what is possible in terms of harnessing citizen response, and highlights what is needed to assist those efforts. However, the energy and enthusiasm of citizen makers/fabricators needs to be organised in order to be useful, including establishing public-commons protocols to provide an interface between government and citizens, and citizens and industrial scale manufacturers, just as there is a protocol/interface between business and government. Governments generally tend to not understand open source, nor have a way to procure from individuals or loose associations of people rather than organisations. There is no central register of needs published by government to guide citizens on where to focus effort (what is needed, in what quantity, and where? And to what specification can they be made, even if not to standard, what is the minimum standard which is acceptable in a shortage crisis?). Conversely, there is not a lot of understanding in government about the capability of what these networks have to offer. Citizen capability, which includes people like engineers, medical professionals and skilled specialists as well as DIY types, could be identified and mapped in the same way as industry capability.

Open Source Ecology[1]

1 https://www.opensourceecology.org/

José Ramos

Photo of Seed Eco-home

Started in 2003, Open Source Ecology was one of the first examples of open source applied to hardware, and was an inspiration to many people and other initiatives. It initially had the goal of making the 50 most fundamental machines open source, that would allow "anyone to build their own tractor or harvester from scratch... the first step in a project to write an instruction set for an entire self-sustaining village."[2] This goal is called the Global Village

2 From: https://www.ted.com/talks/marcin_jakubowski_open_sourced_blueprints_for_civilization?language=en

Construction Set. It is a visionary and comprehensive set of machines that would provide technological subsistence outside of the commercial market economy and within an open source ecosystem - “the 50 most important machines that it takes for modern life to exist .” In the words of founder Marcin Jakubowski:

> *“The set of machines I’m developing covers agriculture, energy, transportation, production — essentially every piece of human infrastructure we rely on to provide a modern standard of living. Do you eat? Yeah, you eat. So you need agricultural equipment to feed people optimally – everything from a tractor to a bakery oven. What other tools might we need? A circuit maker, industrial robots, renewable energy equipment, construction equipment, fabrication equipment. For transportation, a car — a 100-mile-per-gallon renewable energy car, which will run on a modern steam engine using pelletized biomass as a renewable energy source. Algae could potentially work, as well. For renewable energy, we are working on a solar concentrator that’s essentially a point-focus dish-like system made of multiple mirrors, but on a 5-to-50-kilowatt unit scale. These are scalable and modular, so we can build a number of them and produce a lot of power.”*[3]

The ambitiousness of the project has meant that the prototyping, testing and documentation of some machines were prioritized and completed and others have not yet been fully prototypes or documented. According to their website, 4 machines are 100% complete: a Compressed Earth Brick Press, 3D Printer, Microhouse (also documented in this anthology), and Power Cube. Many other machines are near completion / final documentation (7-8), and the rest are half completed or yet to be started as projects.[3] This should not be seen as a failure as OSE has relied on a volunteer community of engineers, hackers and community or foundation funders. Their achievements are substantial even if incomplete, and the “incompleteness” is an expression of the visionary goals (50 open source machines), which have also acted as an attractor and inspiration for many.

OSE are also prototyping the Seed Eco-Home, a demonstration of eXtreme Manufacturing techniques, documented in the OSE wiki.[4] They also run workshops on building the Seed Eco-Home 2, Aquaponic Greenhouse, 3D Printer, Tractor, CNC Machines (CNC Torch Table, CNC Router, CNC Sawmill, CNC Grinder, Metal 3D Printer, CNC Lathe, and CNC Mill) and other heavy machines and construction equipment.[5] They are at time of writing prototyping an open source, 3D printed cordless drill.[6]

3 https://www.opensourceecology.org/gvcs/
4 https://wiki.opensourceecology.org/wiki/Seed_Eco-Home
5 https://www.opensourceecology.org/summer-x-2021/
6 https://en.wikipedia.org/wiki/Open_Source_Ecology

OSE Microhouse[1]

1 https://wiki.opensourceecology.org/wiki/OSE_Microhouse

by Christina Priavolou

Source: https://wiki.opensourceecology.org/wiki/OSE_Microhouse

Open Source Ecology (OSE) is a volunteer collective of diverse disciplines, including designers, engineers, builders, and farmers, initiated by Marcin Jakubowski in 2003.[2] The objective is to create a collaborative platform towards social and environmental justice through the manufacture of the Global Village Construction Set (GVCS). The latter includes open-source tools of 50 industrial machines (such as tractors, wind turbines, ovens, cement mixers, etc.) made of widely available raw materials (such as soil, limestone, hay, and wood) at a fraction of the corresponding conventional costs. Rapid prototyping, swarming construction and module-based design are key elements of the OSE initiative.

2 Open Source Ecology. (2018). OSE Developers. Retrieved from http://opensourceecology.org/wiki/OSE_Developers

Sparked in 2013, the OSE Microhouse project targeted at the provision of expandable, ecological, affordable and autonomous housing (Open Source Ecology, 2018). Its modularity enables the concurrent building of different parts—including plumbing, electrical systems, and building components.

Through dedicated volunteers and OSE machines of the GVCS, compressed earth blocks can be manufactured out of soil and assembled by amateur builders.[3] Thus, transportation costs are reduced, since the primary building material is damp soil subject to compression at high pressures.

3 Reinhart, C. (2013). *Design and Thinking. Alumni Symposium.* Ball State University, USA.

In an attempt to democratise housing by using open-source tools and methods, OSE established a partnership with the Open Building Institute (OBI) founded by Catarina Mota in 2016. The aim was twofold: first, to create an open-source web-based library of modular building components (see figure); and second, to organise theoretical and practical training programmes for the application of building principles.[4]

4 Open Building Institute. (2018). About: What we do. Retrieved from https://www.openbuildinginstitute.org/about-what-we-do/

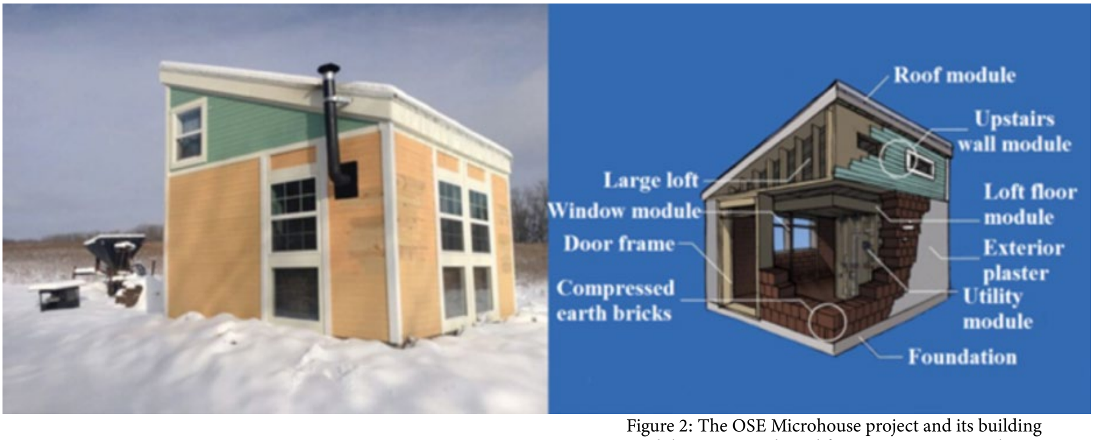

Figure 2: The OSE Microhouse project and its building modules Source: Adapted from Open Source Ecology, 2018

The creation of building designs is crowd-sourced and open to contributions. To address the specificities of various locations due to cultural, climate or resource scarcity reasons, the library is essential to grow. The more designs are submitted to the shared pool, the higher value is added to the system. These designs have been inspired by the idea of incremental house, which refers to the expansion of an initially small house to a more elaborate structure, according to the needs and budget of the individuals.[5]

5 Aravena, A., & Iacobelli, A. (2016). *Elemental: Incremental Housing and Participatory Design Manual* (2nd ed.). Ostfildern, Germany: Hatje Cantz Verlag.

The library modules can be imported into open-source software applications, such as Sweet Home 3D and FreeCAD.[6] The adoption of share-alike licences enables the free use, modification and redistribution of designs, which in turn encourages the participation of non-experts in the construction process. Sufficient documentation (e.g., construction details, energy properties, and static tests) accompanied by stamped engineering designs is also considered. To cultivate the possibilities of the project even

6 Open Building Institute. (2018). About: What we do. Retrieved from https://www.openbuildinginstitute.org/about-what-we-do/

more, advisers, engineers and business experts are recruited or voluntarily offer their expertise in technical details.

All Microhouse prototypes were built in the context of training workshops. In these workshops, participants acquire hands-on experience and training so that they can provide construction services, if necessary. OBI also offers relevant e-books and intends to organise webinars (on code compliance, building techniques, etc.) with the aim to help the public grasp the meaning of building regulations. Workshop tuitions and build service fees constitute sources of revenue for OBI. Moreover, a Kickstarter campaign was initiated in 2016 to support funding for the project.[7]

7 Offgridweb. (2016, July 21). Open Building Institute: Modular Off-grid Housing. Retrieved from https://www.offgridweb.com/preparation/open-building-institute-modular-off-grid-housing/

Looking back at the first prototype of the Microhouse, it consists of a 144 square feet tiny house with a loft, a kitchen and a bathroom. Several spaces, such as bedroom, living room, porch, utility room, and aquaponic greenhouse, were added later. The whole structure occupies an area of 2300 square feet in Missouri, USA. Newer prototypes were built based on experience gained from previous OSE Microhouse versions. For instance, feedback elicited by observations of the construction of the second and the third prototype, respectively, brought out the necessity for detailed documentation and the brittleness of the 3D printed tractor.

With attention fixed on new prototypes, the quality of the structures in terms of thermal, structural and environmental properties was improved. Water-catchment, off-grid sanitation, insulation, and photovoltaics were also added. An 800 square feet aquaponics greenhouse allows for small-scale production of vegetables, fish, and mushrooms while providing passive solar heating in combination with a hydronic heated floor. The water and electric lines of the construction system were placed on easily accessible channels to facilitate their repairability or substitution.

Cost estimations of the OSE Microhouse prototypes indicate reductions of the total expenses at 1/3 of the corresponding conventional costs. Furthermore, the use of OSE machines adds to the acceleration of the building process (i.e, a house can be constructed within five days) and fosters sustainability, decentralised production, and autonomy.[8] Plans for this project include the processing of materials (such as steel, lumber, straw, limestone, and bioplastics) to build up structural strength and energy resilience, the development of mobile structures and the adoption of techniques used in other open-source structures (such as the WikiHouse).[9]

8 Garrido, P. (2010). Open Design and Knowledge Integration in Semiotic Manufacturing Integration. *International Journal of Computer Integrated Manufacturing* - Semiotics-based Manufacturing System Integration archive, 23(8-9), 819-831.

9 Open Source Ecology. (2018). OSE Developers. Retrieved from http://opensourceecology.org/wiki/OSE_Developers

*Note

*This article was originally published as: Priavolou, C. (2018). The Emergence of Open Construction Systems: A Sustainable Paradigm in the Construction Sector?. *Journal of Futures Studies*, 23(2), 67-84.

Christina Priavolou acknowledges financial support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 802512)

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Open Desk[1]

1 www.opendesk.cc

Sharon Ede

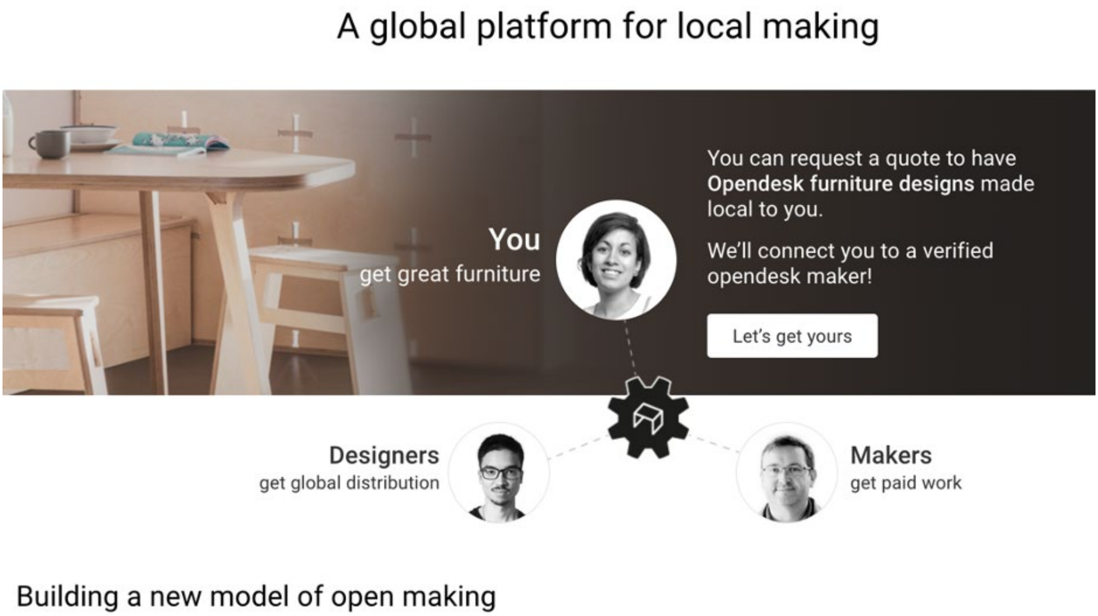


Image from Open Desk

Why?

Furniture tends to be heavy to move and space intensive to store, with such an impact on the design of cities that 'bulky goods' has its own zoning definition in urban planning. The advent of digital design, and the ability to share designs over the internet, opens up possibilities to shift to a more on-demand production model.

Open Desk is a UK company which is a global platform for local making. It enables a customer to choose both their designer (who may be anywhere in the world) and find furniture makers near them from a distributed network of independent makers.

What?

Open Desk curates and hosts a library of designs, meaning anyone can download and use the file to be made locally, and on demand. The range includes seating, tables, and storage by a variety of designers. Designers make their work available under different licences which may or may not allow derivative works, and retain all rights to their designs. Open Desk accepts a variety of licences, from open source to proprietary.

How?

Designers register on Open Desk, and upload their designs. They can choose to make their design free or to charge a fee which they set. Open Desk then adds a 12% platform fee to the total cost. Designers are paid an 8% design fee for every piece of furniture made wherever in the world it is made. The final price may also include delivery or assembly charges, and sales tax. Files are available for non commercial use, but to fabricate designs for commercial sales requires being registered as a maker.

Open Desk is also progressively building a tailoring service, to enable its designs to be customised. It offers an augmented reality feature that lets customers virtually try out Open Desk designs in their own place.

In 2019, Open Desk evolved from taking the customer's order directly and then assigning the work to a maker to a model where customers are connected with makers by Open Desk, and encouraged to contract directly with each other, using Open Desk's Manufacturer Standard Supply Terms to define the arrangement and responsibilities of each party.

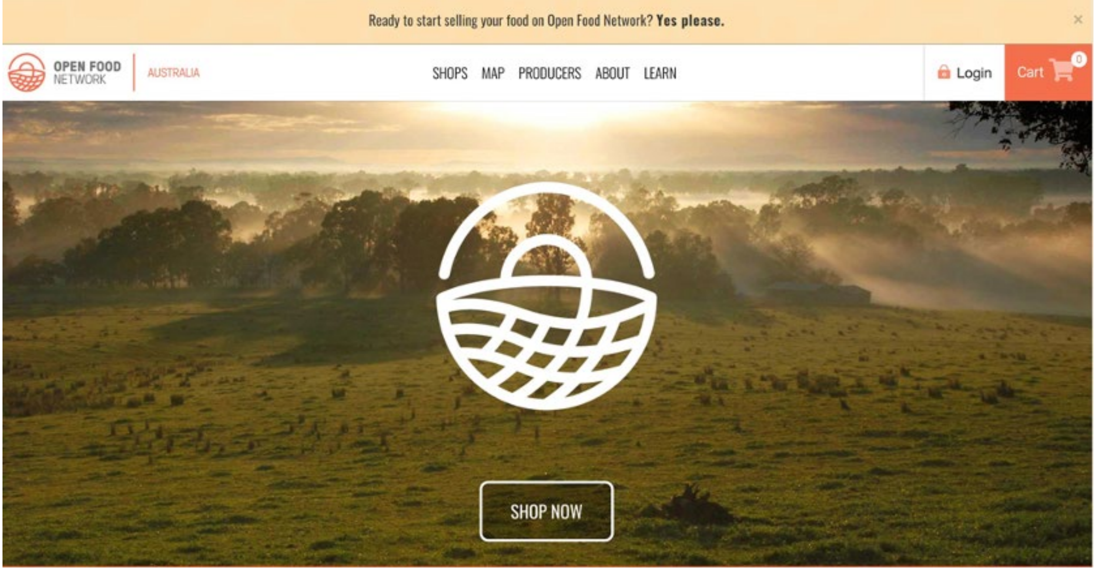
Impact

Open Desk claims that their approach can reduce logistical costs and markup on retail and shipping by up to 300%. In 2018, there were over 6,200 product quotes issued, an average of 120 a week.

Open Food Network[1]

1 www.openfoodnetwork.org

Sharon Ede



Why?

As the COVID-19 pandemic disrupts supply chains globally, the ability for people to have certainty of supply - and for suppliers, ability to get their product to markets - has been brought sharply into focus, particularly when it comes to food. Long and complex food supply chains which have been disrupted are resulting in vast quantities of product being disposed of, while increasing numbers of people fall into food insecurity. We need food systems and supply chains we can rely on.

Open Food Network is a digital platform that helps build local food systems supported by shorter, more reliable food supply chains, by connecting farmers with eaters via local, ethical distributors. These systems can be replicated in any local area, using the open source software.

What?

Open Food Network matches demand for local food with available local supply via an open source platform. A not for profit started eight years ago by two women in Melbourne, Kirsten Larsen and Serenity Hill, Open Food Network now has local instances all over the globe. Open Food Network have experienced a huge uptick in demand as supply chains were disrupted with the COVID-19 pandemic in early 2020.

How?

Open Food Network helps food producers to set up a shop and sell online, free of charge. In Australia, small operators who sell less than $500 a month can use the platform for free, and those selling more than $500 a month contribute 1-3% of their platform turnover to support those developing and maintaining the software.

The platform provides every food producer with the ability to control their own branding, pricing, and stock levels and have their products appear in their own online shop and at any other outlets, such as farmer's markets or a local food hub.

Shoppers seeking local, ethically produced sources of food can locate and buy from the suppliers in their area, or create a virtual farmers' market, or a local food hub.

Impact

Open Food Network is currently in use in 15 countries with 23 more onboarding, and the OFN web site receives 60,000 visits a month. It is community-powered software, which means because returns are not being provided to investors, all revenues go into building new features, supported by a distributed global team that delivers close to 24/7 technical support.

Recent statistics that illustrate OFN's reach and uptake:

Australia: 1000+ food producers, 360+ food shops, 6000+ shoppers
UK: 1290+ producers 630+ shops, 6700+ shoppers

France: 840+ producers, 450+ shops, 9440+ shoppers
New Zealand: 30+ producers, 20+ shops, 640+ shoppers
Belgium: 200+ producers, 90+ shops, 630+ shoppers
Katuma (Spain): 130+ producers, 100+ shops, 400+ shoppers
Brazil: 80+ producers, 30+ shops, 200+ shoppers
Germany: 40+ producers, 20+ shops, 50+ shoppers

Open Insulin[1]

1 https://openinsulin.org/

José Ramos

Why?

Diabetes is a life-threatening illness associated with an inability to produce insulin which affects the body's capacity to distribute glucose. In 1923, Frederick Banting, Charles Best, and James Collip sold the patent for insulin to the University of Toronto for $1 each, because they thought that this discovery was so important, it should be available to everyone. Imagine this. The Discoverers of insulin essentially giving away their discovery for next to nothing, so that many others could benefit.

Fast forward five decades later and it is impossible to get any insulin in the United States without paying exorbitant fees. The cost of insulin tripled from 2002 to 2013 and doubled between 2012 and 2016. In 1996 a vial of Humalog cost $21 — It has increased to $324, up 1,400%. Those without insurance, pay thousands of dollars per month. Diabetes has become the most expensive disease in the United States. By wrapping insulin production in a convoluted and labyrinthine system of process patents, pharmaceuticals have been able to create artificial scarcity.

What

The open insulin project in Oakland, is attempting to bypass the pharmaceuticals by creating their own insulin products. So far they have been successful at prototyping a new method of producing insulin using modified yeast as the agent, and have produced their first test batch.

The project was launched from Counter Culture Labs, a grassroots biohacklab in the East Bay of San Francisco, which promotes open citizen science. Counter Culture Labs is one of 11 collectives that constitute the self-governed Omni Commons. Through Counter Culture Labs, Open Insulin is a structured research project to develop generic, low-cost, open source insulin. As documented by Dana Smith:

"The group was founded in 2015 by Anthony Di Franco, a computer scientist with Type 1 diabetes, and a longtime member of the California hacker scene. At the time, Di Franco had good health insurance through an employer, so the cost of insulin wasn't prohibitive. But the issue became personal two years later when he enrolled in graduate school and there was a temporary gap in his coverage. He ended up paying $2,400 out of pocket for a month of supplies, significantly more than his $1,600 monthly stipend as a graduate student." [2]

2 Smith, D. (2019) Biohackers With Diabetes Are Making Their Own Insulin, *Medium.*

How

Open Insulin's goal is to create an open source insulin product. They used a crowdfunding campaign to raise initial funds. They initially were not able to produce the protein from E. coli and changed to yeast based cultivation. Biochemist Yann Huon de Kermadec was able to isolate a working insulin producing gene for yeasts,, and now can produce insulin protein in small amounts. The group is experimenting with different colonies of yeast to increase output. Di Franco will use himself as a test subject and inject himself with it as he would his regular medication.

Long term the group want to organize networks of production and distribution using a new model production, partnering with "hospitals, free health care clinics, patient organizations, [and] diabetes groups". They envision production centres could be set up in a distributed fashion for communities and institution that need them.

Impact

Progress has been made engineering strains of yeast to produce a modified proinsulin protein. It is in the process of being tested. The team is also developing a protocol to scale production as well as making rapid acting insulin.

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Precious Plastic[1]

Abril Chimal

Source: Precious Platic

The world generates 2.01 billion tonnes of municipal solid waste annually; from those, nearly 380 million are plastic waste.

The lack of proper waste recovery and management has cause plastic leaks to our oceans, becoming the primary repository of waste in the world. Plastic waste is not going anywhere; it doesn't matter how many laws or inventions for different ways of banning or usages; it will stay among us, for at least 400 years from its creation—causing environmental, health, economic, political, and technological repercussions, most of them in the low-income population.

1 https://preciousplastic.com/

Photo by Tobias Tullius on Unsplash

Such a Waste!

Cleaning up plastic waste is imperative for our oceans but is not as easy as it may seem, this complex problem involves many stakeholders with different interests making it harder to work with a common purpose.

Cosmolocalism for a Plastic World

As the purpose of Cosmolocalism is to create solutions available for everyone, document them and keep them open. That's what Precious Plastic intends to be, a Company that began as a student's work by Dave Hakkens for the Design Academy in Eindhoven, 2012.

This project was created to reduce and reuse the plastic that is already in our oceans, and to encourage people to stop using disposable plastic, to try new biodegradable materials, and adopting zero-waste lifestyles among other activities. By Jan 2020, The Precious Plastic Universe was released and aims to become the global alternative open-source recycling system.

Dave Hakkens - Precious Plastic

The Art of Waste

The key elements for Precious Plastic are people and organizations. This open-source project was built for a small scale purpose and is open for everyone who wants to help the planet.

Their offer:

Machines: the company realized that people in the community have a hard time working with different machines instead of just focusing on one. After different prototypes, they came up with three efficient semi-industrial machines, making an easier and affordable process.

Products: to get inspired. Members all around the world are already making beautiful objects from recycled plastic, like furniture, structures, constructions materials, and they continue pushing boundaries to make any idea possible.

Business Tools:
Machines are being used most of the times for educational purposes, to teach that waste can become something valuable. But also to encourage communities to set up a business from recycling.

Community Platform: It is divided into three: How To, Maps, Events and Academy. This program enables people all around the world to share their process, better solutions for plastic reduction, having short-term and long-term projects, to easily locate Precious Plastic Communities around the world, to meet people and start collaborating locally, and the most important thing to learn the process, methodologies, tools on how to recycle, and are available for everyone free of charge.

Precious Plastic Universe

This project has involved more than 400 people around the world educating, reducing, recycling and creating new solutions and products, are changing the way that people and society view plastic, from being something disposable to something valuable, creating successful stories like Citizen Scientific Workshop[2] in Idaho and Precious Plastic USA in Oregon.[3]

The last version of this project received 300,000 euros (about $327,000 U.S.) from a French foundation called Famae[4]. Creating opportunities more than 100 volunteers to work on the project.

Plastic waste continues to be a major problem, making Precious Plastic a game-changer in the recycling industry.

2 https://community.preciousplastic.com/u/citizen-scientific-workshop
3 https://www.preciousplastic-usa.com/
4 https://reflowproject.eu/best-practices/precious-plastic-the-alternative-plastic-recycling-system/

Precious Plastic Bazar

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RepRap[1]

1 https://reprap.org/

José Ramos

Prusa i3 design,
Image source: https://upload.wikimedia.org/wikipedia/commons/thumb/0/01/Prusa_i3_MK2.jpg/439px-Prusa_i3_MK2.jpg

RepRap (short for replicating rapid prototyper) was started by Dr. Adrian Bowyer in 2005 as a University of Bath initiative to develop a low-cost 3D printer, but has evolved into a global, community project with hundreds of contributors which prototype open source 3D printers. RepRap is unique in that, using an existing 3D printer, one can effectively 3D print the parts needed to build a functioning RepRap 3D printer. One can then use a RepRap to 3D print a new RepRap. It is thus “self-replicating” and effectively can decouple the production from most of the commercial dependencies that usually exist. According to the website:

> *"RepRap takes the form of a free desktop 3D printer capable of printing plastic objects. Since many parts of RepRap are made from plastic and RepRap prints those parts, RepRap self-replicates by making a kit of itself - a kit that anyone can assemble given time and materials. It also means that - if you've got a RepRap - you can print lots of useful stuff, and you can print another RepRap for a friend…"*

The project was conceived for evolution, where any addition to the RepRap knowledge ecosystem should be open and allow for others to use and build on it. It is an example of an open contributory ecosystem of design that resists the possibility of enclosure through intellectual property (iterations of RepRaps cannot be patented), and all software and designs sit within a free software license, and the GNU General Public License. As such, RepRap models have iterated through many versions, and there are now many RepRap printer designs.

According to B.T. Wittbrodt et al. "a family using one RepRap to print only 20 domestic products per year (about 0.02% of the products available) can expect to save between $300 and $2000," and "...the unavoidable conclusion from this study is that the RepRap is an economically attractive investment for the average US household already."[2]

2 Wittbrodt, B. T., Glover, A. G., Laureto, J., Anzalone, G. C., Oppliger, D., Irwin, J. L., & Pearce, J. M. (2013). Life-cycle economic analysis of distributed manufacturing with open-source 3-D printers. *Mechatronics*, 23(6), 713-726.

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Wikihouse[1]

1 https://www.
wikihouse.cc/

Christina Priavolou

Since the industrial revolution, we have been relying on large companies to produce land and houses. The current housing crisis denotes the failure of the relevant real estate model. This crisis is correlated with unaffordable living costs, outdated construction technologies, slow production processes and unsustainable construction practices that few can afford. Although these issues have been identified, the construction industry has barely changed.

During the last decade, architects, designers, urbanists and activists have been exploring new approaches of reimagining the cities by relocalising production. In an attempt to democratise the city by combining innovations, communities of people have reinvented the idea of the commons through their organisation in decentralised, self-governing groups. These groups collaboratively manage common resources, share and develop them to maximise their own productivity and well-being.

Such communities are motivated by their desire to fulfil their needs. They work in non-hierarchical networks and contribute to their shared resources based on common ownership approaches and sharing principles. Such forms of open-source production have been labelled as "commons-based peer production" and strive to promote societal change via open access to information. The spread of digital technologies has facilitated the emergence of the digital commons that are shared under the Creative Commons Licence.

The digital commons appear even in the most exclusive sectors. Architecture may be considered such a sector given that engineers design and build for the 1 percent of the richest people. Identical designs are produced by architects without being shared and, thus, innovation is hindered. Alastair Parvin, architect and co-founder of the WikiHouse, explores a social network approach to promote global collaboration in constructions.

Instead of producing one-size-fits-all, homogenised buildings, the WikiHouse project was conceived as an experiment to share design solutions for free. Considering the context-dependent nature of houses, the need for adaptability is essential. In that sense, buildings could be customised according to individuals' changing needs. The advent of distributed manufacturing and parametric design tools offers the possibility to produce customised products, lowering the thresholds of time, cost and skills needed and inaugurating the "fourth industrial revolution".

The WikiHouse is an attempt to develop low-cost buildings through the use of distributed manufacturing, i.e. a Computer Numerically Controlled (CNC) machine. It aims to enable people globally to share their designs based on interoperable standards, so that others can download, adapt, print and assemble parts to create a house locally, like a large IKEA kit. It is based on decentralised manufacture of standardised structural timber panels able to fit intermediate CNC machinery (1200(W)x2500(L) mm). To facilitate the assembly of the WikiHouse building components by non-experts, the components are properly labelled.

Product information (e.g. drawings, protocols, platform, etc.) is available online and it can be enriched by contributors globally. The networked

WikiHouse community shares data over a GitHub repository and communicates over a Google Group. There have been more than 300 prototypes built across the globe. The shared infrastructure is curated by the WikiHouse Foundation, a non-profit foundation based in the UK that is being developed by companies, organisations, and funders.

The WikiHouse library includes three elements: Microhouse, WREN, and OWL. Microhouse is the basic Wikihouse prototype, including a one-bedroom low-energy home, and OWL is an internal door kit. WREN chassis system is the first building system designed for sharing or modifying WikiHouse building types. In addition, Buildx is a digital, distributed supply chain platform designed to deliver the WikiHouse technology to end users. It is accessed through a web application, while the whole building process runs on digital rails, allowing users to choose the level of support they need at each building stage and consult qualified professionals through the platform. Thus, the risks, time and overheads involved in constructions are reduced and information flow is ensured between different stages.

As far as users' liability of a WikiHouse is concerned, users are responsible for conforming to local building regulations, codes and legislation. They should also ensure that no harm will be caused throughout the building process. Security measures, such as a first aid kit and a fire extinguisher, as well as protective equipment, including gloves, eye and ear protection, shall be maintained by the users before the construction commences. Finally, if the assembly requires further knowledge (e.g. plumbing, mechanical ventilation, electrical installations or preparation of foundations) certified professionals should be hired.

The WikiHouse project was designed with three main environmental aspects in mind: sustainability, modularity, and local production. Environmental sustainability is ensured via the use of materials with low embodied carbon and high insulating capability. Modularity entails dismountable and reversible joining elements, allowing for maintainability, upgradeability, and recyclability of damaged modules. Additionally, modularity enables users to work independently and efficiently on different stages or parts of the building process. The WikiHouse was also designed for local production. In that sense, potential environmental advantages may arise, such as minimised transportation that comes from the use of local material flows and local manufacture of building parts.

The potential of open-source design for environmental sustainability in buildings is evident in the case of the WikiHouse project. Although the distributed housing economy has not been scaleable yet, considerable steps have been made towards this direction. A change in roles and responsibilities is required, so that bottom-up initiatives will be able to "build their dreams" through collective intelligence. In this way, architecture could be democratised, hopefully expanding its narrow market from the 1 percent to the 100 percent and providing sustainable buildings made by and for everyone.

*Note

*Christina Priavolou acknowledges financial support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 802512)

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Index

A

accounting

30, 115, 119, 251, 288–90, 292, 301, 302, 305, 306, 309, 317

additive manufacturing

219, 221, 222, 224, 225, 243, 379

agriculture

30, 45, 61, 65, 84, 86, 108, 111, 118, 126, 171, 173
174, 177, 179, 180, 183, 189, 229–31, 239, 251, 269, 270, 272–5
296, 299, 300, 361, 363, 391

AI-enabled

73

algorithms

29, 60, 61, 66, 68–72, 133, 134, 138, 220–5, 310

alienation

27, 65, 70, 177

anthropocene

86, 88, 89, 91, 160, 162

anti-primitivism

69

aquaponics

264, 391, 394

architecture

14, 68, 75, 121, 128, 146, 150, 156, 272, 311, 317, 382
385, 411, 412, 414

arduino

110, 231, 234

artisanal

60, 61, 65, 69, 72–5

artisanal economy

69, 73, 75

B

bio-abolitionism

73
biodiversity
65, 71, 73, 108, 361
biohacking
402, 403
biome
19
biomechanical
323
biomimicry
69, 317
biotech
363
blockchain
19, 115, 121, 129, 136, 228, 286, 291, 307, 310, 315, 318
bricoleur
28, 184, 186, 187, 191, 193, 194

C

capitalism
15, 17, 18, 22, 28, 32, 35, 37, 40–6, 48, 50, 64
65, 78, 79, 81, 83, 85–90, 94, 98, 111, 115, 119, 158
165, 166, 168, 171, 176, 219, 225, 369
carbon
16, 63, 68, 71, 96, 97, 100, 101, 114, 116, 179, 340
371, 373, 382, 413
carbon emissions
96, 100, 114, 116, 373, 382
carbon footprint
68, 71, 371
catastrophe
78, 80, 84, 93, 177
circular economy
15, 24, 25, 33, 55, 59, 63, 65, 96–9, 104–6, 116, 124
125, 127, 175, 306–8, 313, 314, 329, 356, 383
citizens
25, 39, 62, 85, 102, 104, 106, 116, 119, 123, 124, 126

127, 131, 316, 345, 349, 356, 389
city & civics
25, 28, 38, 39, 51, 60, 61, 69, 83, 84, 93, 97
100–2, 104, 107, 116, 117, 119, 121, 123, 125–31, 150, 159, 161
179, 182, 187, 211, 227, 245, 306–8, 346, 356
climate (crisis / emergency)
14, 15, 17, 18, 27, 35, 40, 86, 90, 96, 97, 107
113, 118, 121, 143, 172, 179, 182, 189, 233, 314, 343, 356
393
CNC machines
110, 124, 216, 279, 282, 361, 364, 369, 391, 412
commons
14, 15, 17, 18, 21–4, 28, 31–3, 35, 37, 38, 44–7, 49
50, 52, 53, 58, 76, 80–8, 90, 91, 93, 104, 107, 109
110, 112, 113, 115–9, 140, 153, 159, 160, 162, 167, 170, 174–9
183, 219, 225, 227, 228, 254, 265, 277, 278, 283, 284, 286
290, 292, 304, 308, 315, 318, 326, 327, 329, 337, 338, 342
366, 369, 383, 402, 409, 412
commons economy
115, 119, 227, 292
commons transition
46, 50, 83, 88, 93, 119, 175–7, 183
community development
99, 107, 147, 342, 363
community economy
83, 94, 189, 386
community technology
103, 105
complexity
20, 32, 65, 73, 78, 80, 90, 118, 122, 129, 176, 214
272, 278, 304
complexity theory
65, 78
construction
43, 115, 150, 255, 260, 280, 298, 299, 367, 377–80, 391–5, 411
413, 414
construction systems

378–80, 394, 395, 414
cooperative
30, 31, 34, 109, 114, 116–8, 161, 177, 270–2, 309, 342–6, 384
385
cosmopolitan imagination
41, 49
cosmopolitanism
17, 21, 22, 28, 37–41, 43, 44, 46, 47, 49, 50, 157
159, 163, 170–2, 182
cosmopolitan localism
17, 21, 37, 40, 43, 44, 47, 50, 171, 182

D

decentralisation
27, 114, 129, 143, 147, 170, 176, 177, 180, 181, 264, 266
267, 285, 286, 288, 314, 343, 394, 412
decolonisation
40, 49, 67, 75, 134
degrowth
45, 50, 52, 58, 173, 254, 255, 258, 262, 277, 284
design
15, 17, 19–21, 25, 37, 38, 44, 45, 50, 52, 54, 55
57, 58, 60, 61, 66–9, 72, 74, 75, 83, 97–9, 105, 110
111, 114, 115, 121, 125, 127–31, 133–5, 146, 147, 149–51, 153, 154
158, 162–4, 170, 174, 175, 177, 182, 183, 193, 197, 199, 201
221, 226, 235, 243, 248, 255, 260, 261, 265, 268, 275, 278
279, 283, 285, 286, 297–9, 304, 306, 307, 310, 318, 321, 325–30
332, 337, 338, 340, 344, 348, 350, 351, 355, 356, 360–4, 367
369, 371–4, 378, 380, 382, 383, 388, 392–7, 405, 409, 410, 412–4
design and manufacturing
45, 129, 306, 327, 369, 414
design and production
20, 25, 54, 298, 321, 344, 361, 363, 388
design global manufacture local
17, 25, 45, 50, 52, 58, 97, 170, 174, 177, 182, 369
development
14, 15, 19–21, 23, 26, 29–31, 34, 38, 44, 46, 51–5, 60

61, 66, 69–72, 87, 90, 93, 99, 100, 102, 104, 105, 107
114–6, 122, 126, 128, 129, 133, 136, 144, 146–52, 175, 180, 185
189, 191, 200, 201, 207, 211, 214, 217, 219, 221, 224, 228
235, 243, 244, 251, 255, 263–6, 268, 269, 271–3, 275, 278, 279
281, 282, 285, 302, 303, 308, 314, 317, 321, 322, 326, 329
332, 338, 340, 342, 343, 346, 348–50, 352, 353, 356, 358, 360–3
367, 375, 379, 385, 394
development strategies
19, 20, 60, 61

E

ecology
16, 17, 20, 22, 23, 25, 27, 31, 35, 38, 44, 48
51, 60, 61, 63–6, 68, 71, 76, 77, 80–4, 88, 90, 94
111, 119, 123, 156, 160, 163, 167, 168, 172, 174–80, 183, 228
255, 258, 262, 297, 303, 304, 310, 312, 313, 342–5, 354, 369
371, 390–5
ecosystems
15, 22, 23, 25, 26, 30, 31, 56, 57, 73, 83, 114
118, 129, 161, 207, 214, 251, 267, 301, 306, 307, 309, 310
315, 318, 346, 349, 350, 352, 363, 391, 410
education
26, 67, 69, 74, 101, 130, 145, 161, 185, 188, 196, 198
199, 228, 251, 280, 315, 342, 350
energy (general)
24, 26, 63, 65, 71, 77, 84–6, 101, 109, 114, 122, 123
126, 127, 130, 141, 145, 162, 177–9, 182, 183, 189, 196–200, 202
203, 254–9, 261–3, 285, 301–4, 310, 343, 346, 349, 355, 361, 389
391, 393, 394
energy footprint
177
energy sources
84, 122, 197, 255
energy technologies
114, 254, 263
energy use
84, 85, 178, 179, 183, 302, 303, 310

engineering
53, 56, 57, 69, 101, 126, 221, 225, 235, 236, 238, 239
243, 248, 259, 262, 327, 328, 348, 352, 355, 363, 393, 403
enterprise
31, 103, 112, 115, 117, 136, 138, 141, 142, 144, 201, 287
290, 320, 323, 343, 345, 346, 350, 351, 363
epistemology
19, 117, 118, 157–9, 163, 167, 168
evolution
19, 52, 58, 64, 65, 73, 74, 80–2, 85, 93, 204, 369
410

F

fab cities
17, 25, 33, 116, 121, 124–31, 306
fab labs (fabrication laboratories)
19, 25, 53, 83, 97, 101, 107, 123–8, 130, 227, 228, 282
306, 307, 327, 356, 360, 382, 383
fabrication
27, 29, 53, 58, 72, 97–9, 105, 107, 121, 123–6, 130, 174
177, 193, 243, 281, 284, 286, 306, 323, 324, 332, 333, 352
362, 364, 373, 377, 382, 383, 391
fabrication spaces
98, 99, 105, 107
fabrication technologies
123, 125, 377, 383
factories
14, 19, 20, 25, 31, 33, 52, 55, 56, 58, 64, 65
73, 97, 123, 127, 146, 150, 151, 211–4, 216, 247, 249, 251
252, 348, 352, 384–6
farming
29, 30, 33, 34, 45, 104, 174, 179, 180, 182, 183, 194
199, 211, 212, 216, 229–31, 233–6, 238–40, 244, 252, 259, 260, 262
264, 265, 267–75, 311, 370, 371
finance
14, 33, 42, 62, 63, 65, 68, 79, 85, 86, 94, 101–4
106, 138, 140, 142, 146, 208, 266, 273, 286–8, 300, 322, 363

380, 386, 395, 414
food
25, 26, 31, 34, 64, 122, 123, 127, 130, 145, 154, 172
173, 179, 180, 302, 304, 311, 312, 343, 345, 346, 371, 382
383, 398, 399
food production
64, 180, 311, 312, 371, 399
food sovereignty
173

G

github
140, 231, 283, 359, 362, 413
global-commons
282
globalisation
14, 21, 22, 33, 35, 40, 42–5, 49–51, 89, 113, 118, 119
156, 159, 164, 167, 171, 173, 175
governance
32, 80, 91, 102–5, 116, 124, 127, 146, 150, 161, 187, 190
196, 197, 199, 204, 206, 214, 287, 288, 290, 331, 342, 346
350, 353, 362, 369, 374, 385, 388, 389

H

heritage
60, 61, 66, 69–72
humanitarian aid
372, 373
humanitarianism
254, 262, 372–4
humanity
13, 14, 28, 39, 40, 65, 71, 73, 78, 80, 82, 88–91
94, 122, 137, 157–60, 164, 165, 187, 191, 219, 224, 251, 315
human–machine
69, 73, 75, 278
human-scale
181

I

indigenous (general)
40, 43, 51, 60–2, 64, 66–9, 74, 184, 190, 217, 218
indigenous cultures
40, 190
indigenous design
67, 74
indigenous futurity
60, 61
indigenous knowledge
67
industry
27, 52–8, 65, 72, 83, 87, 93, 100–2, 104, 111, 121–3, 127
134–6, 146, 157, 168, 176, 177, 183, 214, 219, 220, 222–6, 241
243, 244, 250–2, 281, 286, 306, 327, 337, 348, 349, 351, 352
359, 364, 373, 384, 385, 389, 391, 392, 407, 411, 412
infrastructure
43, 47, 48, 53, 54, 57, 83, 85, 86, 97, 103–5, 115
119, 122, 123, 130, 141, 146, 160–3, 165, 177, 197, 214, 281
282, 285, 288, 289, 291, 301, 306–10, 317, 318, 349, 353, 355
356, 364, 367, 369, 378, 391, 413
innovation
13, 21, 23, 26, 29, 33, 37, 38, 44, 50, 52–7, 64
68, 73, 105, 125–7, 129, 130, 134, 147–9, 154, 175, 187, 217–22
224, 225, 228–31, 236, 239, 240, 245, 251, 281–3, 286–8, 293, 312
314, 315, 331, 333, 348, 350–2, 356, 357, 361, 363, 369, 380
395, 412, 414
interdependence
37, 47, 49, 77, 91, 118, 119, 163, 164, 167, 172, 183

J

jobs
99, 100, 114, 116, 218, 220, 243, 248, 249, 251, 252, 353
justice
20, 34, 47, 60–6, 73–5, 77, 158, 161, 163, 168, 169, 173
177, 236, 342, 392

K

knowledge (general)
13, 14, 19, 23, 26, 30, 34, 38, 44–7, 51, 52, 55
62, 67, 68, 76, 77, 82, 83, 89, 90, 93, 98, 100
101, 110, 111, 115, 116, 118, 120, 122, 124–6, 128, 130, 146–51
153, 159, 163, 165, 167, 170–2, 174–7, 179, 189, 193, 213, 227
228, 238, 239, 258, 260, 264, 268, 269, 273, 275, 278, 282
287, 288, 290, 304, 307, 308, 315, 324, 329, 338, 355, 366
367, 369, 388, 394, 395, 410, 413
knowledge commons
23, 83, 110, 153, 174, 175, 179, 304, 366
knowledge exchange
30, 34, 172, 174, 264
knowledge systems
67, 165

L

labs
25, 53, 101, 107, 123–8, 130, 134, 228, 232, 282, 306, 307
327, 382, 402
licensing
16, 37, 45, 114, 115, 220, 222, 225, 261, 265, 281, 283
361, 410
local communities
28, 37–9, 41, 44–6, 48, 72, 76, 91, 126, 136, 159, 171
175, 199, 207, 295, 304, 309, 315, 329, 342, 344, 346, 373
local economies
47, 54, 100, 179, 180, 183, 200, 342, 343, 354, 384
local enterprises
112, 141, 143, 343
localism
15, 17, 19, 21, 22, 26–8, 34, 37, 40, 43, 44, 46
47, 50, 62, 76, 110, 113, 116, 136, 140–5, 159, 161–4, 169–79
181–3, 191, 200, 201, 206, 307, 314, 325–7, 354
local manufacturing
45, 50, 52, 54, 58, 124, 207, 254, 277, 353, 369, 373

382
local markets
208, 255, 353
local needs
126, 129, 130, 149, 313, 314
local polities
21, 171, 172
local production
20, 25, 53–5, 76, 97, 101, 105, 117, 130, 142, 228, 329
373, 385, 413
local resources
180, 306

M

machines
71, 110, 123, 124, 126, 130, 133, 134, 174, 177, 216, 235
240, 243, 244, 250, 252, 255–7, 263, 270, 272–5, 279, 282, 300
361, 364, 369, 390–4, 406, 407
makers
53, 55, 99, 100, 105, 107, 127, 128, 197, 261, 283, 295
313–5, 321, 350, 363, 385, 388, 389, 396, 397
makerspaces
83, 97, 103–5, 107, 130, 243, 281, 294, 297, 298, 307, 321
327, 360, 373, 374, 384
management
26, 52–7, 81, 99, 125, 142, 144, 146–8, 240, 250, 269, 286
315, 318, 328, 357, 404, 408
markets
37, 42, 45, 49, 81, 84, 116, 133, 144, 161, 168, 197
208, 214, 255, 313, 351, 353, 398, 399
materials
24, 25, 39, 53, 71, 76–8, 96–101, 103–6, 111, 121–5, 146, 152
160, 172, 174–6, 179, 180, 182, 193, 207, 216, 220–6, 241, 243
244, 247, 248, 250, 255, 260, 263, 272, 274, 275, 278, 279
281, 283, 289, 296, 297, 299, 301, 302, 304, 306–8, 312, 327
362, 373, 374, 377–9, 383, 384, 388, 392–4, 406, 407, 410, 413

metabolism
25, 30, 123, 131, 301, 302, 304, 306
movements
13, 14, 22, 32, 42, 44, 60, 61, 63, 69, 75, 82
85, 88, 91, 92, 169, 170, 173, 174, 179–81, 347
municipalism
103, 104, 173, 180, 353, 404
mutualisation
15, 23, 76, 81–3, 85, 88, 90, 115, 117, 272, 282, 286
307, 319, 385

N

narrative
29, 130, 131, 133, 134, 156–9, 162–6, 169, 243, 251
networks
14, 19, 23, 25, 30, 31, 34, 37, 38, 42–5, 47, 49
53–5, 60, 61, 63–5, 73, 101, 105, 108, 122, 124–30, 143, 145
150–2, 156, 160–3, 165, 167, 171, 180, 182, 190, 208, 237, 244
254, 257, 260, 261, 268–72, 276, 281, 285–8, 290, 292, 293, 301
306, 307, 310, 317, 318, 323, 338, 346, 350, 352, 354, 360
363, 382, 385, 389, 396, 398, 399, 403, 412

O

open-access
261, 288, 375, 376
open-hardware
114, 255, 261, 262, 370
open-source
30, 45, 53, 55, 58, 59, 111, 136, 139, 145, 177, 179
201, 219–21, 224–6, 230, 231, 233, 255, 257, 261, 262, 278, 279
281, 282, 284, 306, 314, 338, 370, 377, 380, 381, 392–4, 406
408, 410, 412, 413
open-source 3D printing
53, 58, 59, 219, 221, 225, 226, 410
open-source designs
179, 257, 413
open-source licenses

45
open-source software
45, 145, 393
ownership
60, 61, 64, 148, 200, 287, 298, 312, 330, 331, 343–5, 352
354, 355, 412

P

participation
20, 26, 47, 54, 55, 57, 62, 147, 148, 152, 161, 259
272, 282–4, 287, 289, 307, 345, 352, 353, 356, 369, 393, 395
participatory design
20, 54, 393, 395
platform capitalism
15, 18
platform cooperativism
118, 342, 344, 345
platforms (general)
15, 18, 30, 31, 34, 99, 112, 118, 125, 129, 130, 143
162, 163, 165, 235, 264–8, 289, 313–5, 324, 325, 329, 333, 342–6
349–53, 356, 358, 360, 367, 392, 396–9, 407, 412, 413
political economy
24, 42, 48, 49, 52, 57, 64, 66, 75, 82, 84, 87
90, 92, 111–4, 117, 178, 220, 225, 270, 369
political philosophy
39, 50
politics
21, 22, 24, 32, 38, 39, 41, 42, 44, 48–52, 57, 63
64, 66, 75, 79, 82, 84–7, 89, 90, 92, 94, 103, 106
111–7, 170–3, 176, 178, 180, 193, 220, 225, 270, 299, 308, 343
369, 404
post-capitalism
15, 21, 22, 43, 46, 48, 77, 87, 88, 119, 171, 172
174–8, 182, 183, 193, 309, 369
post-colonialism
40, 49
post-development

21, 158, 159, 167
prosthetics
29, 30, 45, 176, 227, 228, 277–84, 323, 329, 330, 363
prototypes
25, 103, 109, 115, 123, 127, 130, 221, 224, 230, 244, 248
267, 270, 275, 283, 286, 299, 326, 328, 371, 378, 391, 392
394, 402, 406, 413
public (the)
16, 17, 32, 38, 42, 45, 49, 51, 104, 109, 114, 116
119, 126, 128, 144, 160–3, 165, 175, 180, 222, 223, 243, 260
261, 271, 273, 280, 291, 313, 314, 352, 354, 359, 362, 388
394, 410
public domain
114, 175, 222, 223, 261
public policy
32, 42, 49, 109, 119
public realm
160, 161, 163, 165

R

regenerative (processes)
19, 20, 23, 65, 106, 117, 118, 122, 129, 130, 172, 313
314
regenerative economy
65, 106
regenerative justice
65
regenerative urbanisation
129
renewable energy
114, 141, 162, 176, 196, 197, 202, 203, 254–6, 258, 262, 263
391
renewables
114, 141, 162, 176, 180, 196, 197, 202, 203, 254–6, 258, 262
263, 391
revolution
13, 18, 40, 41, 52, 54, 58, 78, 80, 82–5, 87, 88

93, 94, 122, 123, 158, 167, 189, 219, 225, 243, 251, 309
350, 411, 412

S

sharing (general)
13, 18, 25, 31, 32, 38, 45, 47, 61, 83, 97, 98
108, 111, 116, 119, 128, 136, 150, 152, 170–2, 179, 196, 217
228, 243, 267, 274, 282, 287, 295, 299, 306, 308, 310, 312
315, 342–7, 353, 354, 364, 366, 375, 412, 413
sharing cities movement
342
sharing economy
18, 83, 282, 342, 343, 346
sharing enterprises
31, 343–6
sharing knowledge
47, 128, 179
software
14, 25, 26, 45, 55, 66, 83, 125, 129, 136, 138, 140–5
220, 224, 230–6, 238, 239, 266, 268, 278, 281, 282, 285, 287
290, 311, 337, 338, 344–7, 349, 350, 352, 358–60, 364, 370, 371
393, 399, 410
solar
25, 29, 60, 61, 71, 75, 109, 113, 114, 141, 175, 196–202
205–8, 254, 259, 262, 311, 378, 391, 394
solar lamps
25, 113, 175, 196, 198–200, 202, 206
strategy
13, 19, 20, 23, 53, 54, 56, 57, 84, 91, 93, 129
137, 148, 149, 280, 287, 324, 328, 338, 342, 348

T

technological revolutions
85, 94
technology (general)
13, 14, 18, 21, 25–9, 35, 37, 42, 43, 45, 52–8, 61
66, 69, 71, 73, 74, 83, 85, 86, 90, 93, 94, 98

101, 103, 105, 108, 110, 111, 113–5, 117–9, 121–7, 129, 130, 134
142, 146–9, 152, 157, 161, 169–78, 181, 184, 186, 189–91, 196, 202
211, 214, 217, 219, 225, 228–31, 233–7, 239, 240, 243–5, 247, 251
254–7, 260–5, 272, 273, 275, 279–81, 295, 299, 308, 310, 312–5, 318
320, 323, 326, 330, 332–4, 338, 345, 349–56, 362, 363, 369, 370
377, 379, 383, 391, 404, 411–3
technoscience
73, 74
techno-social (processes)
86, 288, 291
techno-solutionism
27, 70, 75
temporality
22, 33, 40, 63, 76, 77, 79, 82, 87, 90, 162
transformation
15, 17–9, 21–3, 25, 27, 32, 33, 35, 38, 45, 49, 52
53, 57, 62, 63, 67, 70, 77, 78, 85, 86, 88, 91–4
100, 105, 110, 116, 117, 121, 122, 127–31, 133, 134, 153, 159
165, 167, 189, 211, 227, 243, 283, 299, 302, 304, 306, 342
347, 353, 362–4
transitions
15, 22, 33, 37, 41, 43, 46–8, 50, 52, 53, 56, 63
69, 76–81, 83, 87, 88, 90, 93, 119, 121, 124, 127, 135
158, 159, 167, 171, 175–7, 183, 187, 191, 197, 258, 304, 308
342, 347, 349, 352, 363, 364, 366, 369
transnational
14, 21, 27, 37, 83, 89, 94, 117, 118, 161, 170, 178
180, 182

U

urban (the)
24, 25, 30, 32, 33, 66, 83, 108, 116–8, 121, 123, 126–31
133, 134, 146, 180, 208, 248, 306, 308, 396
urban agriculture
108, 180
urban commons
24, 32, 83, 116–8, 308

urbanisation
25, 27, 123, 127, 129, 170, 179–81, 357
urban planning
130, 396
urban transformation
25, 33, 121, 128–31, 133, 306

V

value (general)
15, 19, 20, 23, 26, 28, 38, 43, 45, 48, 49, 53–5
57, 58, 60, 61, 63–6, 68–73, 77, 81, 99, 100, 104–7, 110–2
114–9, 124, 125, 129, 140, 142, 143, 150, 156, 159, 161–3, 166
167, 175, 189, 200, 207, 272, 286–93, 306, 307, 309, 310, 315
326, 329, 345, 346, 349, 350, 362, 363, 393
value accounting (contributory)
115, 119, 288–90, 292
value capture
65, 104, 107, 112, 162
value chains
15, 43, 45, 48, 49, 54, 58, 73, 116, 175, 200, 286–8
293
value creation
54, 55, 58, 77, 104, 110
value exchange
63, 70, 116–8, 124, 129, 161

W

wellbeing
18, 91, 99, 100, 113, 118, 163, 164, 181, 344, 412
wind power
30, 34, 141, 235, 236, 254–63, 281, 284, 361, 392

Cosmo-Local Reader