THIS IS DISTRIBUTED DESIGN

Making a new local & global design paradigm

Edited by Distributed Design Platform

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Introduction

The Distributed Design Platform was established in 2017, co-funded by the Creative Europe program of the European Union. It brings together a diverse member-base from cultural and creative institutions including Fab Labs, cultural organisations, universities and makerspaces. Over four years, the Platform has provided Europe-wide programming and opportunities to support emerging creatives working in the emerging field of Distributed Design. This book is the fourth in a series of yearly publications dedicated to the topic.

Emerging at the intersection of the Maker Movement and design sensibility, Distributed Design provides a framework for designers, makers and creatives to innovate the field of design towards more sustainable, inclusive and collaborative practices. As global challenges intensify, shifting the global paradigm to support global connectivity and local productivity where “bits travel globally, while atoms stay local” becomes urgent. Distributed Design is a proactive response for makers and designs to prefigure viable design alternatives to the current paradigm, designed for mass consumption.

As the final of four publications developed by the Distributed Design Platform, ‘This is Distributed Design’ presents a state-of-the-art, in an effort to inspire makers, designers and scholars alike. The book is organised into chapters that reflect important aspects of the field, based on the experience of the Platform over the past four years. An open submission process was undertaken to source inputs from a variety of perspectives covering people, products, platforms and theories. Within these pages you will hear from a non-exhaustive list of experts, hobbyists and scholars whose work is advancing Distributed Design, clarifying through practice, its standing as the framework for collaborative, open, inclusive, sustainable design.

CHAPTER 1

The Emergence of a New Approach to Design

Distributed Design is one outcome of the intersection of two global trends: the Maker Movement and the digitisation of the design discipline. This convergence has led to the rise of a new market, in which creative individuals have access to digital tools that allow them to design, produce and fabricate products themselves, or easily connect to a global network of collaborators to undertake aspects of this process with them. But what is the history and global context, pioneers and trends that have led to this moment? This chapter is dedicated to exploring when and where it all started.

Origin Story

The Rise of Distributed Design and The Platform's Proposition.

Kate Armstrong from Fab Lab Barcelona at IAAC. Adapted from the Article Distributed Design: A Platform Approach Towards More Inclusive, Plural Futures for Design published in the Making Futures Journal 2021.

Introduction

As digital design and fabrication tools become more accessible at the domestic scale, and the logic of distributed manufacturing practices become more widely understood, a networked approach to design and small-scale production is growing in popularity. What is emerging is a localised, situated approach to design and production, in which nodes are connected at distance by digital platforms which not only transfer data, but act as portals to like-minded collaboration networks. At the domestic scale, the approach aids hyper-local and hyper-customised design solutions with the ability to meet individual user needs through digital and parametric design and further, it provides space for diversity in materials, techniques, voices and crafts. The digital layer can include communication, tools and platforms that can augment the limits of physical design and production spaces. They open the possibility for collaboration at distance on aspects of the design-to-production process or open access to education and capacity building resources for professional self-development. The local-to-global potential of distributed design can humanise production processes and provide a more sustainable alternative to complex global supply chains and a possible solution to overconsumption and the now well-known ills of mass production.

The Distributed Design Platform arose from this context. It comprises 18 cultural institutions, research centres, Fab Labs and makerspaces to deliver Europe-wide programming across education and training, capacity building and skills development, peer-to-peer exchange and networking; as well as to advocate for and celebrate excellence in the nascent field. It focuses on the generation of new markets, which require new business models and models of distribution. Further, the Platform undertakes collaborative action-research on the state-of-the-art at the convergence of 'making' and design practice in an attempt to narrate the formation of the field. Drawing on learnings, it proposes the development of an approach devised of cultural programming and practical tools aimed at embedding Distributed Design values into design practice. These values; Open, Regenerative, Collaborative and Ecosystemic have emerged from the Platform as defining principles. One important characteristic of distributed design is that it is 'application agnostic' and rather than being confined to a traditional field such as Product Design, Service Design or Industrial Design, it can instead be seen to be defined by process, attitude and values.

The Context: Fab Labs and Fab City

Advancements towards Industry 4.0 have consistently brought networked, advanced manufacturing capacities closer to the domestic scale. Micro-factories and flexible-factories present the opportunity for the un-coupling of production and global supply chains, and the logic of this model has not only led to industry-level innovation but has ushered in the "distributed means of making and open design" (Kostakis and Papachristou, 2014). In 2005, Professor Neil Gershenfeld of the MIT Centre for Bits and Atoms (CBA) predicated the rise of the Fab Lab, a fabrication laboratory of domestic-scale digital fabrication technologies such as computer numerically controlled (CNC) mills, laser cutters, engravers and 3D-printers and subsequently the increased facility to materialise the digital, or "turn data into things and things into data" (Gershenfeld, 2012). Since 2005, demand has seen over 1750 Fab Labs open across 100 countries to date, and this increase has occurred alongside the parallel rise in popularity of hackerspaces and makerspaces. Advancements in telecommunications have led to the digital interconnection of these individual, yet identical workshops into a global distributed production infrastructure which enables the "ability to send data across the world and then locally produce products on demand" (Gershenfeld, 2012). This context allows for more focus on territorial manufacturing, with the intention to support local economies, lessen reliance on central systems and enable wide local participation in design and production process.

Fab Lab Barcelona at Maker Faire

Plastic for Good Challenge, Distributed Design

This domestic infrastructure embodies a logic and intention to materialise the digital and 'move bits not atoms' which on a city-level could have revolutionary implications. This concept can be conceptualised within the wider framework of Fab City. Devised in 2014 in a collaboration between IAAC, Barcelona City Council and the MIT CBA, Fab City proposes a paradigm shift, from the current linear system which is organised as "PITO" (product-in, trash-out) to a circular model that preferences local mobility of materials and global mobility of information: "DIDO" (data-in, data-out) (Diez n.d.). It focuses on the movement of data, use of local material supply chains and distributed production at the city scale as an alternative to the movement of materials and goods from production to consumer. As supply and production chains become deconstructed and decentralised in this model, design too becomes decentralised and hence, distributed. Distributed among locations, laboratories, approaches and cultures, it could be suggested that in distribution, design is also democratised. The decentralisation of production means designers gain access to collaborators, knowledge and tools across global infrastructure networks including but not limited to the small-scale prototyping facilities of Fab Labs. It also heralds the generation of new markets which require their own business and distribution models.

Design and PITO to DIDO

'The political, social, enviromental and economic impact of their outputs become vital considerations for design choices.'

What design practice emerges from the commitment to "move bits not atoms" and how can designers critically engage in this space that questions the state of our relationship with designed products and looks to strengthen local connections between people and materiality? The process of rethinking design begins in the spaces that form this distributed infrastructure. Often Fab Labs, but also possibly makerspaces or cultural hubs, these physical spaces act as local incubators of open design processes and provide access to local production and digital technologies.
They also act as places to socialise distributed design values in pursuit of the "DIDO"' paradigm. Fab Labs and indeed most small-scale physical production spaces (such as the members of the Platform), provide the substrate from which distributed design practice can be taught, shared and nurtured. Acting as "third places" (Oldenburg, 1989) "to promote collaboration (especially professional) and creativity" in order to "facilitate collaboration and knowledge sharing" (Scaillerez and Tremblay, 2017). It can be said that these third spaces humanise the cyber-physical developments occurring at mid-to-large-scale industry scale, such as advanced manufacturing, supply chain optimisation, synthetic intelligence and material development, by providing a window at the small-to-medium scale through which designers, makers and consumers can participate in the rapid development towards Industry 4.0. Further, they become places for cultural development and the breeding of new ways of working, thinking and valuing. As stated by Gershenfeld, "the spread of digital fabrication tools is now leading to a corresponding practice for open-source hardware" (2012) and the digital infrastructural layer used to share at distance with like-minded practitioners is beyond a data exchange mechanism, but part of a wider critical practice in which design is improved and modulated globally (Kostakis and Papachristou, 2014). As such, Tte Platform encompasses more than the design of blueprints or artefacts optimised for production through distributed manufacturing. More, it questions design and making as a holistic process of critical engagement between people and the material world. Active in fifteen locations across Europe, the DD Platform acts as a local-to-global facilitator for the two levels of knowledge transfer: socialisation and development at the domestic-scale and knowledge and data exchange at distance via networks. More so, it provides a space for a critical inquiry through action-based research and cultural programming into understanding what design looks like in the Fab City context.

The Hybrid Designer

Whilst in the context of Distributed Design we see processes becoming "deconstructed and decentralised", in practice, this transition is also causing convergences as well. The profile of the 'distributed designer' not only merges

making and design aptitudes but also acquires a host of other characteristics in order to lead and collaborate with inclusive design teams and develop immersive solutions at the local scale, that can be successfully networked with others. Situated design and production practice requires creative professionals to also act as interlocutors or a form of Community Champion (Making Sense n.d.) who embodies the DD values and connects the local context to the global level of knowledge exchange. These actors can be connected to a physical production space such as Fab Lab or makerspace and regularly engage with idea development or solutions that respond to their own context. This, coupled with supply chain transparency and personal contact with end users means the act of designing takes on new responsibility and meaning. The political, social, environmental and economic impact of their outputs become vital considerations for design choices. As a result the "distributed designer" can be seen to be evolving towards a hybrid profile (Diez and Tomico, 2020), a design profile that mixes various sets of technical and human skills which prepares them to be resilient and agile designers at every scale of the DD paradigm (Diez and Tomico, 2020). Going beyond a multidisciplinary or transdisciplinary designer (Leblanc, 106-122) the hybrid profile describes a practice in which designers explore their own beliefs and engage in situated responses to large-scale solutions in order to have immediate impact, an approach that equips designers to be locally connected (Cosmolocalism, 2019).

The Distributed Design Platform proposition

Over four-years, the Platform has situated itself as the leader of this novel field, with its 18 founding members considered experts in distributed design at the local, European and international levels. The recognition of Distributed Design within the Creative Europe program was arrived at through the potential of the Maker Movement, which was gaining in popularity when the Platform was first funded under the Creative Europe Platforms programme of the European Union in 2017. In 2021 the attention can turn to distributed design as a framework to capture and innovate that potential. The effort made by makers to support front-line workers during the novel coronavirus (COVID-19) pandemic is a fresh memory (and the topic of a 2020 book by the Platform titled "Viral Design") and the popularity of hybrid innovation spaces, purpose-led design and resilient skilled professionals is on the rise. Distributed design is a haven for makers and a sandbox for innovation which encompasses and elongates the potential of distributed networks and a maker approach. The Platform proposes a support framework and common editorial strategy to advance distributed design. Under shared process, attitude and values the Platform aims to evolve the practice of design practice beyond aesthetics; and making (and the Maker Movement) beyond digital fabrication, towards hybridity and a brave new approach to thinking, practicing and organising for more inclusive, plural futures for design.

Fab Academy Challenge 2021

Distributed Innovation

A New Possible and Necessary Model

Enrico Bassi from OpenDot

In recent years, humanity's most significant challenges have caught us unprepared. This has prevented us from reacting in a responsive, efficient and inclusive manner. Being in a globalised and hyper-connected world means that what happens in China affects everyone. Solutions need to be practical and globally adopted on a large scale. The COVID-19 pandemic is not the only recent case in which the most technologically advanced countries have struggled to find a rapid and adequate response. Just think of plastic islands in the oceans[1], global warming[2], migration phenomena, the environmental and social impact of agriculture and ocean acidification.

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Technology has never been as advanced and accessible as it is now. We read stories of visionary innovators who want to connect the human brain directly to a computer[3] or benefactors funding water sanitation projects with billions of dollars[4] This dynamic results from a Centralised Innovation model, which revolves around the hero-inventor – an extraordinary person capable of solving otherwise impossible problems and changing the course of history by themselves. Conceived around the time of Leonardo Da Vinci — when a few brilliant inventors and artists (financed by enlightened patrons) were responsible for the cultural, artistic and technological innovations that featured in historic and cultural revolutions — Centralised Innovation remains a familiar and prevalent model in present day paradigms, including those of Steve Jobs and Elon Musk. Extraordinary stories, often fictionalised, that are so strong, have forged the archetypal innovation narrative in our heads.

In this model however, little is said about the people, those who experienced change. The "common people" did not play a role and didn't enter history with their famous contemporaries.

The Centralised Innovation model has endured and strengthened over the last century due to three key aspects:

- It follows the current economic model, and some scholars[5] believe that it might have had a hand in creating it. Thanks to capitalism and economies of scale, an innovative product can spread quickly and produce large profits for creators and investors.
- The hero-innovator is a stereotype that we know, admire and that intrigues us. This makes Centralised Innovation communication more effective, universal and simpler.
- Our role is only that of the "user" or "purchaser". Our input is simple, momentarily gratifying and deprives us of responsibility.

We face new challenges of a different nature and scale, such as global warming, social injustice, access to education, reducing single-use plastic production, containing the pandemic and gender inequality. All the radical changes we need seem to be beyond individual innovators, innovative start-ups, large corporations and perhaps even individual governments. We need a new approach to innovation. Some phenomena cannot be solved unless we work systemically and include the community. It is naive to think that the invention of a new bioplastic will solve single-use plastics and sea pollution, just as it is naive to hope that the economic system can fairly broker relationships between the players involved. For this reason, Centralised Innovation must be replaced. The current challenges have neither colour nor latitude, they are intersectional and involve everyone. It is urgent to respond to increasingly distributed challenges with "Distributed Innovation".

Distributed Innovation is a model based on five key factors and can help to address many of the challenges we are struggling to meet today.

`Humanity's most significant challenges are catching us unprepared. Being in a globalised and hyper-connected world means that solutions need to be practical and globally adopted.`

Impact

Distributed Innovation stems from the desired impact and the needs of people and the planet. The aim is to respond quickly and field test a potential solution before wondering who might buy it. The purpose is economic sustainability, and not profit maximisation.

People

It is essential to involve people and communities, not just influential and prominent figures. For seemingly utopian solutions to become feasible, it is crucial that many people adopt them and that they do so consciously. Users and communities are not buyers who choose for convenience, but they play an active role in understanding, implementing and disseminating innovation. “Followers”are just as important as “leaders” since they promote change.

Openness

Being open and inclusive maximises the positive impact, because at the heart of Distributed Innovation is the replication of solutions, not the protection of ideas. Ideas must circulate freely if they are to have a global impact. It is not just about sharing designs and code in open-source, but spreading and promoting ideals and methodologies to put them into practice - impact scales by replication, not by growing structures that generate it.

Benefit

If innovation is distributed, the benefit it generates must be too. In addition to new economic models that consider the social impact, systems are needed to track all players’ contribution to redistribute the benefit generated fairly. This allows many to remain an active part of the network and shift the focus from personal gain to a portable contribution.

Network

Innovation is plural and comes from networks rather than from individual innovators. This means that the rules change to maximise the achievable impact. The management of roles, the charisma of the prominent figures, the allocation of tasks, the openness to suggestions, the integration of proposals are critical steps for developing effective networks in “scaling up widespread innovations by replication.”

This could result in us coming out of it fairer, more equitable and interconnected.

Application of Distributed Innovation.

What are the problems that we are struggling to tackle with current models that can benefit from a distributed approach to innovation?

Firstly, problems that are multiplied by distributed behaviour, for example when an action is independently adopted by many people. This includes challenges that cannot be overcome by introducing a new object or technology if human behaviour is not modified. In many cases, an innovation only addresses the symptoms of a problem rather than its causes. A striking example can

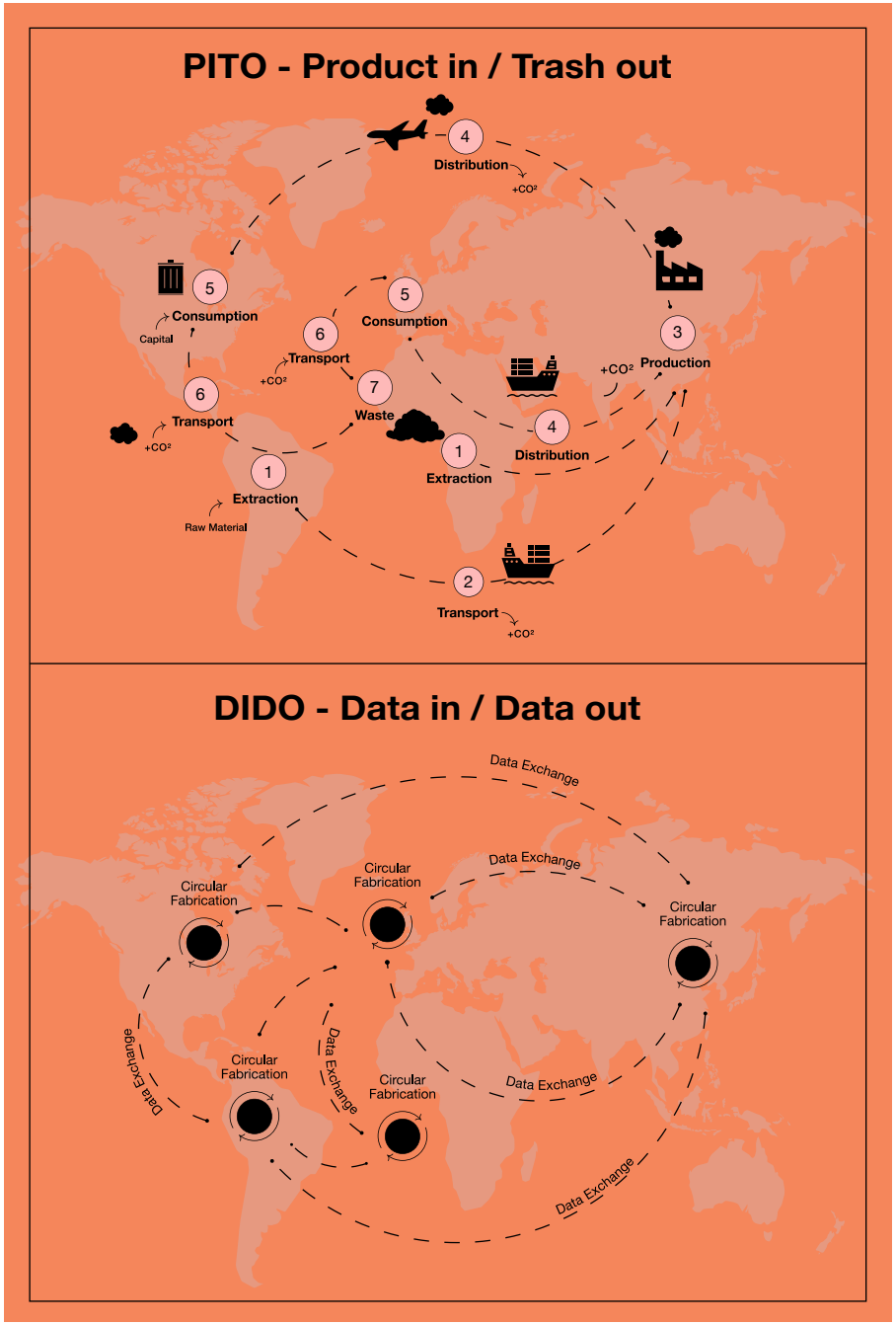
Co-design session at OpenDot - © OpenDot

be seen in the automotive industry. Since the 1980s, engines have become increasingly efficient, yet pollution from private transport has increased[6].

The second category of challenges are those that impact many people in different parts of the world, with different cultures, purchasing power, values, etc. In this context, it is challenging to imagine that a Centralised Innovation solution can be quickly adopted to meet such diverse cases. If Distributed Innovation is adaptable and able to be customized to evolve with local communities, it offers an additional lever for solutions to spread and reach more people respectfully and inclusively.

A final category comprises challenges that can only be met by bringing together many players and linking them with extended value chains. Think of the circular economy: the most popular model to date is the transformative model of large companies, i.e. hoping that companies will take care of all the consequences of industrial production and change the production system. This is insufficient. Achieving a radical change in society needs collaborative projects between different scales — multinationals and small local realities, large companies and innovative start-ups, entrepreneurs and students, policymakers and citizens, people belonging to different cultures and generations. Centralised Innovations usually fit into small parts of existing value chains, rarely changing their structure, which is why they are insufficient in lengthy and complex value chains like these.

The Fab Lab and Fab City network[7] unconsciously applies many of these principles. If we were to formalise the process in its entirety and identify its key aspects, it could increase project effectiveness and impact in a form of Distributed Innovation. Let’s think for a moment about the maker-response to the pandemic. The industrial production system failed to react and scale up quickly to the solutions that arose from below. The only practical approach was



The shift from a 'Products In Trash Out' (PITO) model to a 'Data In Data Out' (DIDO) self-sufficiency model - © Fab City Global Initiative

to produce and design in a distributed and collaborative way. What we saw was an example of Distributed Innovation, using Viral Design[8] as a design process.

Distributed Innovation is a way of tackling shared problems on a global scale while acting locally. It requires a network of interconnected realities that can efficiently act locally and exchange solutions, methods and ideas. In this way, all players have an active role and can generate a positive impact. This includes the local community that wants to see a change in its neighbourhood, or the policy-maker in the European Commission who acts on international laws. To date, unfortunately, the tendency is to differentiate rather than to embrace or strengthen an existing movement. Investment is disproportionate and favours creating something novel, rather than replicating something innovative, albeit already up and running elsewhere.

There is still a long way before Distributed Innovation is recognised as an innovation model that is as important and effective as Centralised Innovation. It should be accompanied by necessary transformations, such as reversing the paradigms of communicating innovation and redistributing the economic value it generates. The good news is that the Fab Lab Network has shown that it has spontaneously experimented with Distributed Innovation projects and could provide a new and unexplored key to understanding the challenges facing us. This could result in us coming out of it fairer, more equitable and interconnected.

The Eternal Return of The New

The Origin of Distributed Fashion Design and its Recurrence Today

Ophir El-Boher & Zlil Busnach

A hundred years ago, a man imagining the future designed what he thought to be the most revolutionary garment of the century. What can be defined as the origin of distributed fashion design, in contemporary terms, was a zero-waste user-centered design, a must-have for your minimalist wardrobe; the trend-setter's normcore outfit. This man was Ernesto Michahelles. Known as THAYAHT, he is mostly remembered for this one-piece suit—the "Tuta". Rather than sending his design to production, THAYAHT published the design's layout and sewing instruction in the newspaper for the public to replicate at home, laying the ground for the contemporary open-source design, in an analog world.

THAYAHT published a rationale for his Tuta, using four basic principles (Loscialpo, 2018). A hundred years later, in my research, I reflected on his theory and confronted it with contemporary issues. A paradigm shift is drawn through these reflections; early 20-century design paradigms defined the current concerns of contemporary fashion and can highlight our direction into the future. Accordingly, in the case study presented, design interventions demonstrate updated iterations of the principles and suggest an alternative for fashion making for our times.

From what he called the future, we look back at THAYAHT, appreciative yet critical of his creation. Revisiting the Tuta in 2021 raises questions about the hopes and promises of modern design, and floods their disappointing consequences like plastic in the ocean.

Introduction

Fashion is the constant change of clothing styles, the eternal return of the new (Walter, 2002). Styles come in and out in an ongoing cycle that continually pushes the old out by defining the new. Old and new coexist inseparably and inform each other. Today, our clothing is produced through a broken system. The fashion industry is confronting huge challenges in its relation to environments. On both sides of this linear system, we are reaching the limit of exploiting our natural and social ecosystems.

Kit's dress, made out of reclaimed cotton, sown with the instructions' print hidden (2019. Portland, Oregon. Mario Gallucci, Pacific Northwest College of Arts)

Tuta making workshop, providing makers with technical skills and companionship. (2019. Portland, Oregon. Amber Marsh)

How Might We Produce, Acquire, Use and Dispose of Clothes in Ways that Benefit Environments Rather than Harm Them?

Upcycling is the process of bringing wasted resources back into a production cycle with added value. During the last few years, a growing interest in upcycling appeared within the fashion industry; from bloggers refashioning old clothing to engineers respinning shredded and melted fibers, making new fashion out of wasted materials the hottest trend of the season. Beyond the boundaries of the fashion field, citizens create clothes in the spirit of bricolage - reclaiming not just the physical materials, but the crafts of mending and making back into their everyday life. This movement of makers, challenges one main factor in waste production: consumption.

How Might we Use Fashion to Balance Global Growth in Consumption?

As fashion designers grow awareness of the harm fashion has caused and still is causing on Earth, an urge to create differently occurs. Ideally, fashion can be done thoughtfully and joyfully, with an emphasis on the people involved in the making of it. Distributing fashion design is one promising direction to that ideal.

Building on the first distributed fashion design piece, the Tuta, I correspond with THAYAHT's rationale, aiming to update his concepts for our times. These are the four principles he presented, and their corresponding sections in this paper:

Tuta la stoffa: the whole of the fabric; sustainability issues.

- Tuta d'un pezzo: all in one piece; production and labour.
- Tuta la gente: all the people; audiences and the ways they inform design.
- Tuta la persona: the whole person; human-centered design approach.

Through an investigation of the origins of distributed fashion design and a design-research process, I created a design intervention that provides makers with reclaimed materials and full instructions to create "your own designer outfit", with minimal expertise needed. Through the activity of making a desired fashion item, I explore opportunities to empower a behavioral shift, transforming passive consumers into active makers. This intervention in everyday life acts as a catalyst for systemic redesign of fashion production and consumption cycles, centering the experience rather than the object.

THAYAHT's holistic approach to design, the focus of his concerns on human needs and the social good, and the concept for distributing fashion, all prove to be relevant for current issues in fashion and the broader design field. However, a century of human progress stands between THAYAHT and myself as a gap, informing the current concerns of humanity and the designer's methods to tackle them. By centering the good of the whole planet, rather than that of the European man, I approach issues of environmental and social crises.

Tuta la stoffa - The Whole of the Fabric

The first principle that guided the Tuta design was to utilize the whole piece of the fabric efficiently. THAYAHT designed the Tuta in reaction to a rise in fabric prices, aiming to provide a sewing pattern for the masses that required less material than the amount needed for sewing the common suit of the time. When cutting the pattern pieces of a man's suit traditionally, each piece is cut along the grain of the fabric. The lines of the cut define not just the fit and the silhouette of the garment, they define the shapes and sizes of the leftover scraps too. Intentionally using the fabric as a whole, instead of cutting it into small pattern pieces, eliminates waste.

"Zero Waste" in fashion design refers to a pattern making approach that uses the whole of fabric to create an item that does not produce any fabric scraps. This approach often uses the Tuta as a point of reference. The contemporary concept of Zero Waste, in fashion, and broadly, is tightly tied to environmental sustainability. It is a call to action for designers to eliminate waste by design decisions and to reduce the footprint of everyday life in reaction to the wicked problem of waste streams on earth.

THAYAHT's efficient use of the material, however, was driven by economic concerns. In 1919, Italy was experiencing an economic crisis, preventing people from replacing their clothing with newer, modern styles. Following the zeitgeist of early twentieth century art movements, especially the Italian Futurism and Russian Constructivism, THAYAHT was interested in neglecting the past and its signifiers in everyday life, and promoting new idealistic ways of living. His ideal new look had to be easy to reproduce and affordable enough for the masses to adopt it. The economic use of the material in the Tuta design, while originally centered on financial sustainability, has greatly inspired today's environmentally sustainable pattern making.

Economic efficiency and sustainable practices do not always go hand in hand. When the primary focus of production is the economical use of materials, efficiency is limited only to the production phase. From a manufacturing point

of view, the material flow is limited to what comes in and out of the factory. If we look through a wider angle lens, we can see the full life cycle of an object. This life cycle includes resource extraction, chemical processes, and treatments of the fabric before its cutting, and those used during and after its useful life.

Production's cropped view focuses attention on economic values, leaving its environmental and social effects in the margins. It is concerned with spending less and making more with less, rather than making less and better. While the industry has been busy with reducing the financial costs of production, the environmental and social costs have been largely ignored. These previously marginalized concerns are now bleeding into the center of our view. Degradation of natural resources, overflowing waste streams, climate change, and extreme inequalities are affecting humanity on scales greater than we can ignore. For these reasons, centering sustainability as the focal point of our view on fashion is an urgent need of our time.

Sustainability has become more central in the fashion world during the last decade. The industry has been taking a variety of approaches to tackle the increasingly visible environmental and social problems. Pressure on the industry to reframe its goals is coming from both inside and outside the profession. Concerned citizens, or conscious consumers, make up a new generation of customers, demanding brands to work towards sustainable goals. Non-profit organizations, like The Fashion Revolution, raise awareness of the crises caused by fashion manufacturing and call for policy-makers to regulate production processes and citizens to readjust their consumption habits. Contemporary brands, like Stella McCartney, practice social and environmental-focused entrepreneurship. Academic institutions, like the Centre for Sustainable Fashion at the London College of Fashion, educate their students to lead a cultural shift toward sustainability. Research practitioners apply technological and theoretical innovation to help tackle the problems created by unsustainable fashion.

The thread that runs through all of these efforts is a holistic view of fashion systems that is critical of the way they affect our world. From a design viewpoint, looking at the whole life cycle of a product includes the resources used before production and those lost or damaged after its useful life cycle.Natural biological systems and processes do not generate waste; instead, every outcome of every process has a nourishing role in its ecosystem. Upcycling is a design approach manifesting this concept. It builds on the concept of recycling but emphasizes an added value of the new product created. Because of this, upcycling is the most responsive way to address waste, while also tackling the problem of degrading resources.Some techniques of upcycling have been in practice for as long as humans have been creating and wearing clothing. Remaking and redesigning a new garment out of an old, unwanted, or unusable one has been a common practice throughout most of human history due to the scarcity of fabrics. This kind of upcycling can be done with fairly simple tools and skills but does require personal attention to each piece of clothing. Therefore, such work is well fitted to amateur individuals or professionals working in limited editions, small batches, or one-off designs but such resource intensity is not readily scalable.

The scale of the waste stream is hard to grasp. The global fashion industry's annual waste is estimated at 92 million tons and predicted to grow dramatically in the next decade. Growth in waste correlates with consumption growth; 62 million tons of apparel were consumed during 2015 worldwide. This already shocking number is projected to grow to 102 million tons annually by 2030 (Kerr, Landry, 2017). The waste stream will grow with it.

Upcycling efforts to address the problem of apparel waste are urgent to the health of the planet. Though, with the current speed of consumption growth, they might not be enough. The amounts of textile waste generated annually are greater than those of products consumed. Thus, balancing consumption growth is essential to balancing the growth of fashion's waste stream. The upcycling approaches described above, only function through incentivizing consumers to buy products. Consumption generates waste and therefore contradicts sustainability.

Humanity does not need more clothes; we have too much and the Earth is flooded with textiles. One evidence for the excessiveness of clothing quantities can be seen in the plan of East African countries to ban imports of second-hand clothing (Banigan, 2018). When we comfort ourselves with donating used clothes as a solution, we are harming the environment and the economy of the locations those clothes are sent to. Recent findings on microplastics in the oceans originated from clothing is another example of the harmful effects of clothing waste on Earth (Napper and Thompson, 2016). With these considerations in mind, it is extremely unethical to continue business as usual for the sake of one more t-shirt in a wardrobe.

Designers may adjust their role; to go beyond just designing the products and to design the systems they operate within. Understanding consumerism as the underbelly of waste streams may lead us to design alternatives for consumption. Distributing the design and production of clothing provides opportunities to balance consumption. By helping others recognize consumption as a problem and build skills as a solution.

Pocket-dress makers, designed with and for non-male identifying audiences (2019. Portland, Oregon. Mario Gallucci, Pacific Northwest College of Arts)

Tuta d'un pezzo - All in One Piece

THAYAHT called upon the general public to make Tutas. In July of 1920, Florence's popular newspaper, La Nazione, published the local artist's instructions for making the Tuta at home. In her article Utopian Clothing: The Futurist and Constructivist Proposals in the Early 1920s, researcher Flavia Loscialpo explains the principle of "all in one piece" featuring "minimal stitching" as "being an example of convenience in terms of workmanship" (Loscialpo, 2018). THAYAHT centered the time and efforts of the maker as one of his principles. Loscialpo assumes that THAYAHT did aspire to serial production of the Tuta, yet he designed it to be easy to make for the everyday person: "... as THAYAHT conceived it, the Tuta is a garment that ultimately questions the fashion project itself, being inherently anti-fashion. It was easily reproducible at home, providing a solution to the high prices of the time" (Loscialpo, 2018).

In that way, the Tuta's importance extends beyond the designed garment. It is an example of a human-centered graphic piece: the spread in La Nazione. It acts as a distributed design experience: leading the maker through the making process. And most importantly, the Tuta is a systemic design intervention: providing the public with alternatives to the existing paradigm of fashion and consumption, by rethinking the system itself.

Making one's garment can provide opportunities for a behavioral shift. Processes of crafting a thing, anything, give the maker a sense of ownership, not just for the object, but for their use of time and labour. Investing in making activities, brings awareness to what our materialistic world consists of. For these reasons, THAYAHT's suggestion to distribute fashion stands relevant and attractive as a consumption alternative for fashion today.

Kit's dresses, made out of reclaimed cotton, sown with the instructions' print hidden or shown (2019. Portland, Oregon. Mario Gallucci, Pacific Northwest College of Arts)

Tuta la gente - All the People

´Understanding consumerism as the underbelly of waste streams may lead us to design alternatives. Distributing the design and production of clothing provides opportunities to balance consumption.´

THAYAHT predicted that the Tuta will be worn by all the people, but his actual target audience was European men and boys of the working class. He designed a women's version along with some other variations of the Tuta, which all followed similar aesthetics and design principles. His vision of humanity dressed as one testifies to uniformity as an ideal. The vision of uniformed humanity was not unfamiliar to the western world's modernity. Chanel's little black dress, for example, was introduced in the United States in 1926, as the "Ford dress, the frock that all the world will wear" (Chanel, 2019). The connection made between the dress and Ford points to the uninformed, homogeneous aesthetic, as a result of the assembly line and its influence on western culture. The simplified lines, monochrome colors, and standardized process of duplication in the model T, the little black dress, and the Tuta embodied a modern western vision of a unified world.

Applying western concepts of aesthetics to "all the people" creates a hierarchy of taste, which limits our acceptance of differences and authenticity. In reality, humans are not all the same, and we should not aspire to be. In nature, the more diverse an ecosystem is, the more it is resilient to crisis. By eliminating difference and aspiring to uniformity, western thought set the ground for humanity's limited ability to deal with current crises. In contrast to THAYAHT and European modernity, today's zeitgeist values diversity, represented by varied aesthetics.

In an article about the dominance of "earth tones, neutral colors, and minimalism" in sustainable fashion aesthetics, Whitney Bauck, associate editor at Fashionista, interviewed sustainable fashion social-media influencers that "see a connection between ethical fashion's most commonly presented aesthetic and the race of the often-privileged people who shape its narrative." Bauck concluded that ethical fashion's choice to reduce colour and pattern alienates people who may use those former elements to connect to their heritage (Bauck, 2019).

Reality is colourful. For example, crowded cities, all over the world, have commonalities in their aesthetics: excessive, multicolored, vibrant, maximalist. Only in their museums, we find "clean" aesthetics of white walls and empty spaces. This "clean" aesthetic, while helping to focus one's gaze on a focal point, does not represent the reality beyond the white cubes that hold it. Removing things from our vision, reducing details, colours, and textures, and aiming to create a unified look, is a western-centric activity. The unifying aesthetics of THAYAHT don't align with values of diversity and inclusion. Aesthetics that celebrate varieties of color and texture may better represent the diversity of human expression.

Tuta la persona - The Whole Person

THAYAHT's principle of the whole person is focused on the whole of the body. In contrast to the separate pieces of the common men's suit of his time, he suggests a full-body suit. By choosing a one-piece suit, he argues, the wearer eliminates waste of time. His concept of being efficient with time is based on a reduced amount of pieces. In Flavia Loscialpo's words "It was a rational piece of clothing, reacting against the need for continuous change […] The Tuta was projected for any occasion..." (Loscialpo, 2018). By eliminating both the need for changing styles and the need for having more than one garment, THAYAHT believed that he would free the people from the hassle of choosing what to wear.

Contemporary fashion discourse around the reduction of pieces has accrued both inside and outside the context of sustainability. Normcore, a conflation of "normal" and "hardcore", is a term that describes individuals "finding liberation in being nothing special" (Gorton, 2014). In common use, the term describes a trend of people wearing "practical", undistinguished western wear. Similar to THAYAHT's principle, the normcore trend eliminates the time and efforts dressing may consume, assuming the act of dressing as a low priority in one's life. Examples used to illustrate the style are Steve Jobs, Mark Zuckerberg, and Jerry Seinfeld. The common thread between these examples is that they are all American, white, affluent, influential males who normally wear blue jeans, t-shirts, and sneakers. If thinking of fashion as language, choosing to always dress in an undistinguished look may be read as a choice to keep silent. Silence is, however, a statement in and by itself, it communicates a lack of interest in the conversation. Expressed by powerful figures, this statement may be read: "I am too busy and important to be bothered with nonsense like fashion."

The minimalist-wardrobe, another contemporary approach reminiscent of THAYAHT's, focuses on easy-to-wear styles, through minimized amounts of garments. It assumes "timeless" fashion and aims to reduce consumption by curating a cohesive wardrobe, as a sustainable practice. This concept, also known as "capsule closet", was introduced by Susie Faux, a London boutique owner, in the 1970s, and has returned during the last couple of years, mostly spread through social media. The "10X10 challenge", dares people to wear only ten garments, combined into ten different outfits for ten days, for example. This concept requires a behavioral change, it is essentially a lifestyle commitment to minimalism. Transforming one's closet into a capsule wardrobe — fashion experts explain in an infinite number of articles online — one must commit to functional pieces that fit great and can be combined in different ways to appeal on many different occasions. This may require a limited range of colours and patterns that all match nicely together, mostly separate pieces that can be worn in different combinations and "classic" silhouettes that stay in style for many years.

Both these concepts, similar to THAYAHT, are based on aesthetic values of reduction, and on an assumption that the activity of dressing should be subdued. This approach ignores the fact that people love to dress. While hyper-consumerism exaggerates our desires, it does prove a common human need for material possessions.

Human-centered design considers the wearer holistically, in contrast to THAYAHT's consideration of the body alone. This holistic approach may reveal why we consume the way we do, and how we might balance it. Rather than trying to tame or ignore human materialistic needs and desires, designers may diversify the activities that can feed them. The making activity may provide opportunities for the maker to self-reflect, practice self-care, and find joy in creating useful objects they will cherish. In addition, those who understand the relationship between consumption and environmental crises, and feel dissonance between this understanding and their consumption behaviours, will also find relief from this inner conflict through the making activity.

Kula Simla - "It's all a dress / All it is is a dress" - case study

Making a Tuta

After researching THAYAHT's principles and his pattern's distribution to everyday people, I wanted to check closely whether his vision is relevant for a contemporary audience. Through the experience of making a piece of clothing, I aim to encourage self-reflection on consumption behavior. Constructing a garment raises appreciation of the clothing we already own. It might lead to taking better care of clothing, a better understanding of quality, and potentially consuming more thoughtfully. The practical knowledge acquired in the process may become an alternative for consumption; the skills may be applied to alter, repair or remake existing clothes, or construct new ones.

Preparing to remake the Tuta with participants in workshops, I finally took the challenge to make my own. Following THAYAHT's instructions revealed where the design was successful and what aspects of it were insufficient. Considering his dedication to simple construction, I believed the process would be simple, yet I was challenged. I was using THAYAHT's limited translation to English and found it lacking. Assembling the pattern pieces was not intuitive. For example, the collar pieces are still an enigma for me. Other pieces, such as the sleeve, while innovative and cleverly designed, did not match in length to its designated place in the armhole.

I had several hypotheses about the reasons I could not get it right. Firstly, information that was missing from the English version I creatively translated from the Italian one, using Google Translate. This linguistic barrier may have created some errors. Secondly, common ways of using tools, practices, and instructions have evolved and shifted tremendously since THAYAHT distributed his design. There is a possibility that when THAYAHT considered the common knowledge of the intended user — an unspecialized person making the garment at home, likely without a sewing machine — he left leeway in the design, allowing the inherent creative problem-solving as an integral part of the process. This aligns with concepts of open-source design;

the design is provided as a concept, allowing the maker to change, adapt, and creatively develop it for their needs and circumstances. The last hypothesis came to me while struggling to connect the sleeve to the armhole, with no seam-allowance to attach it. Frustrated with the unclarity, I suspected that THAYAHT had never actually sewn the Tuta himself, and perhaps relied on expert sewists to make it for him? While these hypotheses could be further explored, my experiment had fulfilled its goal of trying a distributed fashion design. The difficulties pointed out that a clear common language for such projects is necessary for a successful production, among other designers and the makers.

Synthesizing my personal making experience and other experts' advice, I made iterations of THAYAHT's Tuta. An added side seam replaced the fold in the original design, allowing easy insertion of the sleeve, and preventing

Tuta makers, diversifying THAYAHT's vision of uniformity (2019. Portland, Oregon. Sara Meadows, Pacific Northwest College of Arts)

the fabric pulling against the direction of its grain. I redesigned the collar, due to my lack of understanding of its pattern pieces. Some additional minor changes were done, fitting the design to contemporary standard sewing. Iterations were all done to simplify the process as much as I could.

Tuta Workshops

As part of my design research, aimed to establish objectives for a successful distributed fashion design, I surveyed 80 people about their acquiring patterns and garment making practices, if any. When asked "What would help you engage more in making, altering, or mending your clothes?", I had over 40 mentions of skills acquiring or otherwise learning, appearing as the most common need.

According to their responses, I invited respondents to participate in a workshop to remake the Tuta, during the spring of 2019 in Portland, Oregon. I led participants in two Tuta-making workshops. All the participants finished their garments, advanced their skills and knowledge, and shared positive experiences. Here are a few insights from this experiment:

To ensure only reclaimed materials were used, I shared with my participants some definitions (in advance), referred them to potential sourcing facilities, and offered to supply the fabric if needed.

In each workshop, we went through the best practices of the making process. Some activities that I considered basic or simple seemed to be more challenging and time-consuming than I anticipated; ironing, for example. All participants that replied to my feedback form indicated an improvement in at least three skills and most in more than six. Most have had the chance to sew since the workshop, and reported feeling significantly more confident in doing so.

Constructing two-dimensional fragments into a three-dimensional whole was hard to grasp for some. I concluded that fewer pattern pieces might be easier to grasp for beginners.

Finishing, which includes a high attention to detail, seemed less important to my participants. It takes years of intentional observation to build sensitivity towards such details. By acquiring a few simple, affordable tools and iterating the design towards using these tools, I eliminated some of the steps for finishing the garment.

Regardless of the positive feedback on the learning, most of my Tuta-makers attest that they did not wear their garments, and when asked about purchasing, most indicated that since the workshop, they did buy clothing. I concluded that an improved skill set and a good experience isn't enough for a behavioral change; the object itself must feed that desire that otherwise leads to a new purchase.

My experience as the instructor also informed my criteria for a successful design. I was challenged to lead the process promptly, in a one-day workshop. It was an ambitious standard, but I thought it was essential to making the whole experience feel simple and easy to go back to. The Tuta was time-consuming, for it required different techniques for each step. In response, I decided to design a garment that requires similar kinds of seams and finishes all over.

Tailor-made for the Audience - from the Tuta to a Pocket Dress

Considering my audience, I decided to centre non-male-identifying individuals in my design. The majority of my survey respondents identified as either female or non-binary gendered. Those that said they would be interested in participating in a workshop received a sign-up form. Half of the respondents preferred the Tuta and half preferred a dress. I started with the Tuta workshops, as described earlier. Applying my learning from making and teaching THAYAHT's design, I prepared the design, the setting, the participants, and myself for the pocket dress workshops.

The pocket dress was designed following the Tuta's objectives, but centering the needs of my specified audience. Centering on non-male individuals guided my decision to design a dress, allowing comfort in everyday activities from a female perspective. In addition, it guided my fit ideology. I had the dress fitted on about fifteen women in different sizes, whose preferences were included in my design decisions. I designed the pockets around the size of an open hand, big enough to fit a pocketbook. It was important for me to give the ease and comfort of a relaxed fit and big pockets, eliminating the need for a handbag for increased freedom of movement.

My design intention was to facilitate a positive making experience with as few barriers as possible. After two Tuta workshops and ten follow-up sessions, I was determined to design a garment that can be fully realized in one day. The pattern consists of three pieces — the front, the back, and the pockets — and a belt made of long, straight straps. The seams are all straight and short, and their finishes repeat the same techniques. The repetitive operation was intended to create confidence in accomplishing a task through practice. I equipped the shop with some tools (a tape maker and a rolled hem presser foot) that would simplify the process and iterated my design to fit these tools.

In three workshops, I led participants through the process of making the pocket dress. All of the participants finished their garments. Those who responded to my feedback form indicated a significant improvement in their skill set and high satisfaction with the experience of both making and wearing their dresses. All indicated an improvement in at least three of the practices taught, and most in six or more. All participants said they would love to repeat the experience. About half said they had sewn something since, and their confidence in doing so was significantly higher. Most indicated a five-out-of-five positive experience and finally, most have worn their garments since. When asked about their "biggest takeaway" from the experience, many of the participants mentioned their aspiration to continue making clothes in the future.

Conclusion

The workshop experiment was intended as a design research phase, but proved to be a successful design intervention in itself. Social engagement, it seems, was an essential part of the success. In THAYAHT's intervention, he organized Tuta parades; an opportunity for the makers to come together. My experiment proved that the workshop as a design intervention holds an opportunity to engage more makers in distributed projects.

In my initial surveys, I received several responses saying that a lack of companionship is a barrier to making. Therefore, I designed the space and the activity to foster community building. Working within a local community meant that some participants were familiar with each other, and others could assume they will meet again in the future. In advance of the workshop, I asked all of the participants to agree to prepare food and music to share. They were asked to engage in skill sharing and to prepare a personal introduction activity. This was intentionally designed to foster a collaborative environment and encourage relationships between participants to flourish.

Regardless of the workshop's success, I recognize that it is limited to a physical location and reliance on the instructor. Imagining the pathways to scale this project, I wanted to remove these limitations by creating a customizable design. One possible direction to broaden the reach of my proposition was to design a maker's kit to create the pocket dress. The limitation here is that I would provide a product which can undermine the effort to reduce consumption. However, the benefits seemed greater than this limitation, more on that below.

Another possibility was to distribute a digital open-source document. This direction is yet to be explored for various reasons, including material sourcing issues. Firstly, I wanted to ensure that this design is solely made out of reclaimed materials, a challenge when it is freely distributed online. Secondly, choosing fabrics, already limited by the nature of upcycling, is a barrier for beginners. In my research, I observed participants challenged by materials which are hard to work with, disappointed by the feel of their materials once on the body, or by their ungraceful drape when sewn. I concluded that a provided fabric may be a good entry level.

Pocket dress in the making, designed to facilitate a positive making experience with as few barriers as possible (2019. Portland, Oregon. Heather Boyd)

Maker's Kit

Informed by my research, I defined my design criteria for a distributed fashion design kit in response to THAYAHT's Tuta principles. THAYAHT's whole fabric informed an efficient use of material. My update was a broader view of environmental sustainability, rather than the narrow view of economic sustainability. Therefore, for example, only reclaimed materials will be used. Another example, reacting to the problem of disposable apparel, I designed a versatile garment, responsive to changes in fashion trends, and the wearer's body.

All-in-one piece informed THAYAHT's simplicity of operation. My update was instructions that will be clear enough for the maker to accomplish with minimal frustration. It informed the dress's technical design, the tools, materials, and operations required to complete the dress on time.

The "all the people" principle informed my decision to design for non-male audiences, and with diversity as a goal, rather than THAYAHT's vision of unity.

The last principle by THAYAHT, "the whole person" disrupted the fashion system by reducing the time and effort spent on the activity of dressing. This principle informed my decision to suggest an activity of making, rather than a finished garment, as a form of system redesign. It informed the language and tone of my instructions, as well as some self-care practices as part of the process. I set myself a goal to facilitate a memorable and joyful making experience so that the makers would want to recreate it, and making will become an accessible alternative to consumption.

The kit includes all the needed materials and guidance to lead the maker through the process. It consists of one piece of fabric, printed with the full instructions for cutting and sewing the pocket dress. Including best practices for each technique used, the instructions walk the maker step-by-step through the process. This way, the kit acts as a learning tool. The language and tone of the instructions are simple, avoiding professional terminology, and includes some friendly advice to stretch, smile, and be proud, meant to minimize frustration and bring joy to the experience.

Textiles were defined by local post-consumer material flow characteristics. Cotton, I found, was the most common material in large pieces: bed sheets and workwear. In line with circular principles, I sorted out any other fiber content to ensure a consistent and homogenous material for increased recyclability. Sanitised, deconstructed, and sorted by colour and weight of fabric, I reconstructed reclaimed cotton goods into yardage.

The yardage was then screen-printed with the sewing pattern and instructions. The resulting fabric has a unique quality that reduces steps in the process and provides longevity to the final product. Through my experiments, I found that the edges of the woven cotton that were printed did not fray like raw edges. Edges can be sealed, locked, or stitched in various ways, each taking time and effort, and requiring additional materials, techniques, or equipment. Many of my workshop participants did not have the patience to finish their garment's inside seams. Therefore, in response to this challenge, I designed the print with thick outlines on the edges, indicating where to cut and sew while also sealing the edges.

The aesthetics created by my collaging technique, and the printed text over the dress, embodies the concept of bricolage: showing "the action of making" in the finished object. The result is a statement dress that carries with pride the time and effort taken to make it.

Prototypes of the kit were distributed to several makers. I received positive feedback on the making experience and the dress design. However, further development is still needed in a few areas, including the manufacturing processes of the kit itself, iterations of the print graphics, and a more diverse sample group.

Reclaiming became an underlying truth beneath the surface of every choice made through the process: reclaiming used materials, reclaiming making practices and reclaiming the power of the citizen to influence global systems. By pulling insights from the past, both conceptually and visually, we can practice the eternal return of the new, bringing back to life what has existed before and will continue to exist in the future.

The maker's kit, made out of reclaimed cotton, screen printed with sewing pattern and instructions (2019. Portland, Oregon. Mario Gallucci, Pacific Northwest College of Arts)

CHAPTER 2

Practitioners in the Field Today

Today, the principles of Distributed Design such as open, collaborative, sustainable and inclusive practice are being applied to a wide variety of design and making applications. From open-source hardware, to fashion made from biomaterials, to education and co-design processes. This chapter identifies a range of experts and practitioners who exemplify this diversity through real-world applications. It highlights the designers, makers, projects and institutions that are contributing to strengthening the field of Distributed Design, including the 18 Platform members from 15 European countries and the UK.

Open Design & Open Education

Weaving Educational Networks

Enrique Aparisi from GDUT Guangzhou, Beatriz Fernández from ESDIR Rioja, Guillem Ferran from ESDAP Barcelona & Carmela Forés from EASD Castelló.

Introduction

Since the beginning of the 21st century, the open education movement has become a pedagogical environment, increasingly important, both in the fields of formal and non-formal education. UNESCO defines it as a type of education that is closely linked to advances in information and communication technologies, as well as to the development of new educational needs, and new patterns of access to information and learning. In this framework, we want to place open- design as an educational tool that allows us to approach the learning of design from multiple perspectives: social, cultural, economic, environmental and ethical. The need to put both concepts, open-design and open- education, together leads us to the creation of an Open- Design Educational Network. A place that, even starting from a formal education that is still highly hierarchical today, has the ability to promote new models that recognize other people or groups of people as educational agents.

About the Need of Weaving Educational Networks

We understand educational networks as an ecosystem: a community of living beings whose vital processes are related to each other and develop based on the physical factors of the same environment. Our habitat is regenerated thanks to the open culture and, from it, we pursue the creation of innovative experiences that allow the flow of information and the socialization of knowledge. The common objective is innovating and improving teaching practice. The interaction of the different nodes is carried out horizontally, promoting autarky, reciprocity, cooperative models and commitment to the environment.

Weaving Concepts: Open Education and Open Design

As already mentioned, the interaction pursued with the generation of these educational networks is based on open culture, specifically on two pillars: open education and open design.

Open education allows us to contribute to the renewal of the traditional educational system, as well as to create synergies with other areas not directly related to education (Khvilon, 2002). Linked to this movement, we find the concept of “Open Educational Resources” (OER). We understand OER as technological tools under the same principles as the free software movement: freedom of use, distribution, study and modification. From these concepts, the action is expanded to promote education as an engine of social change through the freedom of use but also of dissemination, learning and adaptation of any type of learning material.

At this point, we connect open design as a facilitating tool for the teaching-learning process. From here, design transcends its own purpose to become a resource from which to generate shared knowledge, encourage the acquisition of skills that promote self-management of life, develop critical thinking, prioritize values and needs for and with the people. This enables us to configure products in a participatory way, away from mass production and capricious consumption, from where to feed new economic systems based on behaviors more in line with “being more” and not only with “having more”.

Screenshot from one of our online meetings/presentations between spanish and chinese students and teachers. May, 2020.

Where Do We Come From? First Educational Experiences

Open design, understood as a resource for the learning and teaching of design, and self-production, were the starting concepts, in 2015, of the Download OpenDesign (DOD) project, initiated by teachers from the School of Art and Design in the Guangdong University of Technology in China (GDUT) and the Escuela Superior de Diseño de la Rioja, in Spain (ESDIR). It currently has the participation of two more design schools: the ESDAP of Barcelona and the EASD of Castelló.

The DOD platform (www.downloadopendesign.com) is conceptualized as a global educational community of collaborative work and knowledge exchange from which products are designed, redesigned and manufactured. We achieve this by giving free access to our design information (open design) and with a proposal of product manufacturing within the framework of productive autonomy (DIY, DIWO).

This community structures its methodology in a circular way through three consecutive workshops:

We Make. We are makers. We select a product from the platform, follow the instructions, and build it for our needs and local resources. We "learn by doing" (Dewey, 2014), understanding the materials and processes.

We Redesign. We contribute. Starting from a product manufactured from the platform, we logically find improvements for its redesign or reinterpretation, or the urge to adapt it to our needs, thus promoting collective creation processes.

We Design. Starting from the previous experiences, we acquire the basis to be able to design our own new products from scratch, thus initiating the participation, in this cyclical learning process, of others and other students of the DOD network.

The resulting educational experiences not only seek to promote open design and self-production, but also the improvement of design learning from the perspective of values of collectivity, sustainability and collaboration.

Where are We Going? The Open Design Educational Network

The conjunction of the ideas of open education, open design and DOD, together with the need to expand this project and promote changes in the field of design education, leads to the formalization of an Open Design Educational Network. Our current purpose is to set up a network of schools and organizations linked to open design, managed from an internet platform, from where we can share resources, projects and weave collaborations.

Download OpenDesign Website(Screenshot from http://www.downloadopendesign.com/ May,2021)

Some of the objectives that we had and we propose to embed are:

- Encourage participation and co-creation, through respect and empathy, from the recognition of diversity and interculturality as a way to enrich the project.
- Share knowledge for common achievement. Give open access to students and teachers of the knowledge from previous experiences. This approach is key to increase the public domain, democratize knowledge and encourage co-creation as a tool for improvement and social creativity.
- Feed the culture of know-how, promoting self-management of life as a basis for generating daily empowerment practices.
- Contribute to the transformation of the production model, optimizing the use of materials, processes and distribution, as well as distributed manufacturing.
- Unlink development-consumption through a relocation of the economy and downscaling, promoting responsible consumption and fostering a sustainable material culture on demand.
- Understand higher design education, not only as a gateway to the labour market, but as a place of resistance to the prevailing economic models, from which to strengthen critical thinking and promote the common good, autonomy, social dialogue and openness.

´Encourage participation and co-creation, through respect and empathy, from the recognition of diversity and interculturality as a way to enrich the project.´

From the peripheries of the design education, establish new roles that recognize other people as educational agents for the acquisition of values and promote actions; as well as to propose new relationships between teachers, students and citizens.

How Does the Network Grow? Sharing Knowledge and Synergies.

The network grows through participation, not only of design schools, but also of any educational agent or community groups. Teachers, students or people linked somehow to the learning of design, can be contributors to its development. The level of involvement is decided by each person or centre. From small collaborations to international student exchanges, through workshops, exhibitions, sharing learning materials and resources, uploading results to the web, etc. From this flexible paradigm, the Open Design Educational Network enables the generation of disruptive places that help to rethink the logic of formal education, as well as the skills required to face uncertain futures. From a very practical approach, the network aims to train people to solve problems from autonomy and resilience, to face and adapt to changing, plural and diverse environments, to learn continuously without losing curiosity and the ability to imagine. Finally, it proposes the generation of synergies from an open attitude towards collaborative work, shared knowledge and critical, creative and innovative thinking.

Open workshop in Museo de La Rioja, Logroño. It was given by design students from Esdir to high school students of arts. March 2018. Picture by DOD team.

One of our exhibition posters. Pictures were taken both in Spain and China and the posters were common to both schools. May, 2019. Pictures by DOD team.

Prototyping Hybrid Learning Environments through Distributed Design

Maria Dafni Gerodimou, Oliver Juggins, Santiago Fuentemilla, Xavier Dominguez & Eduardo Chamorro from Fab Lab Barcelona.

Introduction

A shift towards online education has been taking place over the past decade, with online resources for education providing the opportunity to gain new skills at a level of accessibility that wouldn't have been possible for previous generations. This transition allows for new and distributed models of learning to be developed which, in turn, provides a great opportunity in the field of design, where delivery normally takes place in-person due to the practical nature of activities in the courses.

The purpose of this review is to present the frameworks, research methodology and documentation tools developed by the Fab Lab Barcelona team in the transition to a hybrid learning environment during this academic year, for the Master in Design for Emergent Futures (MDEF) program; a key goal of the research being to identify the ways in which a hybrid model approach is not merely a replacement for a fully physical format of delivery (due to the pandemic's restrictions), but a viable alternative that adds value to an overall learning experience.

MDEF as a Case Study

In the 2020-21 academic year, in the face of the COVID-19 pandemic, the MDEF transitioned from a fully in-person master program to a hybrid course, meaning that there was a mix of on-campus and online students. This year's MDEF included remote students from all over the world and therefore the course structure, equipment and planning of the classes had to be adapted in order to adequately respond to the new context.

The MDEF is a complex learning environment as it incorporates different concepts and topics relating to emergent technology including synthetic biology, digital fabrication and machine learning into one coherent course. The course serves as a great case study for investigating the hybrid models educational approach and distributed learning practices as it is itself a hybrid master born from the intersection of design and the maker's world in collaboration with IAAC, Fab Lab Barcelona and ELISAVA School of Design.

Its structure poses several challenges from an instructional design point of view, as not only do each of these different learning areas demand their own dedicated learning strategy, but they must be intertwined into a holistic learning experience where the separate topics are not merely fragments of knowledge, but are equally important parts which complement each other and interconnect.

This context provided the perfect landscape for the education team of Fab Lab Barcelona to concretise ongoing research into hybrid learning frameworks, which has thus far been developed on a yearly basis, and without the urgency of a global pandemic for the global Fab Academy program. As a result, the MDEF course serves as a great case study for how the hybrid model can be implemented into a course with varied content spanning different disciplines and ranges of delivery formats. For instance, in the first term the course integrated different topics and external guest tutors, each one dedicated to a separate one or two week course. This meant that throughout the year, we had to encounter a number of different modules, from fully distributed online classes to hybrid digital fabrication workshops, depending on the content delivered. Whilst the hybrid model might seem to be adding complexity to an already challenging design course, it was a necessary leap to deal with our context. It also simultaneously presented a great opportunity for experimentation and therefore allowed for the emergence of novel learning practices, integrating both physical and digital tools.

In order to facilitate the transition to the hybrid model to MDEF, the Fab Lab Barcelona's educational team defined a research strategy with the purpose of developing a set of tools aimed to successfully extract and organise collected information throughout the duration of the course in an efficient manner. The latter provided valuable observations and reflections regarding the learning strategies and modules used.

There were a series of research questions and aims that were set out to guide the research framework:

- What can hybrid learning environments learn from the paradigm of distributed design?
- What are best practices that can be extracted to improve the learning experiences that are developed by the Fab Lab Barcelona as a whole?
- How will the approach to designing educational experiences evolve with the findings?
- How can we incorporate students and faculty in the research process to make the most of their insights?
- What is the necessary physical infrastructure that needs to be developed to successfully implement the hybrid model?

Future Learning Framework

The Future Learning Framework has been in development by the team in the Fab Lab Barcelona and provides citizens with the necessary methodology, resources and technology so that they can develop key skills and competencies for an uncertain future and become digital, social innovators.

The research activities and the development of the framework has been guided by the Sustainable Development Goals with the focus and definition of education experiences that are designed and delivered. This framework is constantly evolving and serves as a pedagogical tool that facilitates the development skills and competences that are based around three pillars: attitude, knowledge and challenge. Attitude refers to the engagement and interest of the students (or participant of a given learning programme), knowledge refers to the content of the learning experience and challenge refers to the task and goal of the learning experience.

Given the context that has been brought about this academic year, the opportunity to research what an educational distributed design model looks like through a hybrid model presented itself and has been one of the main research lines this year.

Research Methodology

The research carried out was built on an initial study into the hybrid model in order to prepare for the adjustment and planning of the different strategies that would have to be implemented throughout the year. The guide included initial assumptions and preparation in terms of infrastructure, interaction modes and instructional design strategies. The purpose of the hybrid model research is to enrich and potentially reform the guide, transforming it to a toolkit that can be used and adapted to similar hybrid learning courses in the future.

In order to conduct the research, the team developed a research methodology, building on the initial hypotheses but with the intention to dynamically adapt the focus as the course progressed and new learnings were formed. The research methodology includes:

Documentation Tools Used to Gather and Organize Data

- A Teaching Assistant position, created to facilitate the technical needs of the hybrid model infrastructure and observe and document the classes. The assistant participates in all the classes and is therefore responsible for gathering the insights as well as communicating on a regular basis with faculty and students in order to receive feedback regarding the course.
- Assessment methodologies including evaluation tools and feedback sessions with students and faculty.

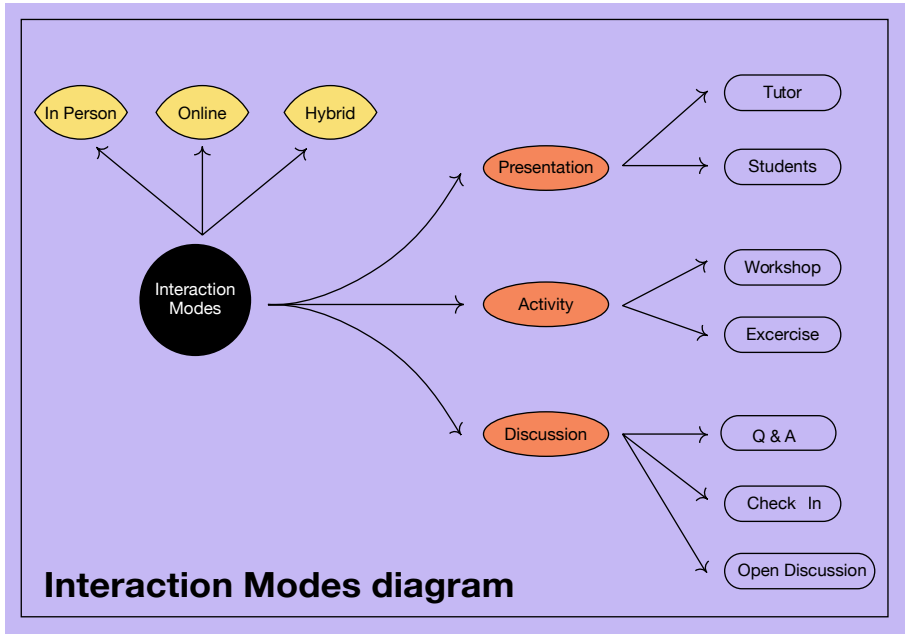
Interaction Modes

In order to analyse the hybrid model and evaluate implementation, a number of interaction modes were synthesized (a term used to define the different types of possible formats of delivery), also looking at how they are experienced within both online and hybrid learning environments. This refers mostly to the interaction between the tutor and the students and expresses the different ways in which learning can take place.

These interaction modes include:

Presentation mode	**Activity mode**	**Discussion mode**
One-directional lecture - tutor presenting. Student's presentation.	Hands-on Workshop / Making. Design Thinking / Ideation. Brainstorming.	Group class discussions. Check-in / Check-out. Q&A / Troubleshooting.

The research aims to identify these interactions, analyse which ones work best in certain situations / contexts, and which combinations of interaction modes work well during an online or hybrid and even in-person environment. By observing and analysing the interaction modes through the research, our intention is to build an instructional guide, as part of the hybrid model toolkit which can be used as a reference in order to improve the specific courses but also the student experience as a whole.



Interaction Modes diagram

Documentation Tools

The Toolkit Template

For the documentation of the research, the team developed a set of tools including different templates and methods with the aim of building a complete documentation toolkit that can be used for other courses as well.

To document and organise the information of each course, we created a Google document containing:

- General information about the course syllabus, objectives and duration as defined by the course instructor(s).
- The delivery format of each module/class (distributed or hybrid).
- Workshop template dedicated to each class including:
  - Structure of the activities including timings and interaction modes.
  - Tools and platforms and technical infrastructure used (physical and digital).
  - Comments concerning problems or unexpected observations that emerged during classes.
- Assessment section referencing the feedback gathered by instructors and students after the course.
- Reflections of the course through which the research team examines to what extent the initial objectives of the course syllabus were met and whether the tools used to support the hybrid model were sufficient.
- Improvements or iterations according to the assessment and reflections.

To complement the toolkit documentation the team also created visual templates with the collaborative platform Miro which includes:

- Diagrams the workshop templates.
- Interaction modes diagrams and templates.
- Visual notes.

These visual tools not only complement the research, but facilitate the understanding of the different workflows and information. In addition, they are a more understandable way to communicate the information that is gathered and processed, not solely for the rest of the research team but also for external organisations and possible collaborators.

Assessment

By analysing the information gathered from the documentation toolkit, the team can then assess each course.

This evaluation process consists of:

- Observation documentation notes.
- Videos, photos as evidence of what happened.
- Student engagement during the course.
- Quality of the student assignments.
- Weekly student reflections (personal documentation).
- Interviews of students and faculty.

The assessment is a vital part of the research, as it validates the observations and reflections generated from the classes, as well as the assumptions made by the instructors when designing the course. This evaluation process provides valuable insights regarding the possible iterations and improvements of the course or similar courses.

Key Takeaways

At the beginning of the year, the planning for the hybrid model was based on initial desktop research, and experience over the years of on-campus activity. Classes were planned for three different setups: on-campus, online and hybrid. Over the course of the year, we gained key insights which can be applied to each of these class formats, some of these include:

- Alteration of different interaction modes within a specific timeline carefully planned by the guest. (Presentation / Group discussion / Activity).
- The importance of paying attention to the timeline of the class to not exceed the predetermined three hours.
- The use of a variety of different interactive tools (during the week but also during each class) to maintain engagement.
- Creative smaller tasks connected to the course (brainstorming, small exercises, thought experiment).
- Give students the opportunity to present their work to the class and get feedback from tutor and classmates. It is important for them to see their classmate's work.
- Integration of collaborative/sharing tools (Google doc where students share bibliography, Miro, etc.).
- Having small breaks during an online class.
- Asking students to share briefly how they feel or what they learned at the beginning and end of the class (check-ins).
- Creating visually engaging material to help students stay focused and interested.

Hybrid Model General Insights, Tools & Equipment

We found that the most interesting insights came from analysing how the different interaction modes can be used in relation to a hybrid class with a focus on making. This class, as predicted, presented the most challenges but the most opportunity for learning. These are some general insights for the hybrid model, and tools and equipment that are useful across each of the interaction modes.

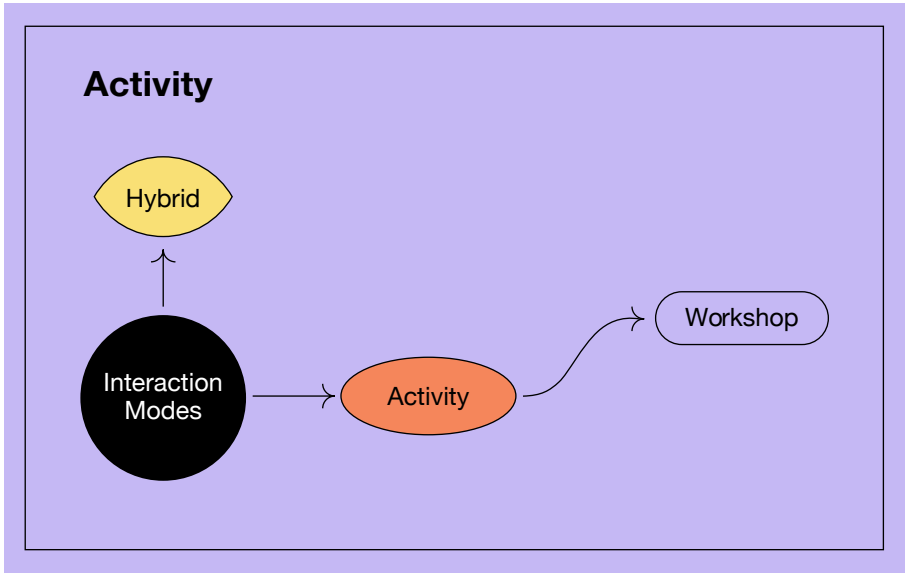
Insights

Extra care and preparation must be taken to ensure the learning experience of the remote students. Appropriate and sufficient equipment as mentioned above. Frequent check-outs from the faculty asking both remotes and non-remote students how they are feeling and how the group work is proceeding.

Tools & Equipment

- Screen(s).
- Projector.
- At least one noise cancelling speaker-phone.
- External camera.
- Zoom / Breakout rooms and Zoom Chat.
- Collaborative working platforms, e.g. Miro.

These are some more specific examples for each of the interaction modes (activity, workshop and presentation).



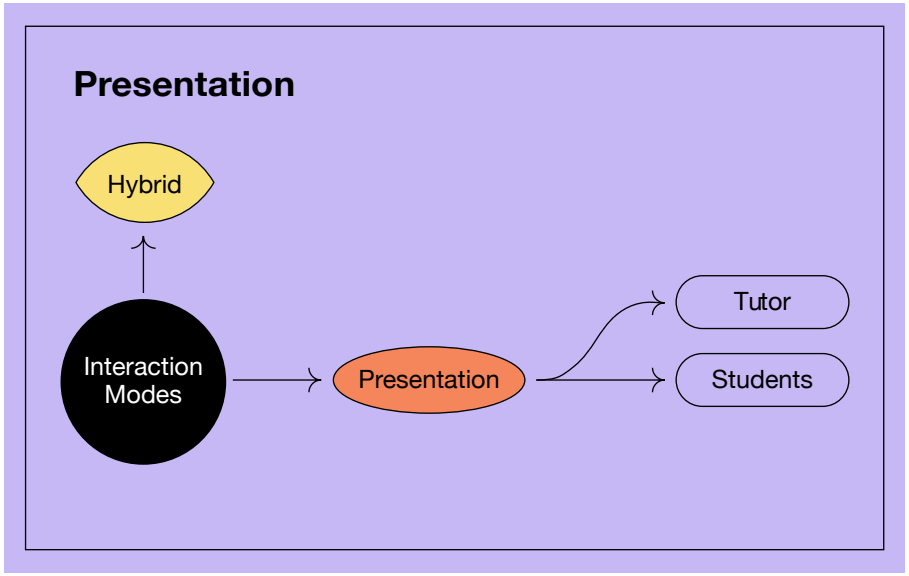
Interaction Modes-Activity diagram

Tips

- Making sure that the speaker is in proximity to the tutor, and checking with the remote's to make sure they are listening clearly.
- Having two screens - one big one for the presentation and one where the physical students can see the remote students so they feel more included.
- Meticulous planning of the infrastructure needed for the class. Noise cancelling speakerphone, screen, cameras with different perspectives to the classroom.
- When forming hybrid working groups, it is essential that the remote students are evenly distributed according to their skill set. Otherwise, it is possible that they feel like they can't contribute equally to the project since not being physically in the lab is already a disadvantage.
- Maintaining a constant communication with students during the course and being able to adjust according to their needs.

Tools & Equipment

- Portable Cameras.
- Mobile phone.
- Headphones.

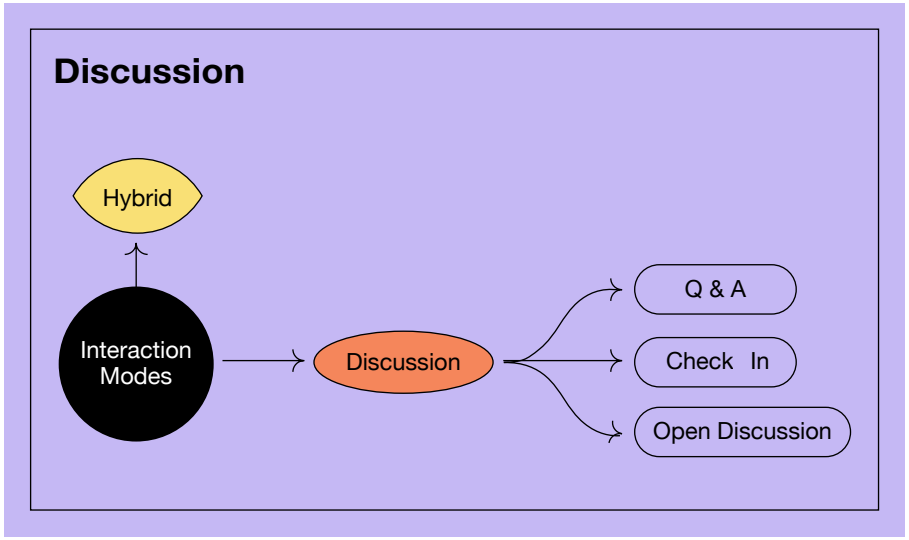


Interaction Modes-Presentation diagram

Tips

- Ensure that the person (student or tutor) speaking is close to the noise-cancelling speaker.
- Adjusting the camera to the person talking, or at least having a clear view of the whole classroom.

- Using the two screens (projector and screen,) one in gallery view and one in speaker view so the students and tutors have better visual contact with the remotes.
- Encouraging the remote students to participate by asking them questions. It is harder to engage in conversation while being remote so the tutor has the responsibility to include them as much as possible.
- Checking the chat frequently to vocalise the comments or questions of the remotes — some students are more reluctant to speak-up while being online so they prefer sharing their thoughts via chat.



Interaction Modes-Discussion diagram

Reflections

The shift to hybrid models of education was an inevitable one, accelerated by the pandemic. The research carried out so far by the Fab Lab Barcelona gives some initial insights into the challenges and opportunities presented by hybrid learning environments, from the extra planning needed for the optimal student experience and engagement, to the practicalities of equipment used and room layout. We realise that, although we have gained some insights which can be taken into account when planning the next academic year, there is lots of room for improvement and a constant process of reflection and interaction will be necessary. The input from students has been instrumental in gaining these insights and will continue to be as the research continues into its second phase. As life becomes gradually more “normal”, and as the changes brought about by the pandemic become less evident in society, we believe it will be important to keep in mind some of the major advantages hybrid learning environments

Experimenting with hybrid solutions during an MDEF class. Picture by Fab Lab Barcelona at IAAC

offer and continue to improve the student experience. For example, there are environmental benefits in tutors not travelling around the world to give a two day seminar if it can be done online.

In the near future, the distinction between “types” of learning environments will become less clear, as we believe hybrid formats will gradually become more common. There will always be a place for on-campus learning, particularly when it comes to making activities. However, as tools become more advanced and digital learning experiences can be enhanced by technologies such as VR, the question as to whether it makes sense to physically move around the world for learning becomes increasingly important and one we should ask ourselves. It is also possible that hybrid learning can apply to entire courses, not just classes where there are moments of synchronous, on-campus learning carried out in conjunction with periods of remote asynchronous learning. While this may be some years away, we think it is important to keep speculations such as these in mind as we work in the present.

The Ten Key Skills for a Successful Distributed Designer

Christian Villum from Dansk Design Center

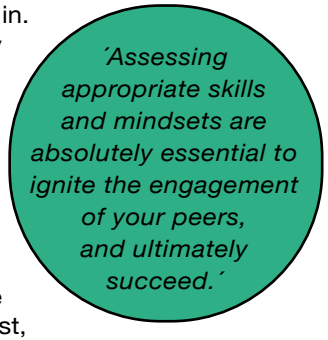
When a newcomer is introduced to the concept of distributed design, we tend to focus very much on the collective process, the value chain of the actual distribution and, of course, the outcome. However, we rarely take a look at what each individual contributes to all three things. Obviously, the whole thing is dependent on the actions, the competences and the mindsets of everyone involved in the process. So what skills are actually needed to meaningfully contribute?

To emphasize the need for looking at the skills and mindsets of each individual, and before we dive into a proposed list of these, let us first kill off the most common fallacy: The "build it and they will come" theory. In other words, the expectation that if only you put an open license on your design, put the files out there on Github or another platform and tell the world about it through all your social media channels, people will line up to co-create with you. They will, most likely, not. In a world of digital abundance, there are so many ideas and so many code repositories out there for the world's creatives to engage with, that your open asset and good intentions will merely be drops in the ocean. Community-driven mechanisms of shared ownership, collected drive and shared visions for success, require additional effort for maximum effect. Therefore, assessing appropriate skills and mindsets are absolutely essential to ignite the engagement of your peers, and ultimately succeed.

Let's look at the list of essential skills and mindsets first (in a non-hierarchical order):

Taking a Network Approach

You want to make sure that your design is positioned for interaction with others and that you flex your social skills in order to share it. Accessible language and your attitude both online and off are important as is the meta-data you offer to ease the onboarding of others. Perhaps you should write up an instruction on how to start, set up an FAQ to help tackle common questions — and maybe create a design manual that also covers how your design is open for remix, and what you are hoping to achieve by inviting others in. You might also need to create some social capital by joining relevant communities to connect with key peers and contribute to their work before you ask them to join yours.



Being Generous

With others contributing to your work, there will surely be efforts that you are less likely to appreciate or be associated with. This is the nature of the beast, and part of the duality of appreciating both amazing and less amazing contributions. Let go of your inner control freak: find peace with the creative exploitation of your work, regardless of the quality. "Your real enemy is obscurity", as prolific open content proponent and author Cory Doctorow famously said.

Carry an Experimental Mindset

It is easy for all of us when creating something to imagine the timeline from idea to polished product. We cannot help but think ahead. But if you plan your direction too firmly, you miss out on some of the beautiful and unexpected factors that your peers bring to the table. You need to

celebrate design's virtues, which is to allow the process to take twists and turns and zig-zag towards the end goal. Find comfort in designing the framing for moving forward, but making it wide so that everyone's ideas can proliferate. You cannot predict innovation as a designer; you have to explore your way towards it -with others.

Exercise Cultural Appreciation

You are a creative soul, otherwise you would not be reading this. However, your perspective is one of many and, regardless of how open-minded you are, bias is commonplace. Bias is impossible to avoid, because much of it is subconscious, and this is why the distributed, peer-based creation process is so potent: it brings diverse viewpoints, approaches and methods together in a manageable way. Make sure your work is presented and discussed in a way that is inclusive towards everyone, and make sure to allow for diversity in the community you are building. Diversity matters - diversity wins.

Show your Collaborative Skills

Even if the open-license allows anyone to do pretty much anything with your design (of course within the boundaries of the law), you will play an absolutely central role in the development of the design. You came up with the initial idea

and you are passionate about it, so of course you will sit in the very centre of your community. This is the reason why you need to use the best of your collaborative skills to drive things forward in a positive way. This means always showing compassion, interest and empathy towards peers, and always appreciating the contributions of others, even when you disagree with them on priority, direction and approach. Look at your shared work as a pool of creativity, which is an "open buffet" for anyone to use. There is always something in a buffet that you like the most and things that you skip when putting together your final plate... ahem, product.

Pick Up Some Degree of Technical Savvy

Design and community building is often not very tech-centric, even if what you are focussing on may be technical. However, as products in all categories are becoming increasingly more digital, and the same goes for tools you will use to co-create them, it would be in your best interests to become "tech-savvy", to make things run smoothly. This means, for instance, learning how to use the common collaboration platforms and understanding the culture for each of them. Or even more concretely, understanding Git and version control in order to navigate the space of multiple stakeholders working on the same design assets at the same time. Another technical component is learning about open licenses and how they differ from each other. You need to decide upon one at an early stage, and it would be a pity to not choose the most ideal one. It is a lot of work to change it later on. Lastly, digital fabrication is a key component of prototyping and creative processes in general when you are making products. Why not learn how to use them while you're building your great design?

Be Humble

By sheer definition, you will be one of the people who knows most of your idea and design, and if you are a person full of drive, you are likely to have an answer for most questions and concerns relating to this design. But be careful that you do not become overly self-assured. There are some brilliant minds out there: connect with them and learn from them, as they also learn from you. Being humble is a great way to make room for brilliance from all sides.

Have Lots of Patience - But Be Ready to Run Fast

When you publish your design, you are ready to go. You may publish your design with a lot of energy and excitement around the prospect of collaboration, but then nothing happens. Or perhaps it happens really slowly, until it suddenly explodes. Both situations can be hard to handle, but it is, again, the nature of the beast. Distributed design innovation and informal multi-stakeholder collaboration ebbs and flows, you cannot always force it — nor stop it. Be prepared and make sure you set up your community with lots of empowerment to those that are willing to take it. This way you are neither a bottleneck when things accelerate, nor the only engine pushing things forward.

Adopt Hyper-Curiosity

What happens when you allow the whole world to collaborate on your idea and design? Frankly, no one knows. By becoming a distributed designer, you are placing yourself on the very edge of digital and social innovation, and we are all learners at this point. This means you need to be genuinely curious about what happens, regardless of what that is. Not normally curious, but pioneering, frontline curious. We are changing the world here, laying down the road as we move forward. Let's be curious together about what it means.

You may feel a bit overwhelmed by reading such a list: that is by no means the intention of this article. On the contrary, these are ideals to strive for, but not prerequisites to get started. Being aware of them is half the battle and, as long as you go into the distributed design process with an open mind and a gentle heart, you will find not only outcome-based rewards, but learnings on a scale that mind-numbingly exceeds the kind you can pick up on your own. So dive in and keep this list handy as you pioneera this space with fellow distributed designers; one of the most visionary global communities of the digital age.

John Schnobrich, Las Vegas, 2018

Citizen Action in Environmental Monitoring

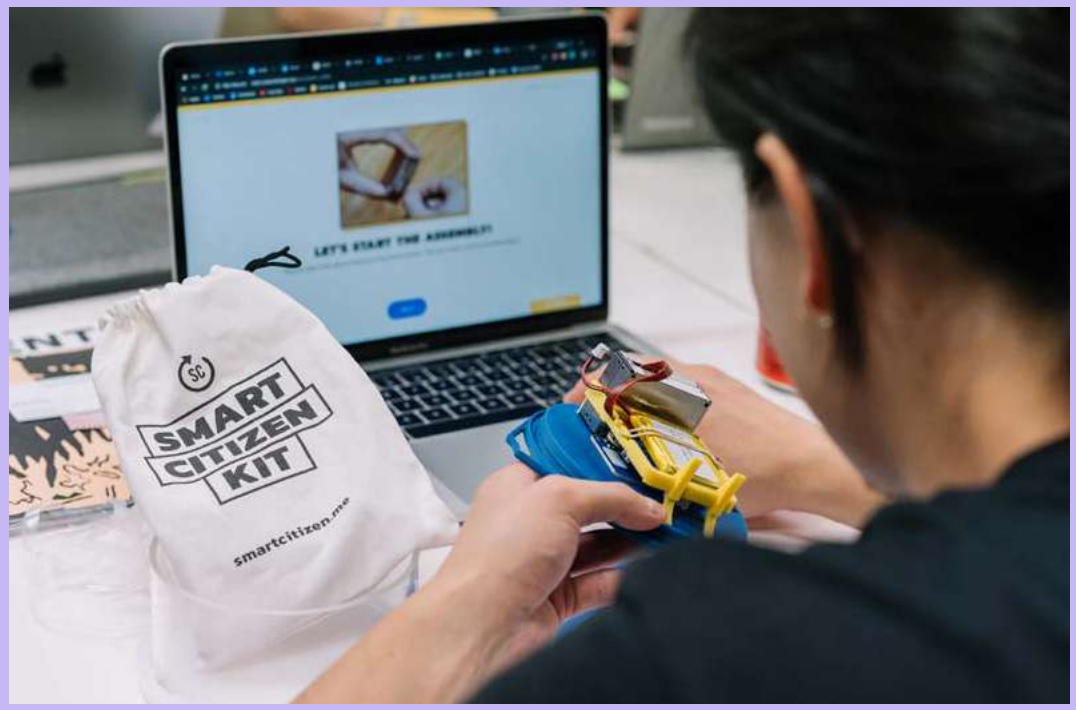
Deplaying a Kit for Smart Citizen

Oscar Gonzalez, Víctor Barberán, Guillem Camprodon
Project team

Barcelona, Spain – Europe
Location

Deployment
Project type

Fab Lab Barcelona
Organisation



Smart Citizen Team at Fab Lab Barcelona

Name of the project

Smart Citizen Kit

Project Description

Smart Citizen offers an alternative to the centralised data production and management systems used by the large corporations that constitute the driving force behind the “smart city” concept. The project empowers citizens and communities to gather information on their environment and make it available to the public, using open-source hardware and software design.

Context and History

Smart Citizen began in 2012 in Fab Lab Barcelona at IAAC. The project develops tools for citizen action in environmental monitoring and accompanying methodologies for community engagement and co-creation. The team believes data is critical to inform political participation at all levels and to generate discussion about pressing environmental issues. In 2019, the latest hardware generation was launched, the Smart Citizen Kit 2.1. The new kit includes sensors such as particulate matter, noise, temperature, humidity, barometric pressure and indoor air quality, and can be expanded through a modular approach to measure more complex metrics related to air, water or soil quality. Smart Citizen’s software and hardware is free and released under open-source licenses.

What is the Need it Tackles?

The rapidly increasing global urban population will necessitate new methods of participatory mediation in which urban citizens should be entitled to collect and gather their own data on their environment. Smart Citizen is a platform which connects people, data and knowledge through sensory data which empowers communities to know about, and own their urban spaces to ensure the collective development and ownership of cities.

What is the global-local relationship of the project?

The project involves customised sensing hardware – the Smart Citizen Kit, and a custom online platform with more than 7,000 registered users and more than 1,900 unique sensors in over 40 countries. The kit is available for purchase online, but all testing, development and customization is handled by the expert team at Fab Lab Barcelona. The team also provides ongoing consultation for the global community who are deploying the kits in their own communities via the detailed online documentation and an open forum.

How was the Development Process of the Project?

The Smart Citizen concept was developed as an output of Fab Academy Barcelona, later receiving crowd-funding and support from Fab Lab Barcelona. Over the past years, Smart Citizen has been part of multiple EU funded research projects such as Making Sense, iSCAPE, Organicity and GROW Observatory. The project has reached a stable phase in which communities are popping up without the intervention of the Fab Lab Barcelona team. Through engaging in open-source practice, these communities are giving back to the project via custom designs on the enclosures, firmware pull requests and forum support, based on their own local deployment experiences. One community in particular, mostly researchers in the field of environmental sciences, are contributing to the global community with an advanced form of analysis and recommendations. Their feedback is demonstrating how a stable open hardware project like Smart Citizen Kit can be a feasible option for scientific research. The Smart Citizen project enables collaboration between traditionally siloed actors such as researchers and scientists, citizens and communities, or makers and institutions.

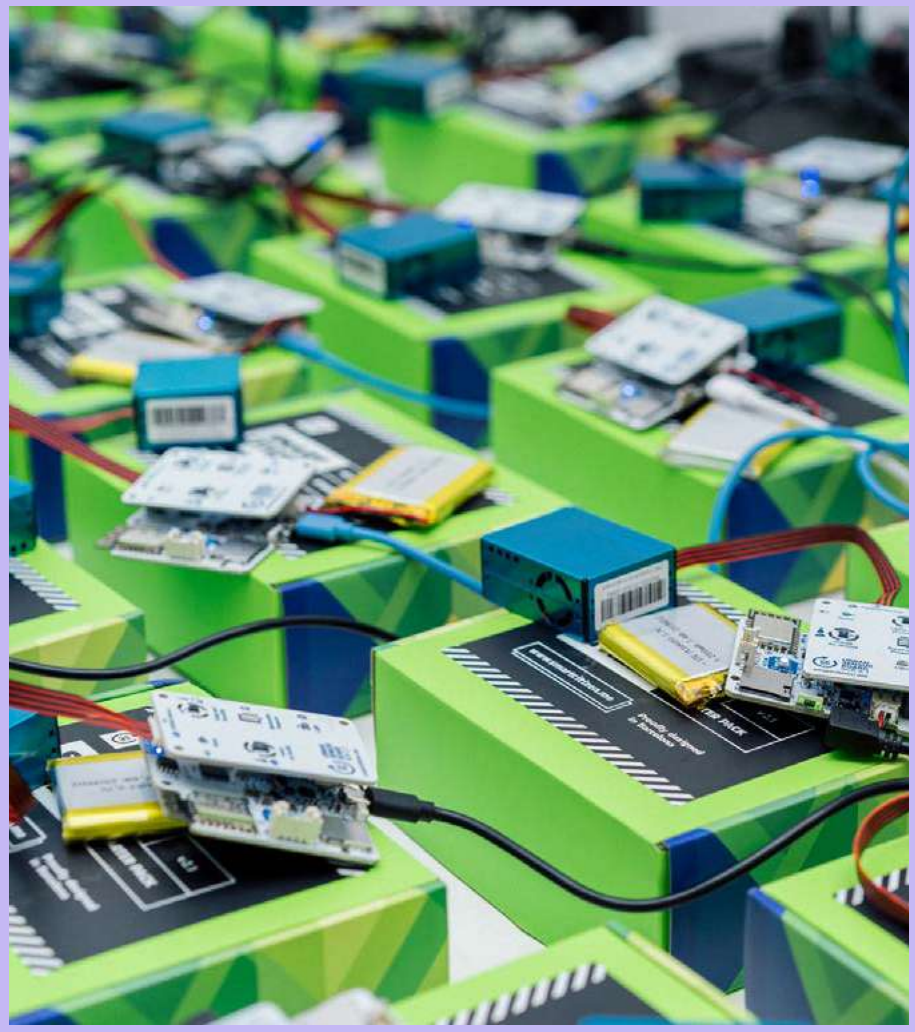
What Results did your Project Accomplish?

Currently, more than 1,900 unique sensors have been deployed in over 40 countries. The total number of users who are registered on the Smart Citizen platform are over 7,000.

The hardware components. Smart Citizen Team at Fab Lab Barcelona

Why is This Distributed Design?

The Smart Citizen project is built on the values of Distributed Design, ensuring open, collaborative, regenerative and ecosystemic practices are implemented where possible. The hardware and platform have been developed in collaboration with pilot use cases, user and developer feedback, and through the engagement of a global network of collaborators. Therefore the application of the technology developed by Fab Lab Barcelona has been customized for deployments with bicycles, boats and even to map air-pollution levels during periods of lockdown during the 2020-2021 pandemic.



Testing the kit. Smart Citizen Team at Fab Lab Barcelona

Welcome to the Domingo Club

We make fermented food, open-source tools and explore collaboration with natural processes.

Maud Bausier, Antoine Jaunard
Project team

Barcelona, Spain – Europe
Location

Product, Platform, Club
Project type

Domingo Club
Organisation

Our first fully functional incubator prototype

Name of the project

Domingo Club

Project description

At Domingo Club, we make fermented food, open-source tools and explore collaboration with natural processes to promote understanding, transparency, resilience and equity in our global food system.

Context and History

The industrial revolution and globalisation have increasingly distanced us from food production and the processes that transform the raw products of agriculture into what we eat and drink every day, thus making us more and more dependent on modified industrial products that we don't understand.

But this detour towards abstraction is relatively recent. All over the world, and since ancient times, people have been growing and fermenting their food to preserve it through the seasons. We used to know where our food came from, from seed to plate, and how to improve it by giving it new nutritional properties.

At the Domingo Club, we like to think of fermentation as a process of partnering with microorganisms to improve our local and seasonal foods, making them more digestible and getting more energy from them. This partnership with living systems is an invitation to move away from rapid, global manufacturing processes, helping us to be more conscious of our natural environment and its resources.

What is the Need it Tackles?

To promote and encourage understanding, transparency, resilience and equity in our global food system, we design and develop an open-source incubator. An incubator is a device that maintains the necessary parameters for an environment suitable for the growth of fungi and microorganisms of all kinds. A necessary tool for the practice of fermentation. As designers/makers, we believe that it is very important to have the ability and possibility to understand and modify the objects around us so that we can repair and adapt them to our own needs. This extends their life and reduces the resources needed to use them. Recycle, repair, preserve, care. This is the message we want to convey with our Domingo Club and its incubator. We started to develop our incubator to make our tempeh. Tempeh is an Indonesian fermented food product originally made from soybeans and a fungus called rhizopus. During the fermentation process, the spores of the fungus develop and its mycelium grows around the soybeans, breaking down their molecules. This process changes the properties of soybeans and makes them more digestible for our body, allowing us to absorb all the proteins available, and making tempeh as high in protein as meat. But using an incubator to make tempeh is just one example. There are many other ways to use it and many more ways to be found.

What is the Global-Local Relationship of the Project?

No more knowledge that gets stuck in proprietary software or behind a paywall. No more capitalist practices that only allow a few privileged people to be even more so. By publishing the sources and plans of our projects, by documenting our work as much as possible, we want knowledge to travel freely around the world so that everyone can learn and understand at the same time and in the same way. To enable full collaboration. We learned what we know today from open knowledge that is freely available online, and that is why we want to continue this knowledge transfer. Furthermore, we have decided to work only with open-source software to ensure that everyone can use our projects without the virtual barrier of a restrictive license. Sharing, collaboration, cooperation and re-appropriation are keys to the success of our project. We want to change people's habits, in a global way, in order to bring about a real positive change for the well-being of people and our planet.

On the other hand, we want to keep the production local in order to avoid any pollution linked to transport and to keep the traditional knowledge close to its raw materials. Support and strengthen the local network. The transparency of the process is more than important in our way of seeing our project. It is by understanding how things are done that we respect them. By observing their rhythm, the resources needed to make them work and the people who make them. We deeply believe that what we do has much more meaning and impact when we are not the only ones doing it. We therefore invite everyone to join the club and move towards a sustainable society where we understand what we eat, what we do, what we use in our daily lives, a society where we observe and question what we usually take for granted.

How was the Development Process of the Project?

In the kitchen, it seems natural to share a good recipe, and tips and tricks on how to please our taste buds. We share knowledge from one generation to the next. We preserve the cultural heritage while allowing it to be augmented by the findings of the community. Unfortunately, this mentality is not found in all sectors. Too often, we put personal profit before the well-being of people. We keep our technological discoveries to ourselves in order to extract maximum money and merit. But this capitalist egoism that leads to unfair products and services only exists when power is centralized in one point, one company. What if we liberate knowledge and allow it to flow in all directions? What if we allow peer reviews to make sure everyone agrees on how things are done? What if we use the principles of Distributed Design and decentralized manufacturing to make sure that everyone in every corner of the globe has access to the same technology? That's what we want to be a part of.

What Results did your Project Accomplish?

We have our first incubator prototype. We use it almost daily for our own tempeh production. From the outside, it is a CNC-cut wooden box that can be stacked and easily assembled and disassembled without glue or screws. Inside is a temperature and humidity sensor and a heating system (heating pad and fan) which, controlled by a microcontroller, regulates the temperature as desired. This allows the microorganisms to grow optimally. The next version will have parametric dimensions so that anyone can decide on the most suitable size for their case-use. A modular approach for the electronics is also being developed, so that it can be used in any closed environment. A shoebox or a drawer, for example. We want to remove any barriers that stand between people and the practice of fermentation. Organizing workshops is our next big step. It's time for us to get out of our lab and pass on our knowledge and practice in a tangible and direct way with people. It's a great way for us to interact, but also to see how people react to our tools, giving us an enriching feedback and the possibility to co-create and therefore amplify our message, all together.

Why is This Distributed Design?

At Domingo Club, we advocate open-source tools to allow others to understand, modify and repair what we produce. We use digital fabrication techniques to prototype and produce our devices. Allowing them to be (re) produced in any Fab Lab / makerspace around the world, according to the principles of open-source and decentralized fabrication. But as we said before, doing this will really make sense when we are all together doing it, sharing our practice and tips. We want to teach people about our findings, but more importantly, we want to learn from them and promote common knowledge. That's why we are developing a club. We want to gather around us all the people who are interested in the same topics as we are. There is strength in unity, together we can bring about the change we want.

The tempeh we produce, which is part of our daily diet

CHAPTER 3

Social and Environmental Impact

Design is becoming increasingly seen as a force for good. Over four years the Distributed Design platform has witnessed open and collaborative design approaches become a vehicle to evolve design practice beyond aesthetics, and making beyond digital fabrication, towards a brave new approach to thinking, practicing and organising for more inclusive, plural futures. By nature, the field has a high impact potential in democracy, social inclusion and the climate crisis. This chapter explores impact through the real-world application of Distributed Design logics such as collaborative approaches, local-to-global thinking, local circularity and open practices.

Designing an Alternate Political Culture through Citizen Participation

Twisha Mehta from Echostream, India

Distributed Design Reinforcing Democratic Values through a Local Election Campaign

The need for distributed design in India's elections has never been more crucial than now. According to the Democracy Report 2021 by V-Dem Institute, there has been a global decline in liberal democracy during the last ten years. This decline continued in 2020 (Autocratization Turns Viral, 2021). India lost its title of "the world's largest democracy", instead gaining the moniker of "electoral autocracy".

Elections are one of the integral components in any process of democracy and must remain free and fair. This virtue of open and clean campaigning was jeopardised in the country in March 2021 by a tough partisan election that lacked political pluralism and participation (PTI, 2020).

This review portrays the case of a municipal election held in Gangtok, the capital city of the Himalayan state of Sikkim, in March 2021. This campaign was a representation of a democratic, participatory election campaign that relied upon open and shared knowledge for the good of the public. The intention of this campaign — run by independent candidates in a party-less municipality election — was to set an example of participatory democracy, where citizen engagement and empowerment are at the heart of campaigning and policy building. The process of campaigning, initiated by a creative community of architects, designers, and educators, reinforced principles of distributed design by ensuring access to tools that allow citizens to dialogue, dissent, and voice opinions, and easily connect to a network of collaborators to undertake facets of this process with them.

'The value in remodelling narratives from local roots for civic engagement is that elaborate and memorable experiences are created through participation´

An Open, Participatory, and Distributed Campaign

Sikkim, a former Himalayan kingdom, bears a special provision in the Indian Constitution under Article 351F that, amongst others, renders previous laws still valid, differentiating it from most other Indian states. Its small landmass and unique Himalayan terrain also distinguish its urban concerns and affairs from the rest of the country. In March 2021, Sikkim was presented with the opportunity of holding municipal elections in a non-partisan manner following a 2020 amendment in the Sikkim Municipality Act. Section 14A states that no person shall contest the election to any municipality with the support (direct or indirect) of any political party (Public Notice, 2020).

This came as a boon, considering the consequences of partisan election campaigns held in the neighbouring state of West Bengal during the same month led to communal unrest and evidence of a tampered election. Described as "the most gruelling and long-drawn assembly elections" (Narasimhan, 2021), citizens of West Bengal felt like campaigning became "more about bullying and ridiculing the opponent camp without talking about the real issues" (Bhattacharya, 2021).

This opportunity of a party-less election in Gangtok was hence grabbed by this creative community. The idea was to prototype and propose an alternate political scenario whose foundational principles lay in dialogue, participatory planning, and dissent. The team unanimously chose two candidates to represent the movement, one of whom was Kailash Pradhan, a senior architect and founding member of the Architects of Sikkim who has been practicing the art of urban design and planning since the 1990s. With Kailash as the face of this political prototype, this community based the campaign's principles of democratised design largely in analogous mediums, owing to the fact that Sikkim does not have an entirely digital civil society yet.

Interactive Installation of the Municipality Concerns using Locally-Sourced Bamboo. March 2021. Lal Bazaar, Gangtok.

As Levine (2011, 266) stated citizens everywhere do require outside resources — both capital and government aid — but to get help, it is crucial for them to have first organised themselves as a powerful political force. The best way to organise, writes Levine, "is to address tangible local problems, even before powerful outsiders offer aid" (2011, 266). So, as a part of self-organisation, this campaign leveraged tools like participatory workshops, interactive public installations and exhibitions, and social media to create a "knowledge commons" and to generate consensus on issues that concerned the citizens. The intention of these workshops and interactions was also to visualise this data so that it could be accessed and interacted with by the citizens of Gangtok. This would allow them to collectively create solutions for the city that would be publicly distributed. The course of these interactions revolved around the welfare of the city of Gangtok, and the subjects of power, authority, and responsibility of the Municipality.

Building New Knowledge Commons with Volunteer Initiatives

The campaign was initiated and supported by a collective of organisations who initiated and supported the campaign. The common objective of shifting the political culture of Sikkim towards participatory governance, centred around citizen engagement and empowerment, resonated with them. The campaign advanced towards this goal by creating "commons". "Commons" is a term that refers to a resource shared by a group of people. The shared resource in this campaign was information and consensus on the urban requirements and concerns of Gangtok.

An elementary factor in understanding "commons" is collected action, here looked at through the voluntary groups working to achieve a shared goal. Among the diverse set of institutions that volunteered in carrying this campaign ahead, were a multidisciplinary design studio called Echostream, an architecture firm named Interweave, the Council for Democratic Civil Engagement (CDCE), the State Elections Commission (SEC), an independent bookstore called Rachna's, the Sikkim police and a local restaurant called Gangtok Groove. These institutions specifically focussed on onboarding the youth of Gangtok through inventive initiatives they could offer in varying capacities. Youth participation is imperative to carry the movement and its values forward. The core values were Umbho Lagnu (Evolution), Sammaan (Respect), Karuna (Compassion), and Imaandari (honesty).

The term "knowledge commons" refers to resources (information, data, and content) that are collectively owned and managed by people, especially over the Internet. However, it is often argued that the Internet favours narrow discussions and categorisation into "small, like-minded groups" (Levine, 2011). And thus, interactive workshops of diverse groups were held in pockets of the city, hosted by volunteer facilitators. Unlike with the "commons" of the Internet, this election campaign created a new geographically defined "commons", one that encouraged citizens to interact with people from different backgrounds, generations, interests, and opinions, providing them with a shared space that allowed for informed dialogue and exchange. These workshops proved to be a catalyst for conversations amongst different groups of people that would have not otherwise interacted, especially over issues of the city.

These workshops were carefully designed to create a local culture of dialogue and knowledge as they were conducted in places where the hilly city of Gangtok could be seen at a glance to create a sense of reassurance and belonging, keeping in mind the words quoted in Collective Action, Civic Engagement, and the Knowledge Commons:

"Any commons relies on a demanding set of norms and commitments, such as trust, reciprocity, long time horizons, optimism about the possibilities of voluntary collective action, and personal commitment."
(Levine, 2011, 253)

Reflections from these workshops helped create better iterations of the facilitation process and this invited people to participate in large numbers. These workshops were documented in great detail, by the means of post-its, films, videos, and sketches. The resultant material was then made open-source for the public, other candidates, and the public sector as described in the following. When an important consensus like this is generated and made a shared resource, accountability is created amongst the people of the city.

A Volunteer Discussing Urban Issues with Citizens at the Interactive Exhibition. March 2021. Lal Bazaar, Gangtok. Marco Bhutia.

Local Roots and Materials Creating Shared Civic Engagement

While there are benefits to the very low-cost offerings of the Internet, we need fairly elaborate products and experiences that may be slightly more expensive to engage a public that is otherwise disinterested in politics (Levine, 2011, 268). Consequently, this campaign focused on creating public installations and exhibitions that allowed one to spatially visualise data with real-time information fed in by the public on the subjects of the municipalities. Two expansive interactive exhibitions were located in the heart of Gangtok, on the roof of the local market. Using games inspired by a mela, a local fair, the audience would find out which electoral wards they were a part of. The value in remodelling narratives from local roots for civic engagement is that elaborate and memorable experiences are created through participation.

Physical manifestations of bar graphs, maps, and charts were important interactive exhibits that led to the creation of real-time shared knowledge using local materials such as bamboo and local fabric, and leveraging culturally familiar activities of tying knots to create data. Using materials that were easy to source and easily accessible, left a sense of self-reliance in the minds of the citizens while exponentially reducing campaign costs. Materials were repurposed in consequent exhibitions that focussed on disseminating insights generated over the few weeks. This data was also shared and maintained online via social media by volunteers that guided interactions across different states of the country.

An Interactive Graph to Gather Consensus on Local Affairs. March 2021. Lal Bazaar, Gangtok. Twisha Mehta.

Self Reliance and Support Mobilisation

The immediate impact of these workshops was that the public voiced their need for competent governance in the city because of their heightened knowledge of the roles and duties of the municipality.

Levine (2011, 264) states that "people want the chance to do collaborative public work, to represent and experience their distinctive local cultures, and to engage in sustained dialogue" and this was seen as an immediate response to these interactions, as numerous people voiced their need for competent governance in the city because of their newly heightened knowledge about the roles and duties of the municipality. The larger impact was the massive inflow of reviews, comments, and dialogue on social media platforms that demanded that other candidates take up similarly designed, democratic approaches to their campaigns. Many young adults confessed that they had previously disassociated themselves with local politics, but this campaign allowed them to not only volunteer for a democratic purpose, but also use their community network to mobilise support for an optimistic vision for the city, which was a win for the campaign's purpose.

After the elections, learnings, methodologies, and strategies were packaged in open toolkits and distributed through social media channels to other Indian cities to redesign their elections. Currently, this team, backed by the local creative community, is working on documenting and compiling insights of this prototype through films, a book, a website, and an incubation centre to scale its cause to make India a clean and free democracy.

Reimagining Governance Through Distributed Design

Local governments make important decisions and play an integral role in creating a healthy democracy through a bottom-up approach. What is important in a democracy (beyond good institutions) is an active public that can deliberate, organise, and act. The concept of creating intellectual commons through open access lies in the core principles of the open design movement. By broadening civic participation through local roots using local materials, spaces, and narratives and by creating civic identities through engagement, design, and production methods help in reinforcing democratic values.

The experience of the four weeks of city-wide campaigning demonstrates the ability of collectives like design and architecture studios to innovate in the public sphere, igniting a hopeful shift in the dynamics of a political system that has long been detached from the concerns of a simple citizen. This campaign also demonstrated the power of the various actors to create rapid networks while dabbling between technologies to remain inclusive and accessible. The value of distributed design in owning and sharing low-cost, volunteer-based methodologies of campaigning contributes to creating an optimistic future with clean, fair, and open elections.

Make Your City! Distributed Design and Urban Regeneration

Meet HUB-IN, CENTRINNO and T-FACTOR, Three Collaborating Horizon 2020 Projects Proposing New Futures for Cities

Karim Asry from Espacio Open.

Cities are amongst humanity's greatest inventions. They act as the canvas for life, the place where we live, work and play; the place where so many move with the promise of better futures.

In the beginning, it was mostly about natural resources, access to food, water and security. With the industrial revolution, came the myth of progress. And humanity started shifting from the rural environment to the urban one, believing that life was better elsewhere. The ladder of progress, unfortunately, seems to be broken nowadays. Recognition of global challenges such as climate change, inequality and labour disruption add layers of complexity, while more specific issues at the local level, such as gentrification or touristification, risk turning urban environments into engines of exclusion and polarisation. The European Commission plays a decisive role in the future of cities. Whether by funding cutting-edge research that extends the field of what's possible in our urban environments or by financing infrastructure and large-scale renovations, the European institutions are actively supporting the emergence of innovative solutions in addressing key challenges in urban regeneration. The Commission is using some of its most significant R&D funding mechanisms to explore new approaches to urban generation that can help cities fulfill the promise of a better future which they were originally invented for. It also actively does so by supporting strategic synergies and collaborations across different projects. CENTRINNO[9], HUB-IN[10] and T-FACTOR[11] are three Horizon 2020 projects working together to develop a portfolio of innovations for inclusive and sustainable cities.

Skipgarden, a nomad community garden in Kings Cross, London. Photo by John Sturrock.

In these projects, standard approaches to urban regeneration based purely on "hard" infrastructure, top-down decision-making and delivery are being complemented with a set of solutions that give an important role to emerging cultures such as Fab Labs, the maker movement and other innovation communities that use the whole city as a canvas for open, participatory and distributed design.

Skateparks in old tobacco factories, citizen gardens and other nature-based solutions, Food Labs, art production centres that dare to ask the critical questions that no one is asking, digital fabrication factories where circular economy is fully embedded in the productive process are just some examples of the many valuable uses that a distributed and inclusive approach to city-making can nourish. This new generation of urban regeneration actions based on civic participation and bottom-up approaches is complementing top-down strategies to create true public-private-people partnerships all over the European Union.

T-FACTOR, HUB-IN and CENTRINNO share the mission of finding ways to preserve the heritage of historic buildings and areas with interventions that go beyond façade restorations and include the cultural component as a strategic asset to transform areas in decay into vibrant hubs that foster concrete solutions to today's problems. The three consortiums are convening a diverse conversation among actors, integrating discourses and practices of actors who too often

run in parallel tracks when reflecting about our urban futures, including city councils, higher education institutions, grassroots organizations and business representatives.

CENTRINNO - An Industrial Renaissance

> *"[...]How can we create positive feedback loops of materials, virtuous circles of exchange within local ecosystems?"*

"Two centuries ago", explains the CENTRINNO team in their Whitepaper, "Europe ignited the Industrial Revolution and economic benefit at regional and national scale became abundant. More recently, globalisation, which was foreseen to strengthen global markets, has led to substantial losses for the manufacturing capacity of European cities. Europe's forced transition to a knowledge economy has resulted in a decrease in manufacturing jobs, a lack of appreciation for these jobs and the neglect of industrial areas. Subject to decay or exploitation by extractive economic activities, historic industrial areas are disconnected to local knowledge or value generation", they add.

The CENTRINNO project aims to develop and demonstrate strategies, approaches and solutions for the regeneration of industrial historic sites as creative, locally productive, and inclusive hubs to:

- Shape new socio-economic and sustainable identities of industrial historic sites.
- Foster social inclusion through craftsmanship, culture and heritage.
- Rethink the way cities govern their material resources.

With Fab Lab Barcelona as the scientific coordinator, CENTRINNO will deploy nine European cities pilots[12] that will explore how the Fab City network — which works with the goal of achieving self-sufficient cities by 2040 — can contribute to connecting the dots between urban regeneration and distributed design.

"We need Fab Labs to look beyond the wall", explained Tomas Diez, Director of Fab Lab Barcelona[13], *"we need Fab Labs to connect to the city, to connect with local communities. And the approach we're testing with the Fab City Hubs in CENTRINNO is going to look at this: how can Fab Labs extend their capabilities beyond technology, engaging socially with local ecosystems not only with people that understand technology, but also with people who don't? How can we create positive feedback loops of materials, virtuous circles of exchange within local ecosystems?"*, he highlighted.

The project, adds the consortium team, is based on project-based learning, focusing on the role of heritage and vocational training, including digital fabrication tools and soft skills connected to local challenges and needs, and, at the same time, producing social and environmental impact by adopting circular economy principles in new urban transformation processes. Ultimately, CENTRINNO will test and assess innovative strategies, approaches and solutions for alternative urban regeneration processes in different European sites.

HUB-IN - Historic Urban Areas and Future-Making

"We have to create livable cities, that's the secret" explained Miguel Gaspar (Lisbon City Councillor for Mobility, Security , Economy and Innovation), during HUB-IN's first workshop in September, 2020[14]. *"We have to recover our historical parts in a way we can offer what anyone else doesn't have, because the past cannot be changed. It's our past, it's our heritage, and what we can do with its uniqueness can be a huge competitive advantage to attract people and attract talent in the future"*, he concluded.

HUB-IN, according to the project team, promotes urban transformation and regeneration of historic urban areas (HUA) using as main catalysts, innovation and entrepreneurship, while preserving the unique identity of the historic areas regarding their cultural and social values.

Aria, by artist Tomás Sarraceno in Manifattura Tabacchi, Florence. Photo by Giancarlo Barzagli.

Installation by Svet Ivantchev and Domo Experiencia during Maker Faire Bilbao 2019. Photo by Borja Agudo.

HUB-IN expects to contribute to reverse trends of abandonment and neglect of historic heritage in a systemic way through the creation of networks of hubs where innovation will be the main driver.

It will also have a direct impact on the creation of new sustainable opportunities for local traditional businesses and for the development of new creative skills and jobs.The project is implemented in eight pilot cities[15].

The project is based on collaboration among different actors in each HUA and between cities. While the methods applied across city partners will be co-created, the solutions for each HUA will be specific and adjusted to local strategies as a result of participatory activities and consolidated visions gathered from a broad portfolio of stakeholders and citizens.

The eight Hubs will be tested and piloted, considering three main clusters of activities:

- Cultural and creative industries including cultural heritage; activities such as craftwork, fashion design, visual arts, music, museums, film and video, video games, performing arts, festivals, fairs, landscape design, architectural services, etc.
- New lifestyles including activities based on digital technologies, circular economy, social innovation, sharing economy and sustainability.
- Endogenous natural & social resources including reuse and readapt natural resources and social dynamics.

T-FACTOR - Temporary Use, Better Choices

"Urban regeneration is challenged by the multiple crises we face. Climate change, rising inequality, democracy deficits, and labour disruptions are turning cities into engines of exclusion, eliminating the inclusive, participatory spaces that are so crucial for urban prosperity", says the team behind T-FACTOR.

"Overly rigid top-down approaches to master-planning have left yawning scars in our cityscapes: unfinished neighbourhoods, brand-new buildings standing empty, soulless districts that become monuments to the paradox of urban regeneration. Even when it appears successful on the surface, the process can hide the violent displacement of low and middle-income populations, a phenomenon that is most commonly called 'gentrification'. Cities need new models.", they add in the project's presentation.

The project consortium has created a coalition with cities, universities, businesses and grassroots organizations committed to contributing knowledge to the inclusive and thriving futures of cities, developing tools & approaches that leverage temporary urbanism with use towards more participatory, inclusive futures.

Years, and often decades, can go by between the approval process of a masterplan to regenerate an urban area to its actual implementation. During these transitional times, a new generation of spaces to foster cultural, social, and entrepreneurial activities have become a determinant asset to adapt cities to the unknown. The project's team will research, create and put into practice a set of tools, guidelines and local pilots in order to extend and explore the use of temporary urbanism across all European Union cities. T-FACTOR's Advanced Research studies some of the most innovative, effective, and forward-thinking examples of temporary use in Europe, USA and China[16] to transform their stories into practical insights for public officials, private developers, and grassroots communities. T-FACTOR's Local Pilots are the project's proof of concept, where the team will put the Advanced Research outcomes into practice in six early development areas in the European Union[17]. In November 2020, T-FACTOR celebrated its first public meeting with stakeholders, gathering experts and practitioners from diverse backgrounds.

The three projects also share the vision of Europe as a place to test ideas that can work at different scales in small, medium and large urban environments to foster new models that recompose the vision of a shared future. This can pave the way for a new era in city-making, expanding the possibilities of what it means to be human in an urban environment.

Space Matters: Place as a Design Tool

Alberta Menegaldo from Fab Lab Venezia

The Web and Technology: Building Distributed Design Where the Physical and Virtual Realms Merge

For distributed design to happen, networks are fundamental, both virtually and physically. While we now view the Web as an essential infrastructure for sharing information, ideas, and artefacts, we cannot ignore the fact that the possibility of distributed design as an expression of practice emphasizes the need for the very physical part of the design process. Integrating design with the concept of decentralization, entails creating a structure for the creative part of the product chain similar to that traditionally associated with delivery and resale, but in an entirely new way. In any network, there are both links and nodes. In this case, the former are clearly defined by web communication, while the latter have yet to be properly explored.

With the ever-increasing availability of technology, new design opportunities have emerged in recent years, where digital techniques and new production processes allow designers to approach projects in a more informed and holistic manner. Indeed, such technologies are no longer the exclusive domain of firms, leading us to envisage a landscape of democratization and ”reification” at all levels within design practice, quite capable of moving beyond academia and embracing the process in its entirety: the practice involves making as part of the semantic principle. With the open-source and maker movements, the central role of the individual as a proactive subject of the realization of an object has been emphasized, combining different skills and being motivated by doing, to constantly learn and refine the project path.

Where Design Happens

On the one hand, networks and digital applications are driving dematerialization and intangible knowledge exchanges while, on the other, the emphasis on digital fabrication as a new informal way of collaborating with production also restores a meaningful connection between a designer and the most material aspect of creation. In this context, two new features acquire a central role in design practice: the prototype and the space in which the process evolves.

Textile Talks at Fab Lab Venezia. Six events with guests and gurus, on digital textile and the different approaches to the topic. 2019, ©Fab Lab Venezia

This space needs to have some special characteristics that relate both to its architecture (not in the sense of the physical features of the built space, but in the sense of the deliberate design of the space itself) and to its content. The space for distributed design requires hybridization of technological equipment, openness to serendipitous and proactive activities, and the willingness to host diverse expertise. As we find that all places for distributed design are based on some similar characteristics, however broad and open they may be, we see the possibility of defining a new kind of space, a loose but archetypal framework that helps us give purpose and identification to the physical “where” of a new kind of design. Far from being a limiting concept, the “space in which design happens” helps us understand that new design practices, and subsequently new economic models, need new words and new spatial forms.

In distributed design, place is inherently linked to concepts of flexibility and cross-contamination, and represents the possibility of being both hybrid and tangible in its activity capability and intangible in its output capability. And this can be achieved through a mixture of tangible and intangible properties. Technical equipment must include many different types of technologies and tools, from analogue and traditional instruments to advanced equipment such as laser cutters and 3D-printers: these tools provide designers with the opportunity to engage in non-linear and speculative design processes where they create a prototype or a finished product from start to finish. Content must be considered in the design of the space, as the machines should not simply be placed in the room, but are part of a thoughtful environment that includes furniture and additions. The space is a valuable project tool as it allows for meaningful work flows and dialogue.

"It is a place where designers materialise their ideas, a space where companies can create and experiment."

Different activities in one space: at Fab Lab Venezia the maker area, the "office" and the co-working area are all together, just behind a wall there are the meeting/educational room, the machines room, the post-production room. 2020, ©Fab Lab Venezia.

A making space relies also on intangible elements: on the one hand, the skills and knowledge of its team, and on the other, an undefined quality that we can characterize as a sense of openness, randomness, and creativity.

Fab Labs – I like to use the noun as a whole word – have established themselves over the past decade as an operational example of precisely this possibility, serving as a physical platform for distributed design while hosting and including a variety of related activities, technologies, and players.

It seems appropriate to intend the Fab Lab; for me, it reinforces its ability to be a general name to describe a specific entity - as a new kind of typological space. By defining its minimal requirements, we can establish the common values for the network that are necessary to create a distributed structure that must agree on some defining characteristics in order to function.

By identifying the Fab Lab, or making space - again I prefer the verb "make" rather than the noun "maker" as it emphasises the process rather than just a category - as a central element of the network, we once again underline its importance as a physical space and we also emphasise its potential in society as a creator of value. The new making space, with its capacity to be an independent entity with its own economic, formal, and intellectual significance, claims its place alongside the other spatial elements that make up a built environment, such as factories and shops. However, this space owns a significant new meaning, as it is by definition open and diverse, and thus able to integrate the different phases of the process. This does not mean, of course, that the Fab Lab space is capable of, and aims to absorb all the different existing processes and activities, but it establishes itself as the pre-eminent place where a new economic and entrepreneurial vision can be built.

The Fab Lab can combine educational activities with production and even sales. It can do this because it exists as a physical space. It is not just about the equipment, even if a proper technical apparatus is pivotal, nor is it just about the people who interact with it. It serves as a container, with certain rules and potentials that make it a catalyst. In the ecosystem of a city, this type of space is particularly important from a social perspective. The Fab Lab can serve different categories of people. It is a place where designers materialise their ideas, a space where companies can create and experiment. It is a showcase of "possible models" for the younger generations and a place where science can conduct its reviews. All of this provides a valid substrate that encourages a collaborative approach to design - which has traditionally been a mostly copyright-oriented, author-centric field.

In my work at Fab Lab Venezia, I see this very clearly. The lab is not just walls and the machinery are not just devices in a neutral space. The sense of place and the complex systems that work within it define it as a Fab Lab - a hub where distributed design, distributed knowledge, creativity and economics happen together.

The Fab Lab Network, through the Fab Foundation, has provided an informal set of parameters that, while aiming to define what a Fab Lab can be and do, also serves as a starting point to begin analysing what key points need to be considered when setting up a network of distributed design spaces.

3D printed modules for Conifera, the architectural installation designed by arch. Mamou Mani for COS at the Fuorisalone Milano 2019, that came to life thanks to the power of the network: four hubs that shared knowledge and machines helped realize and craft the over 700 pieces. 2019, ©Fab Lab Venezia

Here are some of the key points:

- Technical requirements, that is, a list of possible machines and tools - and the knowledge to use them, all of which requires interdisciplinary skills. Digital fabrication is a key word here to understand what kind of devices to expect in a Fab Lab, but it is not exhaustive: great value is added when traditional and analogue processes intersect with more advanced and innovative ones.
- Open spaces: they are spaces of the city for the city. Fab Labs can be a part of the offer of some institutions or they can be units of certain companies. Whatever they are, Fab Labs are for multiple and different users.

A Place for People-Led Innovation

Despite its relatively initial status, the Fab lab is a potential business model, and a particularly disruptive one for the future economy. Not only because it is “innovative” (in relation to the technologies it hosts: 3D-printing, Arduino, robotics), but more importantly because it can create shared value. Fab labs and similar making spaces are the actualization of platforms, namely, contemporary entities that bring together different individuals and entities, which does not always lead to the best results. The transformation of platforms into tangible places facilitates real, virtuous and productive interactions for a new kind of technological empiricism.

The formalization of new ways to create and distribute design and products is strongly tied to the place where this innovation takes place. It is not just a virtual network/online movement - quite the opposite. It is strongly tied to the “where”, thus emphasizing technological power as a physical presence in spaces where the human element is successfully integrated into the production process, not in spite of machines, but thanks to them. The multifunctionality of these spaces generates new visions in which sustainability, sociality, inclusion and self-empowerment play a crucial role.

The formalization of new ways to create and distribute design and products is strongly tied to the place where this innovation takes place.´

Distributed Design and Sustainable Materials

Michael Araujo from Volumes & Fab City Grand Paris, Soumaya Nader from Ars Longa & Fab City Grand Paris, Quentin Perchais from Woma

In the northeast of Paris, there is a strong community of actors who share many reflexes, practices and reflections. For both economical and ethical reasons, the ecosystem grew increasingly interested in the challenge of circular design and how it integrates into a global movement, to have greater impact.

In February 2020, we set up with the Fab City Store, Ars Longa, Volumes, Woma and Fab City Grand Paris, a Bootcamp at the intersection of those topics; circular design and its distributability. But how to integrate sustainable and local materials to distributable design?

Sharable Designs and Replicable Manufacturing

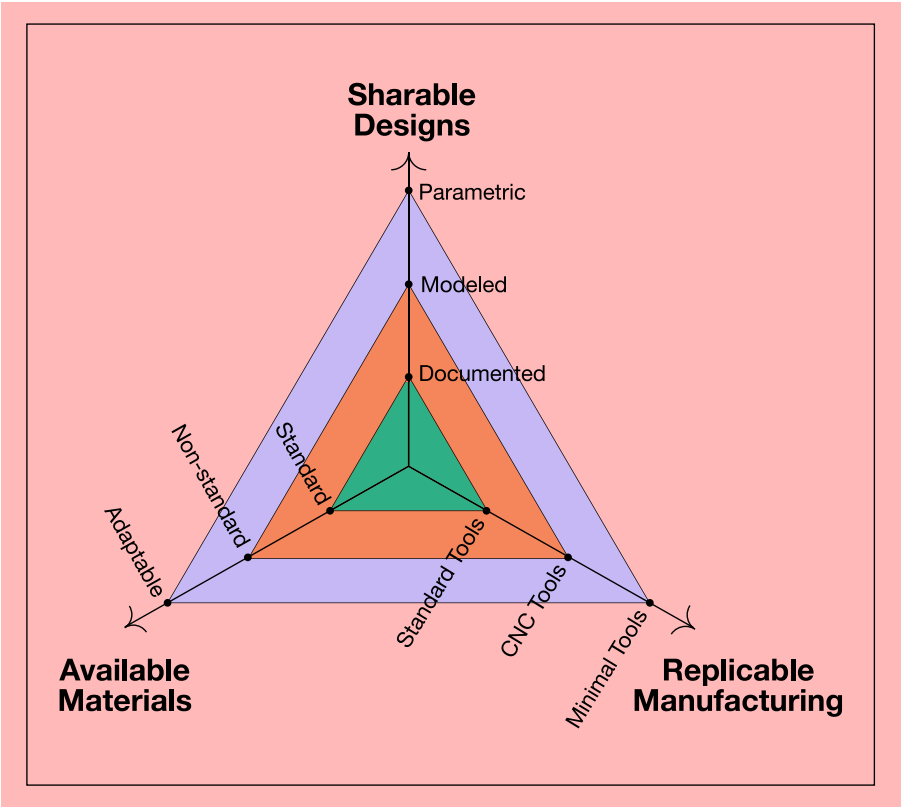
The first and most obvious question is how to distribute and share designs. Thisquestion is one of the most discussed and developed at the moment. Far from beinga simple question, it questions the role of documentation, open formats, anddesigning tools. During our bootcamp, we asked each project to be documented on Wikifactory, not necessarily with plans and models, but also the processes.

The second question is also one that has already been addressed in many ways already; how to be certain that a design can be manufactured anywhere equally.

The Fab Lab revolution is centred around this challenge, as well as encompassing the questions of accessibility of tools and manufacturing skills. Some projects developed during the bootcamp had the specificity of not using any CNC machining but proved to still be very easy to replicate correctly.

Available Materials

The last topic that is not discussed as much, is the availability of raw materials, especially when aimed at circular economy. Through this bootcamp, the objective was to support creators confronting this complexity, and work with them on four different approaches. These four approaches are sorted by “impact”, but of course, each proposition and approach has profoundly intertwined problems betweens design, manufacturing and material, the choice of one impacting on the others.

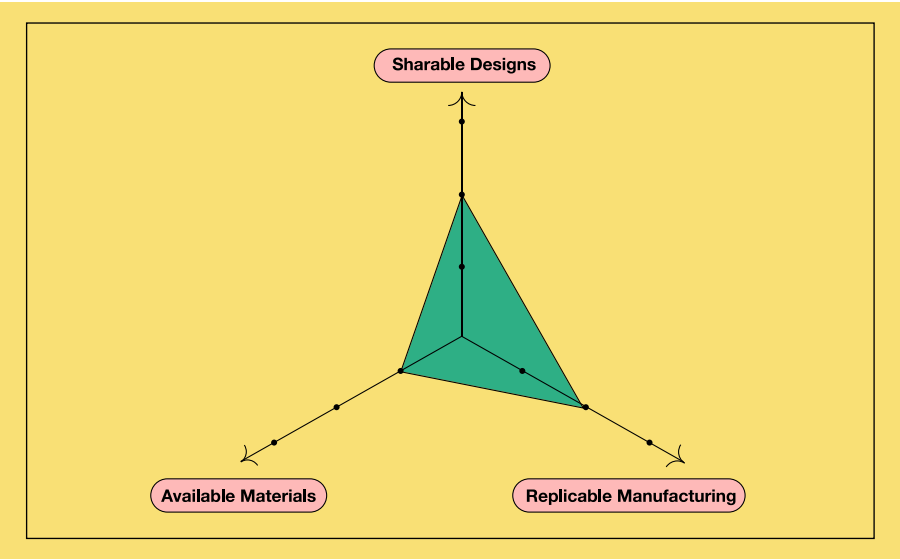


Distributed Design Radar, Fab City Store

Standard Raw Materials

A first project used PMMA sheet material leftovers and resized them to make them easy to work with. This approach aims at working with widely available materials, in order to be certain of their availability “anywhere”. It can be leftovers from plywood, PMMA sheets, bolts and nuts. Even though it might look like the simplest option, global standard materials are not that easy to source as there are standard differences such as metric and imperial systems. Working with standard materials also often means generating new waste in order to “standardise” its shape.

Postcard 2.0: Postcard 2.0 imagines a protocol for integrating a “Fab Lab postcard” into small PMMA or wood scraps that are often unusable because of their size, and goto waste instead of being valued. By adapting leftovers, Audrey Alonso enhances places, whether Fab Labs or the cities in which they are located, to create a library of shapes that can be engraved on small scraps and turn them into symbolic and contemplative objects. Each postcard can be either made locally and sent or made remotely, offering the receiver the opportunity to discover the Fab Lab movement.



Postcard 2.0, Audrey Alonso, Circular Design Bootcamp, Fab City Store, 2020

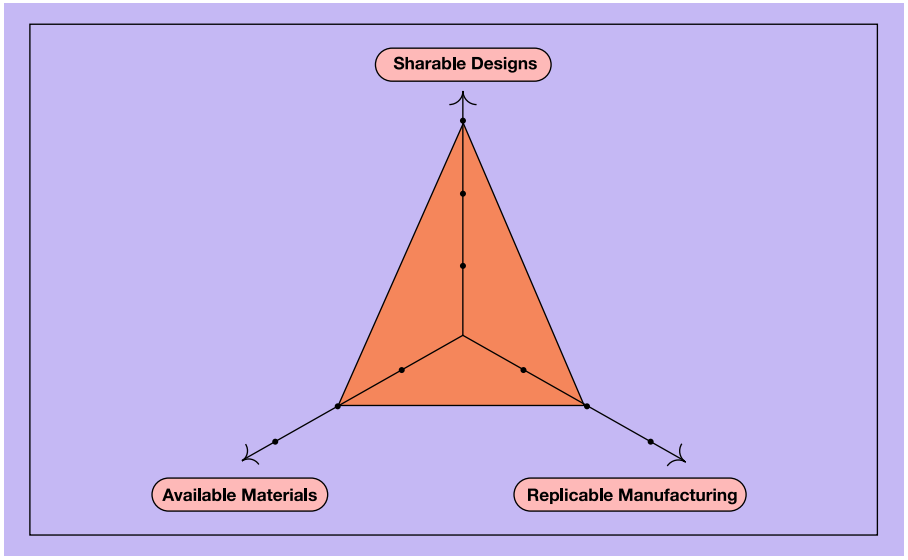
Standard Reused Materials

A second project made use of easy-to-find reusable materials such as bike spokes. Using standard reused materials is a very interesting approach as it allows us to work with predictable materials while still having the qualities of reused materials. Such materials are plentiful, and the challenge comes in their sourcing and how to transform them in a meaningful way. Even though different cultures generate different waste, most of the time the biggest sources of materials are similar, be it tires, tarp, cables…

Spokes: during this bootcamp, designer Magnus Norup Thomsen imagined a lamp made from spokes from bicycle wheels in order to combine digital manufacturing and sustainable design. The easy-to-find spokes also allow them to be changed quickly if the lamp is damaged. Magnus identified spokes as an easy-to-source globally available component. The design is parametric and can offer different aesthetics. And to disseminate this concept, the object is supported by a notice, allowing everyone to make and adapt a lamp model according to their wishes and needs.

Non-Standard Reused Materials

A third project integrated plywood leftovers from the wood workshop, as is. In opposition to working with standard leftovers, working with non-standard leftovers offers huge potential sourcing. This means that a design can account



Spokes, Magnus Norup Thomsen, Circular Design Bootcamp, Fab City Store, 2020

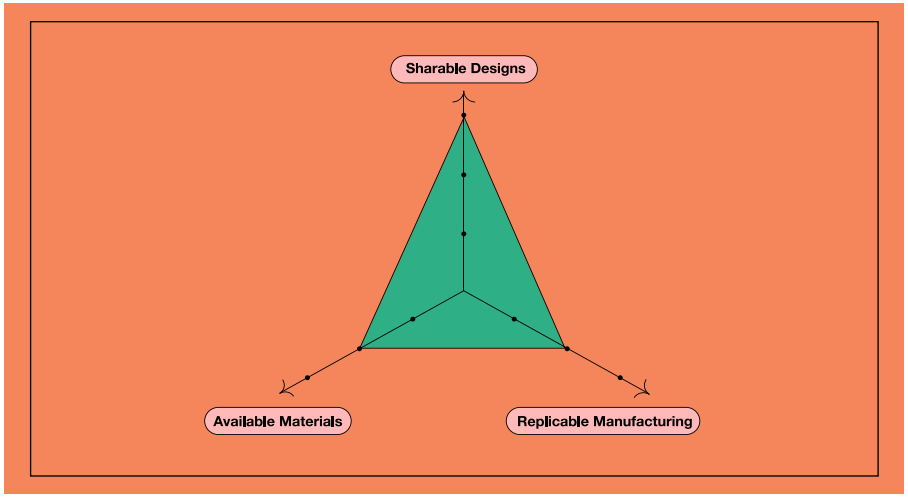
for “any” material size and or geometry. This approach is very interesting but often requires huge design overheads.

Vices Stool: Léo Sprimont imagined a stool base that adapts to different sittings and tops. The parametric model can be modulated to create different heights according to specific needs (stool, table, coffee table, bar table) and in shapes according to the tops (squares, circles…). The legs work as a vice that can hold any shape. To limit unnecessary hardware and complexity of the object, a simple strap keeps the feet tight and stable.

Circular Materials

A fourth project used papier maché as raw material. This material can be recycled by anyone, and makes optimal use of the material. This last approach is the most interesting as it generates no waste and all the material can be reused. The downside is that such materials are rare to find to transform.

100% Papier: Atelier Bouillons’s project questions the abundance of paper in the fields of communication: “We had taken a lot of flyers that we had never used and which, after an event, were obsolete.” Development of this approach was made possible with industries by offering to manage their paper waste. Paper waste is infinitely recyclable, as soaking it in water makes it malleable and allows the possibility to have new shapes. A protocol has been put in place and documented to allow everyone to rethink this material available everywhere, and in large numbers, in a logical, local and responsible distributed manufacturing. This material has been used to build a stool for sitting.



Vices Stool, Léo Sprimont, Circular Design Bootcamp, Fab City Store, 2020

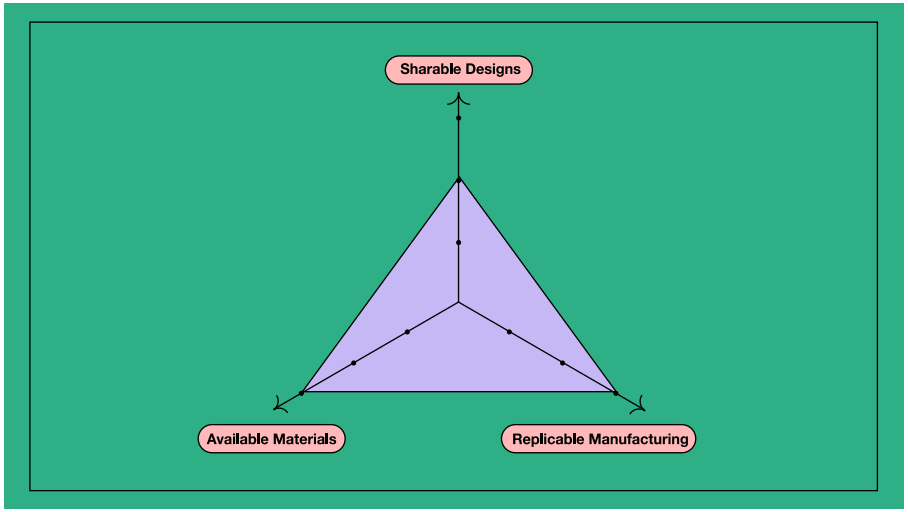
Distributability of Organizations

With the Reflow - EU H2020 project, Ars Longa, in contact with the actors of the Fab City Store, is looking into the strategies to facilitate the use of sustainable raw materials. Reuse still evades full scale automation and standardization. Integrating it into one's practice requires time and skills to source, identify and qualify the material in order to designate a new circuit of use for it. Thus, there is a need to develop a network of local actors able to facilitate those actions.

Organising a Network of Small Actors

More and more, anti-waste laws are emerging in order to limit planned obsolescence and the harmful use of resources. While they are mainly targeted towards big corporations, it makes sense that smaller organisations, such as designers, planners and craftsmen align with these new circular economy practices, in anticipation. They should make use of their size and agility so that the legislation does not work against them, but rather they define the direction. It is necessary to help and support these small actors so that the issues of re-use and the circular economy are facilitated for them, taking into account that often these artisans work alone, with others, but never in large numbers.

For more than ten years, in the northeast of Paris, third places and small businesses have been sharing services, skills, tools and subjects to think up virtuous collaborations in a manufacturing and productive city. A strong interest in less impactful ecologically and energy-efficient practices has emerged, placing at the centre of the reflections, a concern for re-use and recycling. But, faced with the sometimes fragile economic system of small players in creation and design,



100% Papier, Atelier Bouillons, Circular Design Bootcamp, Fab City Store, 2020

these practices sometimes remain on the surface and are almost invisible if they are poorly coordinated. By integrating the RE-Label community and adopting its methodology, the Fab City Store undertakes to facilitate these practices and to democratize them by creating dialogues between territory, manufacturers and re-use players.

A Common Language

The Re-Label was designed in partnership with the Fab City Store community in order to create common protocols to qualify and quantify the different practices and make it visible to partners and consumers. The goal is to facilitate the identification and interaction between all the actors of the productive city.

RE_label is supported by the Ars Longa association as part of a REFLOW action-research program (reflowproject.eu) which brings together around 30 actors (universities, associations, companies) of different sizes and nationalities around six pilot European cities. REFLOW questions the capacity of metropolises to become aware of their ecological footprint on the life cycle and the flow of materials that meet the needs of cities.

To inject re-use into practices that fall under design, it is sometimes complicated to deal with the routines of automation and processes already in place in workshops that undertake small-series production. Re-use requires human time made available to source, identify and qualify the material in order to integrate it into a new circuit of use. These observation and identification skills, sometimes poorly identified and difficult to implement, are the main axis of analysis of the re-label methodology.

Mobile Interpretation Centres at the Forefront of Conservation

Jenny Bentley & Twisha Mehta from Echostream, India

Climate change is one of the most persistent global issues of this century. Research indicates that it is place-sensitive and has localised impacts (IPCC, 2014; Agrawal and Perrin, 2008), thus rendering local observations of impact and adaptation or mitigation activities relevant to climate action. This review investigates how local knowledge and practices of conservation can become part of a global co-created climate action intervention. Our team at the Sikkimese multi-disciplinary design studio Echostream is working on an interpretation centre as a co-created local communication-based intervention in a vulnerable Himalayan region. The project faces accessibility constraints due to the fragile landscape and the political situation -a constraint that has been accentuated due to the COVID-19 pandemic. Tackling these impediments, our team at Echostream has come up with a model of mobile and digital interpretation centres that it is prototyping currently. Therefore, Echostream is utilising distributed design to translocally interconnect local solutions and knowledge systems via digital modalities. Aim is to thereby enhance their impact on a global scale.

This distributed design approach addressed specific Sustainable Development Goals with an innovative model that links local Indigenous knowledge and conservation practices with digital possibilities and art´

Designing mobile interpretation centres is a successful convergence of the maker movement and the experience economy. So far, the focus of the maker movement (Hatch, 2014) has largely been on the innovation and fabrication of physical, tangible offerings like tools, equipment, and products, it is time the movement shifts its focus towards designing for the experience economy (Pine and Gilmore, 2013). Crucially, this distributed design approach addressed specific Sustainable Development Goals (8, 12, 13, 17) with an innovative model that links local Indigenous knowledge and conservation practices with digital possibilities and art.

Impact of Climate Change on Vulnerable Landscapes and Local Communities

The Himalayas have been conceptualised as the third pole, as their ice-masses hold the largest fresh water supply outside the polar regions. Mountains directly support twelve percent of the world's population; besides being habitat to a wide range of fauna and flora and providing homes and livelihood to a significant amount of people, they are the main source of global water (Kothari et al., 2017; UN, 2011).

Lachen Village, 2,600m Above Sea Level. 2020. Lachen, India. © Pagel Lepcha.

Our case study originates from Sikkim, a Himalayan state of India. The region is known to be a biodiversity hotspot with many endangered species, such as the snow leopard, the black-necked crane, and many more (Lachungpa, 2009). Beyond this, research indicates that the Sikkim Himalayas are particularly vulnerable to climate change, quantifiable in a higher increase in median temperatures than the global average or advanced glacier decline compared to other parts of the Himalayas (Saluja et al., 2019, 12; Kothari et al., 2017). The region is experiencing more rain before and after the monsoon than previously recorded, accompanied by an overall increase in relative humidity, while at the same time less rains and snowfall in the winter cause the water bodies to dry up during these months (Bawa and Ingty, 2012; Prasad et al., 2009). Such changes in Himalayan ecosystems and water bodies have ripple effects along the river courses and impact the lives and livelihoods of people downstream.

In Sikkim, some of the most vulnerable inhabited regions are in the north of the state. Therefore, our case study focuses on the high-altitude village of Lachen, close to the Indo-China border. Most permanent residents, called Lachenpa, are Sikkimese of Bhutia origin and followers of Tibetan Buddhism. Traditionally, they are transhumance agriculturalists and traders. They move to Thangu, around twenty kilometres above Lachen, in the summer months for cultivating potatoes, radishes, and some green vegetables. Further above, in the Tso Lhamu Plateau, the semi-nomadic Dokpas reside with their yaks and sheep. Their traditional lands used to cross over into Tibet until the border closed in 1962 (Kothari, 2017, 10–11; Ingty and Bawa, 2012; Tambe and Rawat, 2009) . The prevention of cross-border mobility cut access to traditional pastures and stopped trade, having a significant impact on Indigenous way of life.

Today, Lachens' residents suffer from the changing climatic conditions and its impact on the landscape, the crops, and their livestock. Animal and plant species are moving to higher regions or becoming extinct, as a consequence grasslands have become less productive. Pastures are degrading and water sources drying, making it more and more difficult to sustain sheep or yak herds. Additionally, more incidents of crop pests and livestock parasite infestations lower agricultural productivity. Human-wildlife conflicts have increased, as wildlife raids crops, indicating a lack of wild fruits or prey in their natural habitat. Climate change also increases the risk of disaster; the memory of a large glacial lake outburst flood destroying Lachen in 1965 remains vivid. Mass tourism, lack of waste management, and a strong army presence place additional stress on the high altitude ecosystems (Sharma et al., 2009; Kothari, 2017).

A Lachenpa Craftswoman at a Traditional Ikra House. 2021. Lachen, India. © Twisha Mehta.

Local Knowledge Systems as a Response to a Global Problem

Climate change affects localities in diverse and interconnected ways, even within the limited Sikkimese space. Consequently, to conserve the Himalayan landscape, the local knowledge on the environment and its changes is pivotal. In this context, Indigenous knowledge systems can give valid and crucial contributions to conservation initiatives (Ingty, 2017; Lachungpa, 2009), then as repertoires of place-bound knowledge, experiences, and practices that have been transmitted over generations, they hold the historical depth to map change, as diverse perception studies have shown (Berkes, 2002; Nicolas et al., 2002; Speranza et al., 2009).

Moreover, Indigenous people and institutions have acquired methods of sustainable ecology and adaptation to climate-induced changes in order to reduce vulnerability. Measures regulating the interaction of the Lachenpa with the environment are coordinated by their Indigenous political institution, called Dzumsa (Chettri, 2013; Bourdet-Sabatier, 2004), and the monastery. Both are strongly rooted in the community and the Dzumsa - the traditional system of self-governance - which is empowered to make and enforce local laws through its recognition by the government of India. The Dzumsa, for example, sets the date for the migration to new pastures, defines the amount of fodder each household can collect and at which altitude in order to distribute its impact on the ecosystem. The council selects the crops to plant, also introducing new ones that now grow due to the changed climate, such as maize or pumpkin in Lachen and carrot in Thangu (Ingty and Bawa, 2012; Ingty, 2017). Additionally, religious conceptualisations of environment and space guide these interactions and also justify restrictions in the wider community. Water bodies, for example, are sacred, fishing or swimming is forbidden. This prevents pollution and enables the ecosystems to remain intact.

In Lachen, as in many other places in the world, the transmission of Indigenous knowledge has been disturbed due to changes in livelihood patterns and emigration of younger generations for schooling and economic opportunities. Within this context, the idea of a Lachen Interpretation Centre was born, aiming to preserve local knowledge systems that could mitigate the impact of climate change and contribute to preserving the vulnerable, globally important habitat. The centre is to be designed as a space for capacity-building on conservation issues and as an opportunity for diverse income generating activities for the local community.

Under the UNDP-led SECURE Himalaya project, Echostream is crafting this prototype using community participation. Avoiding pitfalls such as framing Indigenous people as "natural" ecologists, idealising their resilience, or detaching practices and knowledge from Indigenous ontologies (see Nadasdy, 2005; Chandler and Reid, 2018; Houde, 2007), the centre aims at involving the entire spectrum of local stakeholders in knowledge co-creation. In order to validate the diverse knowledge systems and Indigenous ontologies, it uses a multi-vocal approach to their visualisation. Importantly,

decision-making with regard to the centre occurs in interaction and accordance with the Dzumsa, offering it legitimacy and enabling trust-building within the community.

Interactions with Three Generations of Knowledge Holders. 2021. Lachen, India. © Jenny Bentley.

The Lachen interpretation centre will take up crucial topics of climate action, such as conservation of glaciers and wetland systems, medical plants and endangered species; human-wildlife conflict and illegal wildlife trade; as well as the laws on wildlife and environment protection. Guided by these, the centre builds a repertoire on local knowledge on traditional agricultural practices and animal husbandry, life cycle, Indigenous medical knowledge, local craft and art, local history writing, as well as religious practices, myths, and songs. Built as an interactive space, these local knowledge systems will be displayed and activated within their capacity to improve conservation of the vulnerable landscape and strengthen the local communities' reaction to climate change.

Reimagining Conservation through Open-Knowledge

The design of Lachen's interpretation centre focuses on combating local issues through open shared knowledge. The Himalayas' restricted accessibility as a geographically but also politically sensitive landscape paved a path to invent around conventional, physical interpretation centres. This pushed our team at Echostream to explore blended-digital options and work with a concept of virtual and mobile interpretation centres, aiming at eliminating mass tourism's brunt on Lachen's ecosystem.

A system of these interpretation centres can be understood in three-folds:

- First, the project is working on creating a network of display spaces — like cafes, museums, and other interpretation centres — across the globe that will share the curated material of Lachen's Indigenous knowledge systems. Such local displays will encourage an active exchange of local responses to climate change across borders. The goal is to amplify the importance of these knowledge systems in the context of climate action by allowing for a global discourse on environmentally critical areas like Lachen. Such a set-up will give Lachen exposure and acknowledgement in their local conservation practices despite their geographical disconnect and enhance knowledge exchange on impact and mitigation strategies between different localities.

A Traditional Carpet – Handwoven Textiles of Lachen. 2021. Lachen, India. © Twisha Mehta.

- The second component of the project is promoting the creation of virtual interpretation centres for conservation, just like Echostream's prototype-in-progress. By offering the experience of different localities through ecological and affordable technologies like augmented reality, such centres have the potential to reinvent models of tourism and knowledge exchange. These efforts will bring areas with limited access to the forefront of the dialogue on community-based conservation practices.

- The third and an important aspect of promoting community-based initiatives through such distributed experiences is revenue generation. Echostream aims to share toolkits on revenue-generating systems for these interpretation centres through open platforms. Rationale behind this is that sustaining local responses to global issues must benefit Indigenous communities. These revenue-generating systems enable local communities to promote their arts and crafts in order to achieve the economic sustainability of their conservation efforts and lastly also their own subsistence.

This project's current goal lies in sharing knowledge on designing such conservation-based interpretation centres through open-sourced mediums. By building networks on available collaborative forums, Echostream aims to create connections between a cohort of designers, anthropologists, and conservationists that aid in creating more such mobile physical and digital interpretation centres for other culturally and ecologically-rich landscapes. Sharing learnings on creating physical interpretation centres will also promote local fabrication and production.

It's Only the Beginning

Climate change comprises several complex and interlinked hyperobjects with place-sensitive impact. Therefore, amplifying local responses to climate change is a global need. From a design perspective, it is pivotal to adapt designing to the context of experience economy by shifting the focus of the makers movement. The access to (digital) tools empowers designers to design, conceptualise, and curate experiences. Similarly, distributed design allows to mobilise support for critical landscapes with local communities. Combining both — as this review shows along the prototyping of mobile and digital interpretation centres — can be fruitful in climate action.

Echostream's prototype-in-process is an initiative to respond to this call to action through distributed design. In order to do this, the mobile and digital conservation centres are conceptualised three-fold: a physical centre in the Lachen as a prototype as well as in other localities around the globe, a virtual interpretation centre offering additional experiences without physically having to reach the endangered landscape, and open-source revenue-generating toolkits for local and Indigenous communities to render their conservation intervention financially sustainable.

In order to achieve this, the design process is embedded in a strong strategy of local multi-stakeholder participation, knowledge co-creation, and decisions-making as well as global network-building on digital platforms. Additionally, it sets the emphasis on designing locally in order to respond to climate change in the most antifragile way, by strengthening and diversifying local capacities. In this way, the project contributes to the facilitation of a global exchange of local conservation practices, knowledge, and art.

Augmented Reality Interaction with Restricted Landscapes through Tickets. 2021. Gangtok, India. © Echostream.

CHAPTER 4

Conceptualising Distributed Design

From its roots in the Maker Movement and digital fabrication, Distributed Design employs prototyping and co-design as tools to prefigure design alternatives. In the dedicated activities carried out on a yearly basis by Platform members they have been used to advance situated responses, hyper-customisation and community-driven approaches. This chapter examines how such a ‘maker’ approach to conceptualisation is empowering both makers and users alike. It looks at design for good, needs-based design and design for speculation within education, community building and systems thinking.

Rethink the System, Together

Articulating a Circular Economy with Maker Communities in China

Dr. Kit Braybrooke from Kings College London Department of Digital Humanities, Sophie Huckfield from Studio We & Us, and Prof Nicola Thomas from University of Exeter Department of Geography.

Introduction

Workshop participants collaborate to create a sustainable ecological system.

"*Every community practices the design of itself.*" - Arturo Escobar, 2018

The regeneration of our world's overstretched socio-ecological systems requires considerable practical and cultural shifts amongst multinational institutions and local neighbourhoods alike. Decisions about how to proceed, however, are all too often left to society's most powerful actors, with communities of practice sidelined. Makers (from craft practitioners to designers, tinkerers to fixers) are creative thinkers and strategists, with a unique understanding of materials and production processes. They liaise with suppliers and distribution networks, and advocate for sustainable alternatives. What if they could play a more active role in reshaping the systems within which they live? What happens when they explore the opportunities and possibilities open to them to support actions that move towards ecological regeneration?

'Makers (from craft practitioners to designers, tinkerers to fixers) are creative thinkers and strategists, with a unique understanding of materials and production processes.´

In this chapter, we ask how distributed design can assist makers and designers in articulating environmentally conscious action on their own terms, in ways that are personally meaningful for them. We conclude with a set of design recommendations for the aid of practitioners wishing to facilitate future hands-on workshops that explore complex systems in collaboration with creative communities. In doing so, we illustrate how economic policy frameworks can become distributive and regenerative by design (Raworth, 2017) and global in scope, while also remaining sensitive to local experiences, values and needs.

The Circular Economy: Reframing Economic Development through Systems

One of the models commonly explored in European and North American contexts to conceive of how ecological regeneration can work in practice is the circular economy (CE), a vision of economic development where things are designed, made, used and reused within planetary boundaries (Ellen MacArthur Foundation, 2018). The CE takes the "Three R" principle of "reduce, reuse, recycle" to a new level through a systems-based approach which integrates CE principles across the entire economic supply chain, with nine R's to support it (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover; see Potting et al., 2017).

This is a reconceptualisation of economic production which remains broadly aligned with global capitalism, and compatible with international and national policy objectives. At the same time, the CE resonates with environmentally conscious resource circulation practices which predate its formal naming (see Reike et al., 2018). The CE therefore speaks to a variety of stakeholders, from policymakers and planners seeking sustainable solutions to climate action groups seeking more radical postcapitalist configurations (see Gibson Graham et al., 2013).

As humanity faces ever-increasing environmental threats in response to its own actions, the CE offers one of the more palatable social imaginaries with regards to economic greening, with design and technology articulated as key parts of the solution. As a result, it has traveled widely, as we see here, with China as an early adopter of CE policy frameworks (see e.g. Zhijun & Nailing, 2007; Yong, 2007; Mathews, 2009). There is, however, a difference between the

adoption of policy, and the changing of cultures and minds in practice (Calisto Friant et al., 2021; Guo et al., 2017). The challenges of reconfiguring the global economy towards environmental justice are significant, and there is a danger that the CE offers a hollow promise which does not ultimately result in transformative solutions. Because the CE remains in its early stages of adoption, stakeholders can struggle to integrate new approaches and new ways of working into existing frameworks, many of which are not easily aligned.

One of these challenges can be found in the difficulties of delivering the CE practically, as it depends on a whole-systems reorientation of the global commodity system (Calisto Friant et al., 2020). This includes, for example, agreements around international governance for environmental protection linked to resource extraction and manufacturing; an equitable trading system which accounts for circularity; a rearticulation of what "economic value" means in a system which encourages different types of longevity and consumption practices (see, for example, Flynn & Hacking, 2019). Alongside this is the need to educate and train the labour force to work in a circular way, and incorporate a very different approach to how materials are perceived and used in society by consumers (see, for example, Korsunova et al., 2021).

It is also important to acknowledge that the CE in its current framing has emerged from a place of privilege, which articulates values around environmental concerns from a majority world position. As a theory developed from European and North American perspectives, it reflects a particular positionality wrought through generations of colonial wealth extraction from the minority world, and the environmental consequences of economic growth under the conditions of industrial capitalism. In light of decolonising movements, it is essential to reflect on how the social imaginaries of making and design practices are constructed, distributed and institutionalised as we explore their possibilities and limitations (Braybrooke & Jordan, 2017).

Circularity in China: Building an Ecological Civilisation

China offers a particular example of how ecological development can proceed in line with global standards, while also retaining regional specificity. China was the third nation in the world to institute the CE into national policy in 2013, and it signed onto the UN Sustainable Development Goals in 2016 (Zhu. et al., 2018). In line with these commitments, the concept of "ecological civilisation" (shentai wenming 生态文明) was written into the Chinese constitution in 2018. This vision of sustainable development, which evokes 2000 years of Chinese philosophical traditions, articulates the conservation of nature as a requirement for a balanced and harmonious life (Naustdalslid, 2014; Hansen et al., 2018). It is now used as the core ideological framing for policies addressing environmental degradation at all levels of government. By pursuing economic and social development in harmony with environmental concerns, the aim is to realise the dream of a "beautiful China" through policies that offer an alternative approach to that of neoliberal environmentalism (People's Republic of China, 2018).

Workshop participants explore environmental concerns through making.

As delegates of Living Research (2015-2019), a British Council initiative connecting makers and academics between China and the UK, we wanted to understand how current framings of the CE translated into majority world contexts, and to learn more about how the existing practices of makers might sit within a CE approach. We looked at education provision for CE design, understandings of the CE across wider maker cultures, and the daily practices and rituals that aligned to a CE ethos. What we encountered was a complex process of change, as makers and governance officials grappled with how to transition towards more circular approaches.

We focused our attention on Chengdu, a culturally rich city located in one of China's most productive agricultural regions which was about to implement compulsory recycling laws for the first time. We started by meeting with a variety of groups and individuals, from industrial recycling bodies and engineers, to policymakers integrating circularity training into school textbooks, to explore their engagements with the CE as a means of promoting environmentally conscious action. We found that much of the rhetoric around the CE remained focused on the "Three R" model - reduce, reuse, recycle - to address the urgent demands of widespread environmental damage from industrial production and other byproducts of rapid growth.

To explore these dynamics with maker communities in Chengdu, we organised a participatory workshop at a craft centre which implemented hands-on approaches to explore how participants incorporated the CE into their own creative practice. The workshop was attended by local makers of different kinds who were invested in ecological action. Together, we engaged with the CE's possibilities and limitations, finding that participants' lived realities of circularity painted quite a different picture to that of CE policymaking rhetoric. In the next sections of this chapter, we will describe the workshop in detail, and conclude with a set of design recommendations for other practitioners looking to organise workshops of this kind.

Workshop Process: The Maker and the System

Participants visually scale their priorities for daily life in a circular economy.

By providing a variety of participatory activities, our hope was to build an understanding of participants' emotional encounters and relationships with circularity as well as their material engagements. To prepare for the workshop, participants were asked to bring an object they had made to share with others. We started by inviting them to introduce their objects in ways that identified both their material and immaterial components, including the origin of their materials, their aesthetic inspiration, their purpose, and social ecologies they were a part of. Objects were shared in small groups, to give participants the space to observe the multiple points of connection and exchange involved in the process of creative production.

We then provided participants with a range of visual cues on paper which illustrated common signifiers of typical environmental concerns (e.g. air pollution, concentration of plastics, consequences of environmental change) and typical everyday life concerns (e.g. family, finances, money, food) alongside blank cue cards, also on paper, which participants could use to add their own. The aim of this exercise was to assess the concerns that most resonated with participants as high priority, while gauging a sense of how closely systems-level environmental challenges were associated with these. Participants were invited to add their chosen cue cards to a board, where the cards were positioned on a circular scale of importance. The exercise revealed a wide-ranging awareness of environmental challenges, and suggested that participants felt disconnected from the rapid economic development of China. Indeed, many participants expressed concern over the rapidity of "progress", stating that an overemphasis on GDP growth was detrimental to their lifestyle, and out of touch with individual concerns.

Having located participants' values in relation to issues of environmental concern, we guided the workshop back to their own practice. We invited the makers to "map" their practice and the objects they create, in order to explore their process while considering how their practices, design and materials already worked (or not) in relation to CE thinking. We asked participants to consider the sourcing of materials, how they were designed, the tools they used to make their products, and the afterlife of the product once it left the workshop (for example, can it be repaired? How is it transported to customers? What might its long-term future be as it cycles through the current system?). The aim of this activity was to consider the ways in which CE thinking may already be present in the maker's process, and how straightforward it would be for participants to position themselves within a CE system of production and consumption.

The workshop then moved into a role play activity with the goal of collaboratively creating a sustainable system. We invited participants in teams of six to take on an identified role within the system: Consumer, Creator, Manufacturer, Material Supplier, Transporter, Advocate. The group decided on a "product" (for example, a drinking vessel, item of clothing, or piece of furniture) and each person in their chosen role was asked to decide on the best mode of production and distribution for the product throughout its lifespan. Following this, groups presented their ideas in their role-play characters, sharing mock-ups of the "product" and models of their system. In doing so, they worked together to identify the many complexities and opportunities of designing within a CE system. By mapping the interrelationships between different actors, participants built an understanding of the structures currently in place, and what was still needed to build a self-sustaining circuit of production and consumption.

In sharing their final concepts, participants discussed a brilliant range of ideas and suggestions for how CE thinking could be incorporated into their practice. Some participants grappled with how to design materials and objects so they could be reprocessed more sustainably, in ways that might enable customers to return old products and have something new made with these materials. Others explored alternative industrial relations such as lower-impact transport and distribution. Transporting goods could offer more transparent pricing, participants suggested, which might make visible the costs of different types of transport (and illustrate how delivery by bike, for example, might be the cheapest and most sustainable option). Others discussed the design of objects using materials that could be chosen specifically to accommodate an aging process that featured the life and character of the object over time. As our Chengdu participants entered into the spirit of the CE role play, they expressed a deep and intimate understanding of the supply chains and creative strategies necessary to institute change.

Workshop Outcomes: Increased Awareness through Local Relevance

These outcomes illustrate the possibilities of applying distributed design as both concept and praxis. We observed several issues common to nations transitioning towards CE thinking: a disconnect between policy and practice, a need to make systems thinking locally relevant, and a struggle to rationalise the long-lead time required for widespread culture shifts regarding environmentally conscious action. By working with maker communities

Participants present their own circular systems.

through hands-on approaches that spoke to their creative sensibilities, we witnessed the diverse ways in which individuals in China made sense of complex concepts around circularity, in ways that were personally applicable. While participants articulated an awareness of the practices involved in building an ecological civilisation, they were less confident in discussing how the CE fit into this. Most participants had been unaware that they could play an active role as producers in shaping the CE through their engagements with regional networks and suppliers. This speaks to the value of connecting social imaginaries across borders, in ways that meet local concerns.

These insights illustrate the importance of applying place-based and hands-on approaches in inviting producers to engage in systems thinking for ecological action. Although the principles and policies of the CE may be determined at government level, their success lies in the mundane exchanges of social actors, and the kinds of worlds they believe they can build. The level to which systems thinking like the CE will be successful depends on these encounters, and determines the transition from government rhetoric to everyday practice. Policy frameworks are essential in instilling the principles that direct our societies towards a more distributive future, but our findings illustrate that makers are brilliantly positioned to design social imaginaries that actually work in practice. By inviting creative communities to explore the diverse affordances that can be mobilised when they take on an active role in reshaping economic systems, we also plant the seeds of transformation.

Design Recommendations: Systems Thinking with Creative Communities

We conclude this chapter with a list of four design recommendations (Ostrom, 1990) for the use of other kinds of practitioners who wish to implement hands-on workshops that explore complex systems in collaboration with creative communities in a variety of contexts.

Speak to participants' lived experiences

By breaking down the actors, materials and interactions involved in a concept at the systems level, a multi-level engagement with seemingly remote production and consumption processes is encouraged. Creative communities respond well to working with hands-on materials in ways that invite them to think with their hands, and imagine new solutions beyond the factory and studio. For example, participants were at their most creative in envisioning sustainable strategies for how to transport the materials they encountered on a daily basis.

Think in life cycles

Tasking creatives with the responsibility of envisioning the full life cycle of the things that they make, fosters creative engagement with the processes and materials they might use to develop future products. Issues of repair, materials selection and longevity became a core conceptual practice for participants that helped them imagine what could be made. From reusable filaments to nanotechnological gold repair, many of their design suggestions explored whether objects could be designed to gain value as they visibly age from use.

Invite cross-collaboration

The climate crisis is not a problem that can be tackled on an individual basis. Creatives participating cross-collaboratively with other groups (from policymakers to distributors, and also with creatives operating in other regional contexts) to address the full design of a life cycle and supply chain can open up the interconnectedness of complex issues, and inspire new means of collective response.

Find commonality across concepts

While sustainabiliy is now defined in the UN Sustainable Development Goals, a shared understanding of systems-level frameworks like the circular economy is not a guarantee, and as we found in China, concepts which speak to local histories and needs are often much more applicable. Start your workshop by building a shared vision about what you are talking about, and leave their definitions open for revision. Moving beyond dealing with the symptoms of climate change by actively responding to the causes requires the construction of a shared social imaginary which is relevant to the contexts of creatives.

By offering these observations from our time with maker communities in China, we hope to make space for others to articulate complexity, in ways that are locally useful. We wish them the best in this worthy endeavour. As the renowned systems thinker Donella Meadows put it: "We may not be able to control systems or figure them out, but we can dance with them!"

From Design Challenge to Real Need: Pupileira Kindergarten

Carla Queiroga Werkhaizer, Francisco Gabriel de Macedo Araújo, Juliana Barros de Rezende, Karine de Arimatéia, Rodrigo Andrade Barbosa Bard & Rodrigo Figueiredo Reis from Newton Paiva University Center

In 2020, the rapid spread of the pandemic worldwide brought an unprecedented challenge to post-modern civilisation: to avoid contamination of 8 billion people at the same time, developing technologies to prevent, treat and combat a virus that is still not well known.

The challenge was enormous, but the Fab Foundation - the international network of Fab Labs - has, as its values, distributed production: local production. From the sharing of global knowledge and the use of high technology for the development of quick solutions, the response to the worldwide situation has reached a speed undreamt of by traditional industry, not to mention being liberated from the international logistic barriers.

In response to the challenges of this scenario, the Fab Foundation launched FabX Live, adopting as its theme the COVID-19 pandemic and the solutions generated by the members of the network. Within the challenges offered by the sponsors, Fab Lab Newton participated in the Mobile Hand Washing Challenge, for which it has designed, in seven days, the EcoSink, a portable sink that can be produced anywhere in the world, designed to be adopted by low income communities, with poor or zero access to water.

EcoSink was shortlisted in the top three projects and the final project was then published at the Fab Lab Newton profile on Wikifactory. The characteristics of the open design project are: furniture with simple design, which enable wood cutting to be done manually; tap and sink and door hinges in 3D-printing; front doors and side drawers in laser cut. The materials used are also universally used such as acrylic, mdf plywood, marine wood plywood, and PLA filament (Fab Lab Newton, 2020).

At this point, StudioN, the academic office of the Faculty of Architecture and Urbanism at Newton Paiva University Centre, got to know the project at Fab Lab Newton's Wikifactory page, an online platform for open projects, and incorporated EcoSink to the revitalization project for Ernani Agrícola Pupileira Children's Centre, a day care centre for needy children from zero to seven years old, located in Belo Horizonte, Minas Gerais, Brazil.

The Fab Lab Newton and StudioN, both Extension projects of the Newton Paiva University Center in Belo Horizonte, have been working closely since 2016 in fostering students to develop distributed design, through attending international competitions and taking workshops in the Fab Lab on open design, open software, creative commons and digital platforms for publishing projects.

Fab Lab Newton is an academic Fab Lab founded in 2015 by Newton as the first Fab Lab of the Minas Gerais state and became the platform to foster and incubate the projects and interdisciplinary teams engaged in different challenges.

At StudioN, the Architecture and Urbanism School Office, students learn by doing, solving real problems brought by the local community that could not normally afford to pay for Architecture and Urbanism services.

Sharing knowledge and making a cultural change prepare the foundations for developing the projects to a positive impact. The hands-on experience for the students, guided by the Fab Lab tutors, and in collaboration with local partners is the ultimate goal, the only one for a real transformation.

Architecture to Embrace and Transform

"Architecture that embraces and transforms", is one of the projects of the StudioN office-school, led by professor Karine Arimatéia with the aim of incorporating into the architecture of the childcare centres solutions that provide embracement and affection.

Pupileira's kindergarten - Entrance view with three Pupila units (StudioN, 2021, credits to the author)

The Eunice Weaver Society, locally known as Pupileira Kindergarten, is a philanthropic association, founded in Belo Horizonte in 1931. At present, the childcare accommodates 316 children from six months to six years old. For the reopening after fourteen months of lockdown during COVID-19 pandemic, a significant project of renewal and adequacy of the spaces to comply with the sanitary protocols by the local government has become imperative for the return of the classes.

"“Open design practices, underpinned by sharing design files and solutions through digital networks, can address barriers to wider diffusion of Circular Economy[...]”.`

That was when Gabriela Oliveira, Pupileira's director, requested StudioN to help her with this challenge. And at this moment, the introduction of portable sinks became the essential item for this new moment of childcare.

Extensive market research was carried out to identify suitable industrialized models, but no models designed especially for children up to six years old were found. Other factors that hindered the adoption of industrialised models were the high cost of the equipment and the impossibility of adjusting the size for the children.

It is these common barriers typical to the linear mode of production and consumption that become opportunities for implementing open design products such as EcoSink.

“Open design practices, underpinned by sharing design files and solutions through digital networks, can address barriers to wider diffusion of Circular Economy. For example, through the development of a meaningful/viable open-source (legal / business) framework, to overcome intellectual property issues that currently hinder CE, but also by fostering greater supply chain transparency” (Prendeville, 2016).

A Child-Centered Design Transformation

The EcoSink was not designed for children either. But thanks to its open design, it has been fully adapted to meet the school's rules and the children's needs and preferences.

All dimensions were reviewed based on the average height of a five-year-old child. The sink and faucet, originally printed in PLA 3D, were remodeled to fit the measurements of the new furniture. The tap, which in the original project was activated by a pedal, was adapted to be manually operated, which reduces the total costs of production and maintenance of the product.

The raw material of the furniture remained the same - 20mm naval plywood - for being lightweight, easy to find in the area, low cost and water resistant. The water storage tanks were reduced from 50L to 20L to adapt the furniture to the height of the wall space , preserving the air ventilation of the surroundings. The water tanks storage area was reviewed to be easily replaceable, thus eliminating the need of hydraulic adaptation works at the school's entrance, which would make the project unaffordable.

Pupila furniture assembly process - first prototype
(Fab Lab Newton, Belo Horizonte, 2021, credits to the author)

Providing Belonging and Affection through Design

In addition to these factors, because it is an open design to serve children, and in a place that requires a strong affective appeal as a childcare, it became necessary to adopt a feature that was not in the original project: the affective design.

The school entrance is usually a place with strong emotional appeal. To support the introduction of the EcoSink in a playful and effective way, an animal was introduced to the project that is a symbol of the city and easily found in the region: the capybara. Capybara walk in flocks and are friendly with children. The mammal is native to South America and inhabits the coastline of a tourist attraction in the city. It has therefore gained the affection of the locals. Inspired by the capybara, the furniture was slightly modified with eyes and a head whose shape resembles the anima. It was given the name Pupila (means “pupil” in Portuguese, referring to “Pupileira” which means “lots of pupils”).

Although it is possible to adapt the whole project to the local needs, the features that make Pupila an open design have been preserved, such as CAD design containing the arranged elements aiming at the maximum use of wood; 3D-printing stl files of the tap and sink; use of 20L tanks in standard format; and use of naval plywood (pine), a wood easily available in several parts of the world.

The new EcoSink, now called Pupila, was totally approved by the Pupileira director Gabriela Oliveira, and the units are under production at the Fab Lab. The Pupila final project will be available for download at the Fab Lab Newton Wikifactory's profile on the 21st of June.

The adoption of distributed design in an institution managed by the local public power, sets a huge precedent for the revision of public investment policies. The interest of public institutions to break with the traditional linear production mode and investing in a circular production chain may be the answer to building a fully sustainable future for the city of Belo Horizonte.

Designing for Uncertainty? Start with Making!

The Power of Distributed Design to Raise Consciousness of Complex Systems

Nat Hunter and Gareth Owen Lloyd from Other Today

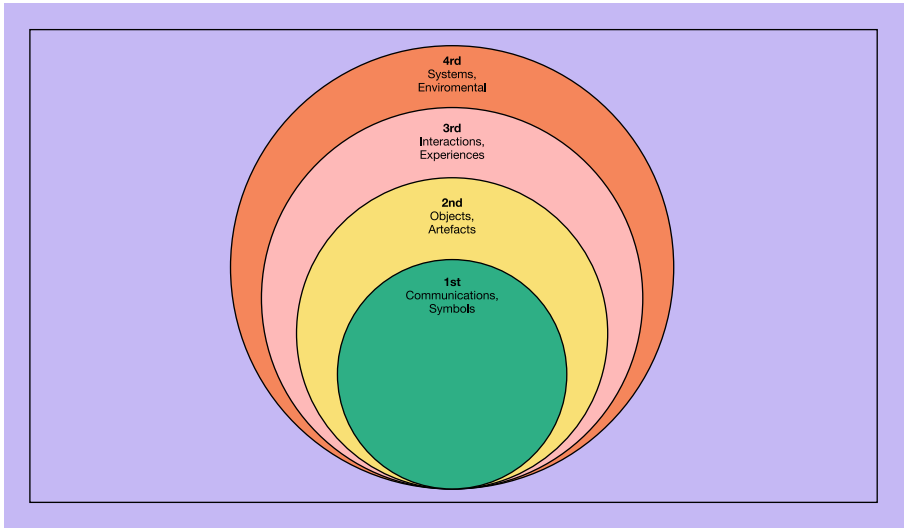
Introduction

As a platform member of Distributed Design Platform since 2018, Other Today has experienced an increasing complexity in the understanding of distributed design as an approach. Many of today's leading design institutions are also changing their understanding of design's role in society, for instance here in the UK, Design Council and The Royal Society of Arts have made significant changes to their communication of how design can contribute to our rapidly changing world. We believe that systems-thinking, combined with hands-on making and engagement of citizens can create and support change.

Increasing Complexities Within Design

Buchanan's Four Orders of Design (below) shows how the design profession covers a spectrum of complexity from the stylistic to the systemic. In the past, students have begun their design-learning journey with an initial degree at the simpler end of the spectrum, where they learn making skills. They might then move to the higher orders as they undertake further education or gain professional experience. Our world is under so much pressure to change, with many governments committing to reaching net zero within the next 30 years. To teach design at a low complexity level is no longer tenable, it risks sending graduates into the world who have no understanding of how their creations will affect interconnected ecosystems.

´We believe that systems-thinking, combined with hands-on making and engagement of citizens can create and support change.´



Buchanan's Four Orders of Design

Other Today and Distributed Design

When we started working on this platform in 2018, we believed that in order for distributed design to make an impact, it needed to mature beyond the prevailing maker aesthetic we were familiar with from running makerspaces. We gathered a group of talented designers who, through a collaboration with the lighting brand Tala, pushed the look and form of digitally fabricated products with a collection of distributable lamps. In 2019, we began to question the business models that were possible within Distributed Design, and started to explore product-as-experience. We took one lamp design and explored what it would take to put it into batch production, quickly realising that there was an opportunity to invite the purchaser of this lamp to participate in its making. This participation was beneficial in many ways - it engaged the purchaser in the understanding of the parameters of the object, and created a narrative and business model.

"I've eliminated the words 'consumption' and 'consumers' from the way I speak because I believe in changing mindsets. If people stop thinking of themselves as consumers and instead think of themselves as citizens, people, humans, then maybe they'll have a different attitude towards things."

- Paula Antonelli

When the consumer buys into the experience of making, they become complicit with the object and as a citizen, begin to care about its origins and end of life. We found that the designers who applied for our third year of activities embedded this care for product origin and end of life into their projects, for example, a tool for processing waste wool situated on a farm in Cornwall, and a new biodegradable material made from local seaweed. To us, this demonstrates that distributed designers are starting to think and make more systemically.

A New Design Methodology

The nature of our educational context has meant that over the last two years, we have begun to codify what we mean by distributed design - expanding the definition from the distribution of data and things to include the distribution of values and power. As Kate Raworth argues, a new economy is required that is regenerative and redistributive by design. This has led us to question whether or not distributed design is a design methodology in its own right. Design methodologies rationalise the design process into phases and on most undergraduate product design courses, a design-thinking approach is built into the curriculum. Across the course we currently teach on, students are taught to build empathy with users and to conduct research, probes and to generate insights and to prototype.

This "Human Centred" methodology is excellent for arriving at solutions that improve users' interaction with products and can even discover solutions for problems that people didn't even know they had. However, while it is an iterative and discursive process, by following it, designers risk centering on the human at the expense of the bigger picture of the planet and humanity.

What distributed design adds to the curriculum is the idea that design is about more than just products - it is ecosystemic and any object made needs to join the dots to show its entire distributed network. This means that our students develop new manufacturing possibilities, alternative business models and design practices for ambitious and hopeful futures. The fourth level of Buchanen's orders of design is System design - a point at which it is usual for the role of design to move beyond the tangible and become about policy.

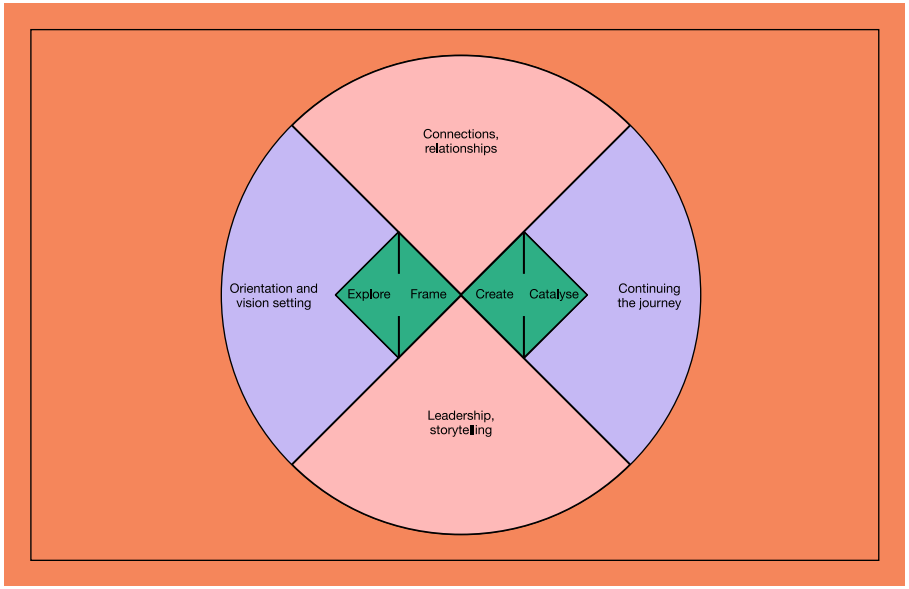
We believe, however, that with distributed design, it is possible to bridge the four levels of complexity and as a problem-posing practice, it is inclusive of the citizen in the technical and design process - a shift in design from products to projects.

Setting a Vision

"Complex environmental and social challenges are not static: they can't simply be 'fixed'. Rather than seeing your work as a 'problem and solution', you should start with a hopeful vision of what you want to achieve, and develop a clear mission from that." - The Systemic Design Framework, Design Council, 2021

Like many design schools, our curriculum is structured along a design-thinking process similar to the Double Diamond. In teaching distributed design however, we have found that we need to build on this traditional pathway, and have been teaching our own distributed spin on the design process.

Published in April 2021, the Design Council's new Systemic Design Framework formalises some of the adaptations we made in our teaching. The new framework advocates starting with making much earlier in the "explore" phase and book-ends the design process with two new phases; "orientation and vision setting" at the start of a project and "continuing the journey" at the end. Most importantly, it recognises the importance of the "invisible activities" that sit around the design process: orientation, vision setting, collaboration and leadership are seen as important threads that weave through a successful project. These activities are not often taught on a design curriculum.



The Systemic Design Framework, launched by Design Council in April 2021, re-drawn by authors

We begin our year-long teaching with orientation and vision setting. This is about ensuring students appreciate that design is about more than just products, and needs to consider the system that you are operating in, connecting you to who you are and the vision you want to manifest. We dive into the ethics of design and the mapping of supply chains. In setting the scene, we introduce distributed and circular design systems and show students exemplar projects from the discipline. During this phase, the students develop a set of values and design principles personal to them which becomes a manifesto and guide for their work. Throughout the year, we loop back to this early phase with sessions on personal position (why you get out of bed!) and design context - setting the scene and landscape of challenges. At this stage in their career, we are really keen for the students to be able to articulate what they are interested in - to identify a specialism or approach that is individual to them.

One of the exercises we do is called "Loose Associations", inspired by a lecture series by the artist Ryan Gander. The students prepare a Pecha Kucha that they have researched by following divergent hyperlinked tangents. We see this as a distributed approach to research - a rhizomatic way of exploring in order to help the students find what they are interested in. This journey of self-discovery continues with the use of coaching techniques where we set out a hopeful vision of the future into which students can imagine their near and far future to set goals. This hopeful future exercise is also championed by the Design Council:

"We need to change the narrative about what designers do, creating expectations that designers can challenge a brief in service of the planet and support the organisations they work with to imagine more hopeful futures." - Beyond Net Zero, Design Council, 2021

Start With Making

From this foundation of orientation, we enter into an exploration phase. In the new framework, the Design Council suggests this should "start with making." This is a welcome shift: design thinking has progressively pushed making farther and farther back in the process to the point where many design thinkers have no grounding in making at all.

Other Today are firm believers that designers should think with their hands, and distributed design's maker culture celebrates tinkering, hacking and serious play. By starting with making, students explore-by-doing how things connect and how they are related within a system. Our "one sheet brief" is a typical distributed design project; students design a product that can be made out of one sheet of material and also fit through a standard letter box. Although simple, through this project we introduce concepts such as local material use, supply chains and the impact of things that you make on people and the planet.

In later briefs we loop back through this exploration phase and introduce "overt research probes" - inspired by manufacturer mapping organisation Make Works. We physically get out of the studio and into the world; building critical consciousness of complex issues that need addressing by mapping and working with factories and facilities in our local community.

Paulo Friere introduced this process of critical consciousness in his book Pedagogy of the Oppressed. For Friere, one must intervene in reality in order to change it and ultimately our goal for distributed designers/citizens is that they take action. Not only should designers observe the real world systems, they should participate in them.

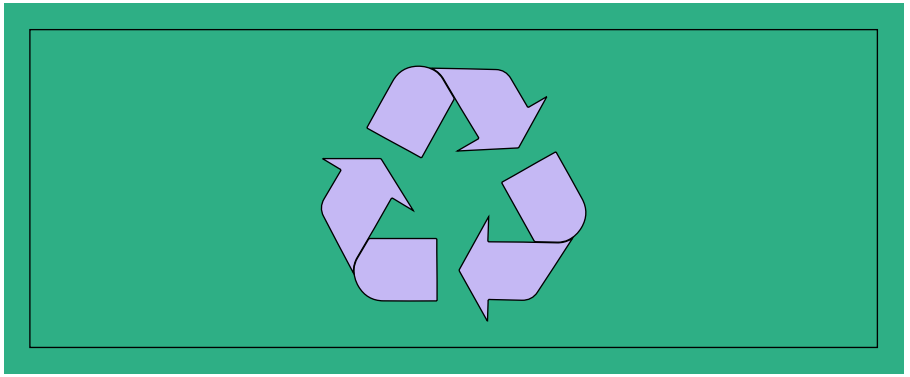
Continuing the Journey

Fundamental to distributed design is the importance of telling your story - filming your making, keeping detailed documentation of the process and sharing how you did it in the end. This spirit of openness and transparency allows the distribution of knowledge and ultimately the objects themselves. In the final phase of "continuing the journey", the Design Council encourages us to "open up and share the knowledge you created so that others can build on it" and to analyse the "impact your intervention has had on the system"

We do this using the platform Wikifactory. Students include manufacturing drawings and do-it-yourself (DIY) instructions into their instructions and publish their work under a Creative Commons licence. Most importantly, they conclude by reflecting on the successes and failures of their projects.

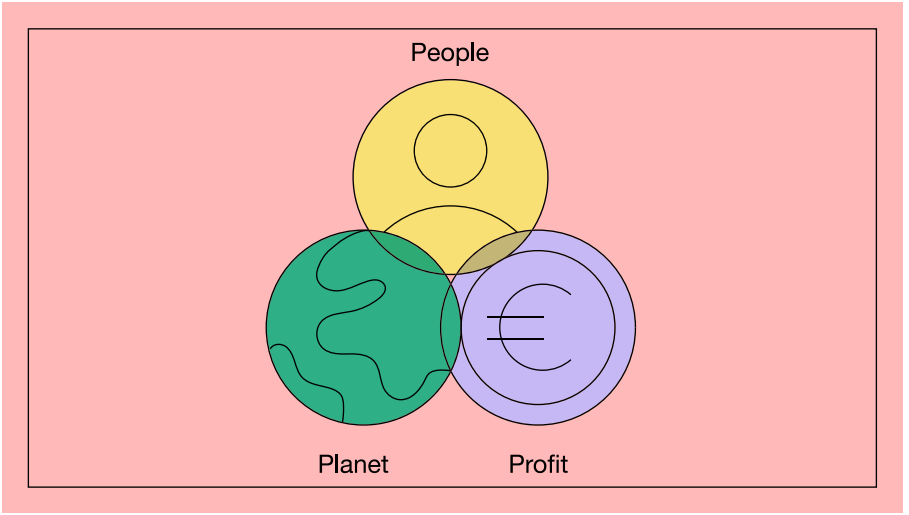
Symbols Replacing Meaning

In 1970, architecture student Gary Anderson was wandering around his campus when he saw a poster for a competition run by the Container Corporation of America, to create a symbol for recycled paper. He entered,



Original design of the recycling logo, Gary Anderson, 1970 (Wikimedia commons)

won and at 23 became the designer of one of the world's most famous symbols. For our product design students, the recycling logo has replaced the meaning beneath it and they fall into a trap of using it as a shorthand to mean "sustainable". Rather than design for the whole system including a product's end of life, students design a thing and say "it will be recycled". In reality the symbol is problematic; there is not really such a thing as recycling, only downcycling: for instance, the reprocessing of plastics degrades the material, produces harmful emissions and ultimately creates end-of-life products like park benches. This is an example of how the overuse of symbols can cause them to lose meaning and become buzzwords. To counter the ritual knowledge of buzzwords we need to become comfortable with complexity.

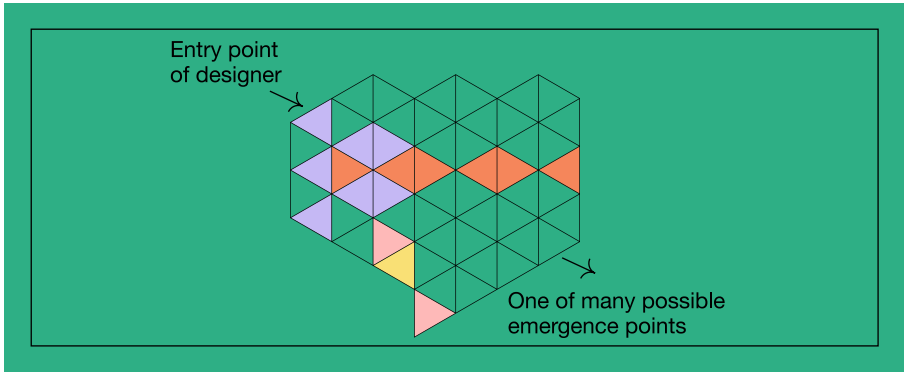


Triple bottom line (TBL Model) Elkington, (1994) diagram by authors.

We introduce our students to complexity in their practice through the lens of John Elkinton's triple bottom line business metaphor of "People, Planet, Profit".

This decouples the designer's focus from the usual human-centered one of consumer (Profit) to also consider the impact on and interactions of humanity (People) and the environment (Planet). A distributed design approach, however, has the potential to go further and be non-centred - with multiple intersectional starting points and no hierarchy.

For our students, this means mapping the distributed constellations of connections that make up a product's supply chain, it means conducting rhizomatic research and building an awareness of their personal context in relation to others and the world.



Schematic representation of the behavior of a multidisciplinary team. Papenek (1971) Re-drawn by authors.

A distributed approach is not new. In 1971, Victor Papenek tessellated the double diamond into a networked mesh representing a multidisciplinary team.

We argue that the contemporary distributed designer needs to be able to embody multiple perspectives, but instead of the nodes being those of customers and clients, they should include communities, objects, rivers, companies, animals and be open to the "many possible unpredictable emergence points". (Papanek, 1971)

Navigating Uncertainty

Design methodologies are not static and designers must find their own paths through them. We ask our students to imagine themselves as backpackers instead of tourists. The difference is that a tourist would book a hotel and get comfortable in one location, whereas a traveller would pack a bag and explore with an open attitude to new experiences. A distributed design student needs to tolerate uncertainty which, in this rapidly changing world, is a great skill to have. We teach that there is not one way but that it's your job as a designer to learn how to find your way.

Pedagogists Osmand and Turner describe this tolerance of uncertainty as a fundamental threshold concept for designers. Yet it is one that cannot be taught by telling; it can only be learnt by doing. In other words, you cannot give the student the map, they have to get lost themselves. A distributed design project is both systemic and specific; it layers macro and micro issues as the student has to simultaneously deal with the coding of a CNC machine, the understanding of a material's life cycle and the creation of open-source instructions. This is the power of distributed design - through making you experience and become aware of the complex systems behind things which in turn can change your mindset.

Conclusion

In a Fab City future where distributed design flourishes, it is not only students who are designers and makers, but all citizens. Design students also need to shift their identity from consumers to become citizens.

This engagement is pedagogical; people cannot simply be shown disruptive technologies as solutions to problems - they need to perceive and value the problems and participate in finding solutions. Design is a vehicle of change. In order to understand the change that is needed, it is necessary to leave your desk and explore the problem. This active exploration mode changes your understanding of what's possible and moves you from passive consumer to active citizen.

The Design Council Beyond Net Zero report identifies four significant characteristics that repeatedly occur within a group of people creating successful change. They could be held by one individual, or by different people within a team. Design and making is one of them of course, but the other three are system thinker, connector/convenor, and leader/storyteller, so the Distributed Design team needs to have the ability to both sense and communicate the wider system, to practice across multiple disciplines, as well as being fluent in making, and in operating machinery. They should be able to advocate for their vision through narrative and leadership; to be able to join the dots and build a movement behind their idea, and to make sure that all the right stakeholders, from citizens to rivers are in the conversation from the beginning.

Distributed design has the opportunity to build on its foundations in the citizen-led maker movement and the technologically empowering maker-mindset to become a narrative and vision-forming discipline that facilitates this shift from consumer to citizen.

About Other Today

Other Today is a London based design studio that promotes the power of Distributed, Circular and Open design to radically reduce planetary impact, shift power and create a fairer society. Founded by Nat Hunter and Gareth Owen Lloyd, the studio explores how regenerative culture and organisational behaviour can positively impact people, society and the planet. Other Today lead a Distributed Design studio at Brighton University on the Product Design with Professional Experience BSc(Hons).

Design and Community Building to Tackle Women's Mobility Issues Locally

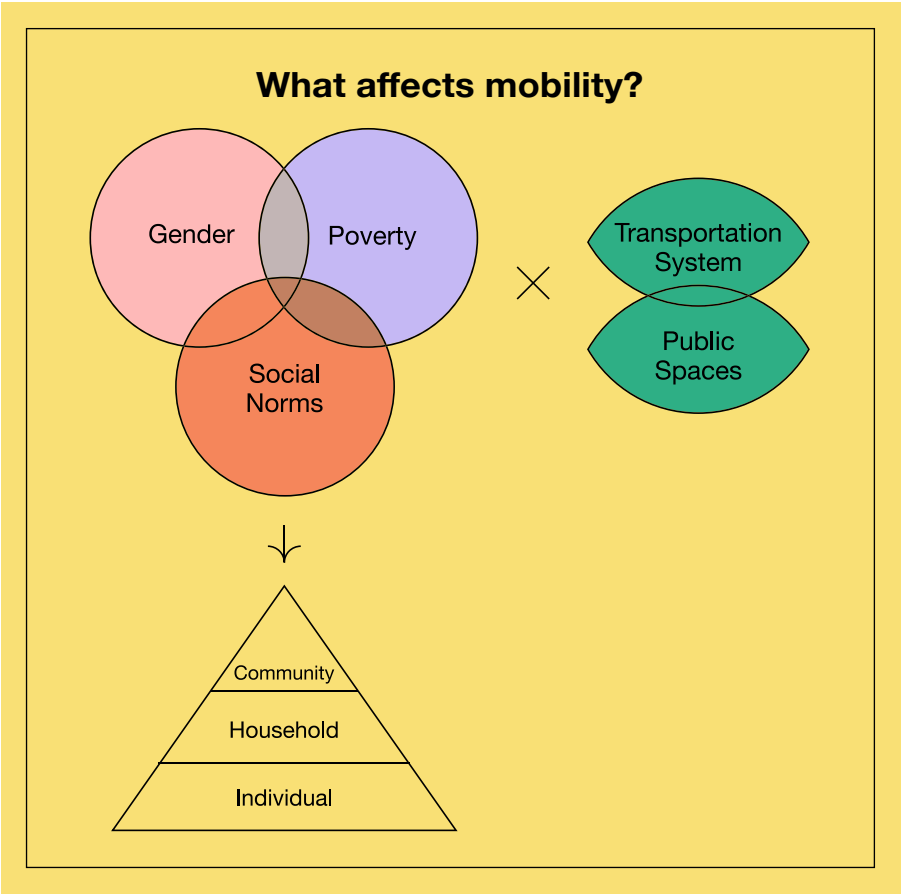
Twisha Mehta from Women's Mobility Project

Introduction

"Mobility" refers to the ability and the freedom to move (Dominguez Gonzalez et al., 2020) and has been defined as an essential human right. It is an enabler of an individuals' participation in social and economic life (Dominguez Gonzalez et al., 2020). As such, mobility is the "fulcrum that allows women to participate in the workforce, which can create a societal shift to transform the entire world economy" (Shah et al., 2017). However, the International Labour Organisation places India as low as 120th of the 131 countries it ranked on women's workforce participation rates, with less than a quarter (20.3%) of women over the age of fifteen participating in the labor force (Prabhu, 2017), resulting in a huge economic implication for the country. What does this tell us about women's mobility?

Women's ability to access public, economic, and social spheres is a factor of their mobility in the city. Gender, poverty, and social norms as systems contribute to individual constraints on mobility. Social norms are enforced and perpetuated at three levels that find their way into affecting one's mobility: community, household, and individual (Dominguez Gonzalez et al., 2020). Moreover, these systems are a consequence of socio-political and economic systems of states and regions.

A simple example of these levels of social constraints in action is the phenomenon of unequal labour division at home, the brunt of which is faced by women. This leads to fewer women having the time or resources to access the public sphere, making spaces outside male-dominant. This creates an unsafe and unaccommodating environment for women outside their homes. And this is only made worse when poverty disables a woman's access to a safer, private means of movement.



Systems that Influence One's Mobility in a City. 2021. © Women's Mobility Project.

While geographical, social and political restraints in India still prevent a significant amount of women from being mobile, public spaces and transportation systems in the city comprise the external constraints on one's mobility (Dominguez Gonzalez et al., 2020). The restrictions placed on women by the way public transportation and public spaces are designed —from ticket pricing systems, to safety and security, to gender neutral designs — impact their decisions just as significantly (Bhide, Kundu, and Tiwari, 2016). Such external constraints render public spaces and transportation systems uncomfortable for women. As a consequence of this, it is safe to say that the inequalities and narratives arising from the socio-economic systems, and constraints such systems place on women, are further perpetuated and exacerbated by design, especially in transportation systems and public spaces, by making mobility physically and psychologically inconvenient and uncomfortable.

In this essay, I discuss an intervention in distributed design that I am currently co-strategising called the Women's Mobility Project (WMP), with the main goal to bring a shift in design for mobility in order to empower women to feel safe and free to move. First, I sketch out the issues of women's mobility in India and explore three examples of gender-neutral designs that are directly constraining women's mobility. Then, I place the focus on the WMP and show how, by means of an open platform, it can aid in creating socially inclusive societies through addressing different facets of women's mobility in Indian cities. With its roots in systems design, this intervention focuses on methods to bring individuals, communities, and organisations from grassroot levels together to design multi-scalar interventions in the field through knowledge exchange and local-needs based iterations. In the last section, I put the spotlight on one specific initiative that used art to visualise women's mobility and constraints in mountainous regions.

Women's Mobility Issues in India

When design for mobility fails to acknowledge various multi-leveled factors that shape women's capacity to make decisions about their mobility and act upon them, they end up affecting women's right to the city. In India, gender manifests itself in multiple ways in women's agency in mobility. Studies have shown that peculiarities in women's mobility patterns are dictated by safety, gender norms, and poverty. A study conducted in Delhi by Jagori in 2010 (as cited by Shah et al., 2017) reported that over 90% of women had faced some form of sexual harassment in the past year; more than half of them faced harassment inside public transport, and another 42% while waiting for public transport. Equally worrisome data was found in Mumbai, showing that 46% of women reported facing sexual harassment inside buses and 17% inside trains (Empowering Women's Mobility: A Program with Transport Systems, 2016).

These occurrences have effects on women's confidence, mobility, and accessibility. For women, the fear of sexual harassment makes it so important to seek assurance of safety and security in public spaces that it defines how, when, and where they choose to move. The lack of safety and security affects women's ability to participate equally in the city and impedes on their access to human rights (Shah et al., 2017).

Specific gender-based norms and imposed societal duties also heavily shape the modalities of mobility. These factors regulate how and why women move, making their patterns different from those of their male counterparts. For instance, as the primary member of a household that handles all the care-work, women make more multi-stop trips to run errands and accompany the young and the old, while men make more linear, direct, to-and-fro journeys from home to workplace (Dominguez Gonzalez et al., 2020). Awareness of such gendered patterns leads to questioning the logic behind the payment systems that are clearly based on to-and-fro journeys, thus rendering male movement patterns the norm and cheaper to sustain.

In India, the brunt of the care economy is unevenly borne by women. 2021. Gangtok, India. © Twisha Mehta.

Mobility at a personal level is further affected by poverty. The work of Mahadevia et al. (2016) addresses that women of all income and social classes tend to use public transport or its replacement paratransit more than the men. One reason for this is the women's lower financial capacity (Peters, 2002). Additionally, more women walk as compared to the men of their social class and that low-income women generally walk to access work and various services (Mahadevia et al., 2016). Having to walk to access public transport or paratransit to be able to afford daily-commutes burdens women with respect to time, causing a phenomenon called time-poverty. Being consumed with household activities and long commute hours reduces women's right to pleasure, and further access to opportunities. Walking to access public transport while having unsafe, under-lit streets, and risky paratransit, further limits their travel and consequently their choices in life.

These combined design factors significantly reduce women's agency in mobility and lay open how the design-decisions that are made in the male-dominated mobility sector are based in gender-biased, patriarchal, and colonial mindsets. Questioning such male-dominated design of transport and public space, and seeking to incorporate women's requirements is pivotal, especially because design that continually obstructs women's mobility reinforces the socio-economic systems that regulate different aspects of women's movement patterns. A simple example can underline this circular logic: social norms restrict women's access to public spaces because there is a general assumption that they are not safe. If these streets are not lit or designed in such a way that women can experience safety, there is no incentive for this social norm to change.

When public spaces are made accessible, safe, and inviting for women, they can pursue their quest for the right to pleasure in the city by regaining agency in making decisions about their mobility (Phadke, Ranade, and Khan, 2013). To make cities more accessible to women by dealing with multifarious aspects of women's mobility — which is the focus of the intervention introduced in this essay — it is important to discuss some examples of these transdisciplinary design issues that manifest themselves in non-inclusive cities.

Example 1: Misrepresentation in Public Signage

Two important spaces for women, where the brunt of commuting is felt to a lesser degree, are the ladies compartment and ladies special trains of the Western Railways in Mumbai. These special compartments and trains constitute a culture of camaraderie where women let their guard down and experience a shared sense of belonging. This experience of a safe female space, however, does not find representation in the official design of the space. The official graphics on the trains that indicate this reserved section for women display a singular woman, similar to a graphic often seen on public toilets. It often depicts a woman wearing a bindi and a mangalsutra – "both symbols of Hindu matrimony" (Phadke, 2013), blatantly excluding non-Hindu, non-gender-conforming, and unmarried women. This image reveals the hegemonic image of an ideal Indian woman that then uncritically permeates public space (Phadke, 2012). Even as an attempt to make trains more gender-inclusive, this misguided design intervention is implemented without a gender-sensitive approach.

In 2019, the Western Railways decided to "modernise" this graphic. The previous misrepresented image was replaced with a visual of just another fair cis-woman dressed in western formal wear. This switch is not only a colonial representation of the "new ideal" Indian woman but also retains the perception of the previous "good", docile woman to a "well-respected" working woman – one who has the right to be present in the public space only because she conforms to her role as a breadwinner, if not a married woman. Publicly projecting images that don't accurately represent reality and significantly undermine those that don't comply with constructed norms, making them vulnerable to adversities. Phadke shares this view when she writes that "though pretty harmless, such symbolism only serves to reproduce and perpetuate a stereotype which, by normalising a particular kind of woman, marks all other women as incomplete, undesirable, and unworthy of full citizenship." (Phadke, 2013).

The under-representation of women in decision-making bodies in the mobility and transport sectors contributes greatly to this issue of unrealistic, stereotypical representation and, in fact, requires a visual communication design intervention to reinvent these normative narratives.

Example 2: Gender-Biased Design of Vehicles

Apart from ensuring unfettered mobility, transport can increase women's productivity and promote gender equality by opening up earning opportunities and facilitating access to health care and education as well as to other services and necessary infrastructure (Bhide, Kundu, and Tiwari, 2016). However, even when access to public transportation systems is ensured to women, the experience of using these is sub-optimal. Then, as stated in the report Why She Moves, the development of most transport infrastructure and services has historically been gender-blind, i.e., does not consider the differing needs of women and men (Dominguez Gonzalez et al., 2020).

For India, as an example, Bhide et al. argue that gender-neutral designs impede smooth experience (Bhide, Kundu, and Tiwari, 2016). Comfortable commutes in Mumbai's public transport system is almost a pipe dream for all, but especially for women. Their study highlights that large gaps between footboards and uneven platforms in local trains play themselves as recurrent issues for women. Similarly, the women commuters cannot reach hand straps without stretching, and the obstructive, and thus inconvenient location of the hand pole at the door makes boarding difficult for them in these trains (Bhide et al., 2016). For some women-commuters, especially pregnant women, women with special needs, and elderly women, the effects of this gender-blind railway system are amplified.

The fact that gender-blind design is not merely about comfort, but can endanger women's lives is put forward by Caroline Criado Perez in her book titled Invisible Women. She shows how women are at higher risk in rear-end collisions while seated in a car as they have less muscle on their necks and upper torso than men. This physiognomic difference makes women up to three times more vulnerable to whiplash. However, this is not considered in the car's design. Modern seats, she adds, are too firm to protect women against whiplash injuries as the seats throw women forward faster than men because the back of the seat doesn't give way for women's on average lighter bodies (Perez, 2019). Perez concludes her argument by reasoning that "cars have been designed using car-crash test dummies based on the 'average' male", and the ill-effects of this are borne by women (Perez, 2019). Therefore, this negligence due to gender-neutral design amplifies women's vulnerability instead of using the design to reduce her risk.

When mobility design for the high-income strata of society itself fails to address the much-discussed western feminist design ontologies, to incite that the build of heavy vehicles for public transportation be gendered in a developing nation seems like a behemoth of a task. However, it is not entirely impossible.

Example 3: Unaccommodating Public Spaces

Public spaces are only as safe and inclusive as the amenities they provide. Holistic design and management of public spaces are important design decisions that must be made on a local level. An example of gender-blind design in public spaces are the public toilets in Indian cities. Research shows that women use toilets more frequently and for longer than men, and women as subjected to their roles as mothers and primary caretakers often carry large bags and take children to the toilet with them. All of this calls for differently designed toilets for them (Phadke et al., 2013). Yet the design of public toilets does little to accommodate this disparity. Further, the fact that women's toilets in Mumbai close at 9pm, unlike men's urinals that are open throughout the night, reinforces social norms that "women are not expected to – and not supposed to – be out in public at night" (Phadke, Ranade, and Khan, 2013).

The design of women's toilets, their management, and the decisions taken around it strongly oppose the idea of women claiming cities at "odd times" while ensuring that at the times that they utilise these facilities, their experience is made subtly but incrementally inconvenient, to such a point where it is easier for them to limit their movement to closer and familiar spaces to avoid interacting with public toilets.

Hence, to make spaces used by women comfortable and safe, their functioning and design must accommodate for gendered differences.

Challenging Gender Power Structures: Empowerment through Mobility and Data

These examples underline that the gender-blind approach towards development in the field of mobility hampers women's movement and contributes to the perpetuance of what women have been socialised into: to see the private space of the home as their "safe" area and the public space as "unsafe". Increasing women's mobility is thus closely interlinked with their empowerment. According to an evaluation of a women's development project by Saraswati Raju in 2005, one of the most empowering changes that women reported was simply the ability to move outside the home, into public spaces, and attend a variety of activities on their own (as cited in Hanson, 2010). Being socially and geographically mobile is generally seen as one of the central aspects of women's wellbeing (Srinivasan, 2008) and while it results in increased self-confidence, women being able to enter the public domain and talk with strangers for the first time, it also incrementally challenges gender power structures (Hanson, 2010).

Shared Spaces in amidst the City. 2021. Gangtok, India. © Twisha Mehta.

´In order to design for women, interventions require the data to make the difference´

In order to design for women, interventions require the data to make the difference – as shown in all the examples above. They blatantly highlight the staunch gender data gap that exists in India as well as other most other parts of the world. It has clearly been pointed out that India's public transport agencies don't separate their data by sex (Bhatt, Menon, and Khan, 2015) and this dearth in primary-gendered data is the root cause of having gender-blind mobility systems in the country. The current paucity in gendered data in mobility is also evidence to the fact that, "the idea that women might have different needs didn't occur to the (mainly) male planners" (Perez, 2019) reinforcing the need for a fairer representation in designing and planning for mobility.

In order to solve the women's mobility issues, there exists a dire need for concentrated data and research on women's usage and experiences within these spaces along with a channel that feeds this gender-specific information into the different levels of design for mobility. The latter is crucial because the data on women's mobility that does exist — collected by feminist researchers, scholars, and social scientists — too often remains within academic circles and rarely reaches policy-makers or institutions implementing the nation-wide, state-level, or local infrastructure, services, and interventions. Upon this backdrop, the Women's Mobility Project was formulated.

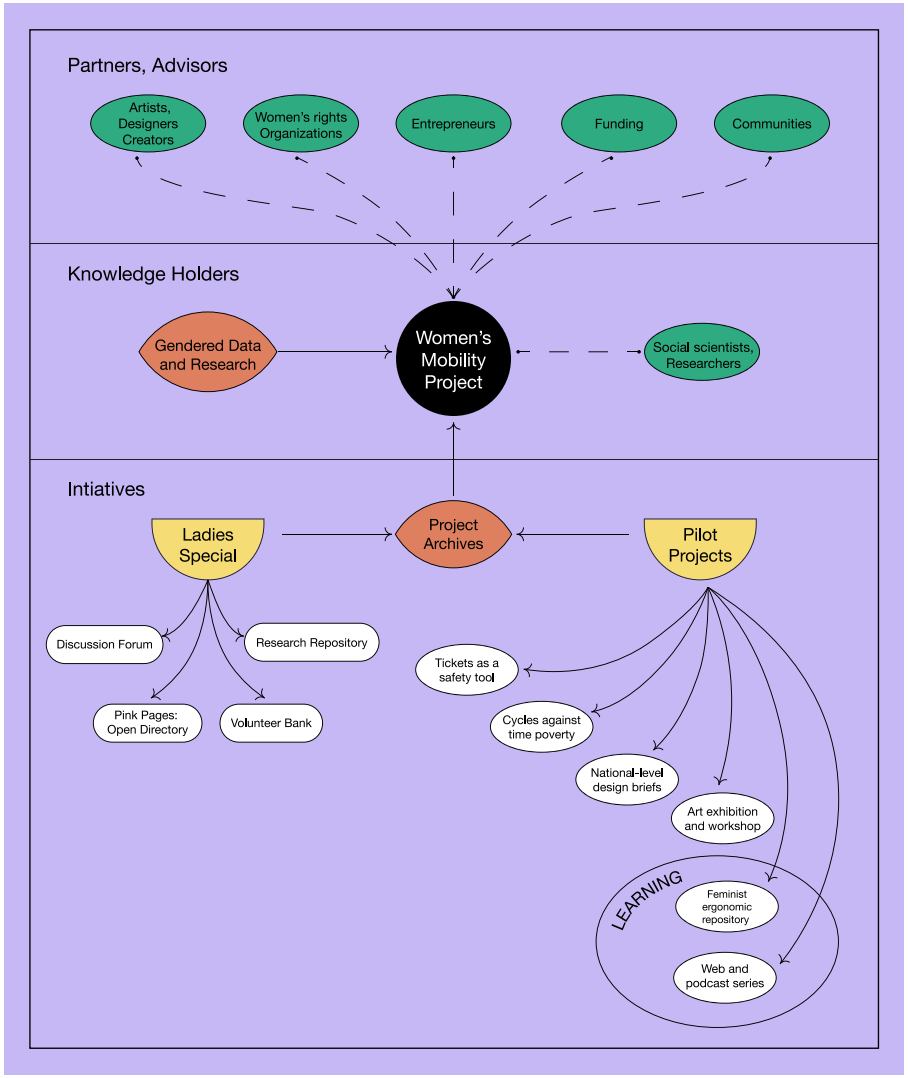
The Women's Mobility Project

Women's Mobility Project (WMP) has its roots in a systems-design project that analysed the systemic forces that influence the phenomena of restricted levels of mobility for Indian women. WMP was conceptualised based on insights generated from observations and data dedicated to the Indian scenario of women's mobility. As a group of social designers and design strategists working on a social issue that has multifaceted consequences, we analysed that women's mobility is a factor of several subsystems. Broadly speaking, these are: public spaces, transportation systems, and socio-economic systems that mirror the social structures and the wealth of nations. This approach made the process of identifying gaps, forces and influences in the system easier to conceptualise and innovate around. Our findings contributed to understanding the need for a forum that converts the issues to design interventions by connecting women-centric organisations, researchers, and communities to artists and designers to prototype and pilot these solutions.

WMP is a collective that presents itself as a forum to connect women's studies scholars, feminist researchers, social entrepreneurs, funders, management professionals, and women's communities with designers, artists, and film-makers. This forum is dedicated to designing and implementing projects that affect women's mobility in different Indian cities, through a community-based approach. WMP addresses two of the UN's Global Goals for Sustainable Development (SDGs), i.e., i) achieve gender equality and empower all women and girls (SDG 5); (ii) make cities inclusive, safe, resilient and sustainable (SDG

11). It aims to do this through distributed design principles that are based on knowledge sharing and strengthening partnerships in design.

As an umbrella organisation that plays an active role in creating independent initiatives, Women's Mobility Project leverages the design process to test, prototype, and iterate pilot projects in numerous capacities, that have their genesis in feminist academic work. With participatory design at its core, each idea will be strategised and prototyped by local community leaders to suit diverse political, geographical, and social contexts of their locality/city, facilitated by feminist designers and artists.



Conceptualising in Distributed Design. 2021. India. © The Women's Mobility Project.

Moreover, within the WMP network, the initiates do not stand by themselves. WMP's goal is specifically to mobilise support and share methodologies, toolkits, evidence, and learnings through open-source platforms from each of its projects. Offering the network and capacities, WMP intends to encourage women to launch similar initiatives in their own localities to propagate change through prototypes, while sharing data with the larger WMP community.

By primarily organising conferences and hosting forums, WMP will be involved in creating parameters that can be standardised as indices to measure women's mobility in different contexts. These indices will push the movement forward by persuading private enterprises and state governments to work towards creating a Women's Mobility-Friendly atmosphere starting locally. By using these parameters to document and refine the impact of the interconnected projects, WMP encourages governments and entrepreneurs to make these projects scalable, sustainable, and autonomous. As an organisational structure, WMP works as a sociocratic collective by distributing responsibilities and roles amongst the teams of the collective. WMP works towards a common purpose while allowing different teams and initiatives to maintain individual opinions and projects. The WMP collective's philosophy lies in providing space for each member to have a voice while brainstorming, executing, introspection, and reflecting throughout the process. The WMP collective focuses on building capacity of each of its members so that they are encouraged to initiate and prototype their own projects that arise from new findings.

Prototyping in Distributed Design: Ladies Special

A part of the Women's Mobility Project plan is an open repository called Ladies Special which acts as a collaboration hub. Currently, Ladies Special is a live multimedia document that has a resource-bank with a compilation of focused academic work, films, government schemes, budgets, and provisions that address the issues on women's mobility in India. Ladies Special consists of five broad subsidiaries:

- WMP: initiatives.
- WMP: research Repository.
- Pink Pages: an Open Directory.
- An open discussion forum for contributors.
- A community calendar to track upcoming events and milestones of diverse projects, teams, and initiatives.

In the initial conceptualisation phase of the "Women's Mobility Project: Initiatives", our core team detailed out some pilot projects. These initiatives are local interventions that address specific issues and scopes laid out by fundamental researchers in the field. The first of a few initiatives, which I will elaborate on, experiments with tickets as a tool to ensure safety. The proposal is based on the observation that women are more likely to travel during off-peak hours because of the lack of personal safety on public transport. This was noted in a study that stated how women tend to adjust their travel

patterns and behaviour according to security considerations, including the fear of sexual harassment. To normalise women being in public spaces at all times, their security concerns must first be taken care of and one of the ways to do this is to increase the safety index (Bhide, Kundu, and Tiwari, 2016) on public transport. The measurement of a location's safety index comprises three factors: the experience of harassment, the use of complaint mechanisms, and the awareness of relevant helplines (Bhide, Kundu, and Tiwari, 2016).

The public transport system is constantly trying to make travel cheaper by all means, and while doing so, it overlooks equity in movement. In our research, we found out that large percentages of the Central government's Nirbhaya Fund, a fund created to support women's safety initiatives, remains largely unused (Pandit, 2019). The WMP initiative's proposal simply reallocates these existing resources to increase the above-mentioned safety index. It does so by making the section on each ticket reserved for the women's helpline more prominent, while eliminating unnecessary information. This design intervention can increase the awareness of, and normalise the seeking of aid. A passenger helpline number is a general customer care number that is currently located on every ticket amongst other illegible information.

An initiative like this is an example of how WMP conceptualises interventions in localities where a network of researchers, designers, and communities can come together and mutually pilot a project. The impact, evidence, and learnings from the above intervention in Mumbai's transportation systems will help in scaling this project citywide, if successful. Otherwise, sharing the learnings from the pilot amongst the WMP network will help other smaller cities in creating their own versions of improving safety indices through common mobility articles – like tickets.

Other beta initiatives of the WMP Collective include:

- Testing a culturally-appropriated cycling enterprise that aids in curbing time-poverty for women from low-income households.
- Partnering with women's organisations to pitch to national organisations to launch design briefs and challenges that allow for female-centric innovation in the transportation sector (in our case, starting with suburban railways), and hence informing, educating, and pushing for a gendered-understanding of design.
- Combating the same issue on a smaller scale, WMP has created a repository of women's ergonomic issues with measurements in these trains along with relevant statistics, a list of design-industry mentors, researchers, and experts, and means to gather constraints and 3D-models of the vehicles. The aim of this initiative is to possibly launch collaborative design projects that can address the grossly overlooked needs in the country of women-appropriate train systems.
- Launching a web-series that translates mobility-related knowledge in multiple Indian languages from women's studies institutions and organisations to community leaders, designers and citizens with the goal to encourage independent bodies to build capacity and work for the cause in any capacity possible within their communities. The goal of this initiative is to interview researchers, experts, journalists, politicians and founders working in the field of women's safety and gendered transportations to dialogue and demyth the Indian mobility scenario to discuss, critique and reimagine equitable mobility and ways to push for it in the country's vision for the future.

'Partnering with women's organisations to pitch to national organisations to launch design briefs and challenges that allow for female-centric innovation in the transportation sector.'

These initiatives are research-based, and to a certain extent also produce data. Having spent time learning about women's mobility through literature reviews and reports from different women's rights organisations, it was made obvious to the core team of Women's Mobility Project that countless research, literature, and policy recommendations have been made over time by experienced social scientists, urban policy researchers, and community leaders. Additionally, audits and annual reports of different grassroot level organisations dedicated to women's safety in Indian cities have also added to numerous policy recommendations and suggestions that must be made at institutional and governmental levels. Most of these recommendations address the local needs of safety, right to the city, and gendered planning as interventions. However, there is a disconnect between the data and the implementing agency, because this research is not bundled in a way that initiative can profit from it. Therefore, another focus of WMP is to curate an open-source research repository.

The initiatives are open projects that can be undertaken independently. In order to bring the resources, methodologies, and knowledge persons required for these initiatives together, WMP compiles a directory – Pink Pages, which makes available contacts of organisations, researchers, ministries, and feminist designers and artists to connect with.

Art: A Premise for Community Engagement

Among other art-centric interventions, a work-in-progress initiative of the Women's Mobility Project is a street-photography exhibit representing women's mobility in Gangtok, the capital of the Himalayan state of Sikkim. This intervention is a result of collaboration between an Indigenous photographer from Sikkim, and myself.

The exhibit aims to expand the connotations of mobility and is coupled with an interactive workshop. The goal is to encourage dialogue amongst the community around women's agency through mobility in mountainous regions.

Sikkimese Women traversing the Hilly City. 2021. Gangtok, India. © Pagel Lepcha.

Conceptualising Meaningful Collaborations in Design for Social Inclusion

The Women's Mobility Project arose from the need to intervene in the vicious cycles that perpetuate social norms by design. India is a changing country and designing for it needs to change with the times. Not just superficial visual ways, but by changing systems to enable social justice and inclusion. An androcentric approach to design for mobility fails to integrate women into the socio-political and economic spheres, where "more and more women, especially in the developing countries, are joining the workforce, both formal and informal" (Bhide et al., 2016). Similarly, it is important to acknowledge and address the roles women play in bearing the brunt of the care economy, and design for this on multiple levels: from their representation in spaces to travel fare structures, public spaces to infrastructure. Finally, policies and national strategies are quintessential to their empowerment.

As designers, the ability to translate the observed systemic issues into tangible solutions is deemed the most plausible use of our agency. The Women's Mobility Project works with a distributed design approach to address community and individual necessities in women's mobility, and the impact of social inclusion seen as a distribution of value generated by the system among the community. Importantly, the distributed design intervention is based on the principle that combining a systemic understanding of the issue through discourse and dialogue with available toolkits and a supporting network of experts can mobilise citizens and organisations to be agents of change. Hence, the designers' role here is to stand as translators between agencies across domains that we believe add value to the cause by adding value to one another.

Considering the multifarious independent bodies working towards solving isolated instances of the issue, the WMP wants to seize the opportunity to solidify the community by bringing them under the same goal of a safer, more equitable society. Through an open design community working for a singular cause, the project empowers those affected to intervene in indigenous ways, thereby applying a working philosophy that is sociocratic, women-centric, locally productive, participatory, democratic, systemic, inclusive, experimental, iterative, and open-source.

WMP conceptualises in distributed design principles in order to design for women's mobility by creating the following opportunities:

- Applying regional networks: WMP contributes to a shared metric to evaluate progress towards growth and self-sufficiency in different regions through a dashboard and a directory (Pink Pages).
- Ecosystem for knowledge sharing: this aspect, in particular, is addressed by the Ladies Special platform. Here, the focus is on distributed and decentralised repositories and value exchange mechanisms for transdisciplinary collaboration for transformation in women's mobility.
- Shared strategies, adapted to local needs: WMP will hold and participate in global conferences, programs, podcasts for feminist mobility systems. Further, WMP and its prototypes will implement and deploy strategies learnt and adapted from these programs.
- Distributed incubation for women's mobility: WMP works on channelising the power of a distributed network of knowledge to conceptualise, design, and create initiatives
- Distributed infrastructure for innovation in women's mobility: WMP builds on people, communities, and virtual spaces (e.g. Ladies Special).

As creators and generalists, our ability to create platforms for informed dialogue is a huge step towards fighting against patterns that are a result of multi-scalar and multifactorial procedures, and deeply rooted in social norms. By providing these forums of exchange and filling gaps in communication and representation amongst experts, we can use our skills to paint a finer picture of women's mobility in order to push for and guide discussions for change. True breakthrough that will change the course of women's inclusion will come from individuals, creatives and networks of feminist researchers, entrepreneurs and communities.

CHAPTER 5

Collaboration and Connection

Distributed designers are connected at distance by digital platforms that not only transfer data, but act as portals to like-minded collaboration networks. The Platform aims to support and provide visibility to makers and designers and the local-to-global potential of distributed design contributes to this, by humanising processes. The local impact of a designer in a community can be scaled to the network through shared knowledge and open design. This chapter covers examples of such collaboration in the Platform including co-design methodologies and train-the-trainer education programs.

What Kind of Openness is Consistent with Distributed Design?

The vivihouse Case: How Commoning Could Lead the Way.

Nikolas Kichler from vivihouse

In this article, I will share our thoughts on behalf of the vivihouse team on openness that lead to commoning. First, I will start with introducing the vivihouse project and then describe our insights via three steps.

Introducing vivihouse

vivihouse is a building system with the aim that as many people as possible can use it for planning, realisation and circular-resource flows. It should serve as a comprehensible construction kit for planners so that they can create affordable, ecologically sound buildings independently and in harmony with local conditions.

The building framework is therefore modular, allowing each element to be planned and built separately, while all parts remain compatible making up to six-storey buildings possible. In a way, we have applied the mechanics of open-source software to this building system. This construction kit can be conceived and expanded as a library, so that new technologies, approaches and applications can be constantly added. It is our ambition for example that each element can then be adapted to local building regulations or climate zones with just a click of a mouse.

The planning phase was designed to make production low-threshold as well. For the basic models, an electric screwdriver along with a few other hand tools should be sufficient to prefabricate the elements in a safe, ground-level production room. High-tech should by no means be excluded: those with advanced access to tools and knowledge may automate these processes, for example.

Once the building structure has been built, the interior should then be adaptable to the changing needs of its users; all kinds of mixed-use scenarios should be feasible with little effort. And last but not least, the freedom of action of future generations should remain unrestricted. Therefore, the buildings can be dismantled, transported and reused in new configurations. In this way, the elements either take part in the circular economy or will be composted. So much for the concept.

In mid-2017, we started the planning and engineering phase - as architects together with civil engineers and building technicians. In 2018, we managed to build a first one-storey prototype, mainly made of wood, straw bales and clay. Then, in the summer of 2020, we built a three-storey prototype that incorporated all the elements of the first prototype, which was prior to that being dismantled. A few of the building elements were designed by architecture students. The pre-production process was guided by straw bale construction trainers. About 100 international students and other enthusiasts managed to build almost all the necessary elements themselves. The assembly on site, on the contrary, was carried out merely by professionals. In total 50 supplier companies were involved.

`This is Distributed Design` Documentary still frame

Openness as Unrestricted Open-Source Licensing

Having had this prototyping phase, we were ready to open the project to a wider audience. We quickly identified a first major difference to open-source software: while almost everyone has access to a computer with which software can be compiled, not everyone has a few hundred square metres of production space and tools at hand.

When completely open knowledge is dependent on material resources and production facilities, it seems that those with market power get structurally advantaged (Helfrich, 2020). The original purpose of open-source was to protect works as commons by preventing players from enclosing them so that they remain accessible to the public. The central question hereby is: what is the validity of this idea if this knowledge relies on production facilities and raw material sources that are proprietarily exclusive? Why would makers that prefer open ecosystems want to shift the power imbalance further, in favor of the established and exclusive market powers? Why not foster accessible means of production that actually would meet the collaborative modus operandi instead?

So if we were to open vivihouse with a simple open-source licence, we would automatically privilege those who have access to adequate production halls. In our case, this would be the well-established timber industry. It can be safely assumed that for instance the Open-Source Wood initiative, which is hosted by its industry, primarily helps to benefit them from the sale of its timber products, on which the open-source projects rely on. This is worth noting since many open-source business models take advantage of scarcity and dependencies - things that we find not consistent with the long-term distributed design vision.

We want to think about how we can create a kind of reciprocity that serves our livelihoods while increasing the capacity of setting up open production facilities and access to raw materials, while not losing the idea of openness and collaboration. From a vivihouse perspective, large-scale production facilities are urgently needed.

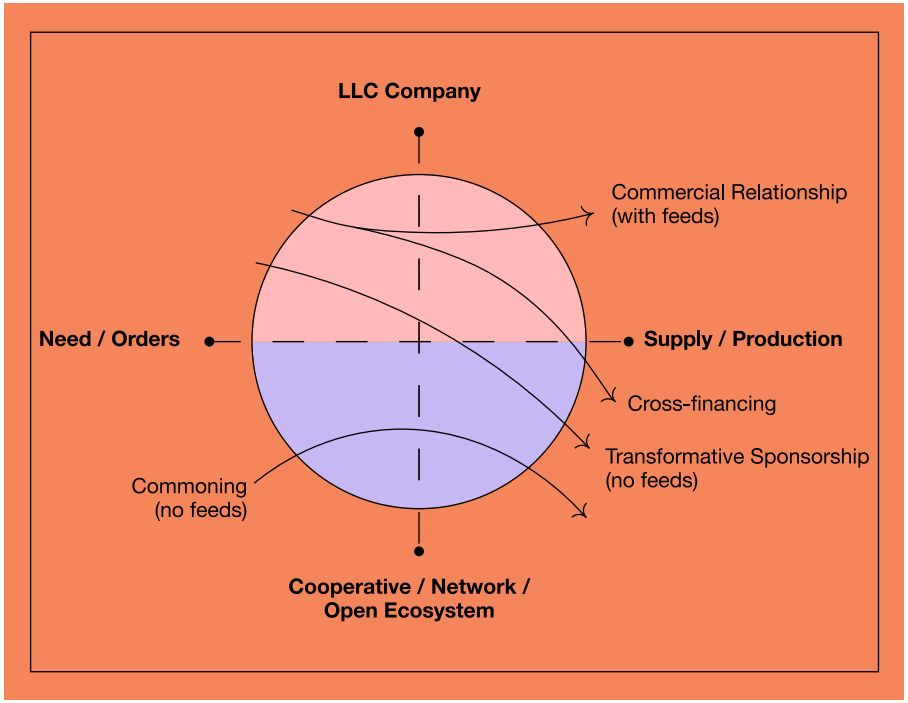
Openness through Distinguishing License Models

2018 we came across a licence router named Coopyright[18] by La coop de Communs in France. It uses Creative Commons variants and determines which licenses apply in which cases and what fees can be charged and when. Specifically, Coopyright distinguishes between commercial and non-commercial contexts. Fees are charged from the commercial context to cross-finance the non-commercial context. This seems counterintuitive at first, because the familiar Creative Commons licenses like CC BY-NC (Creative Commons Attribution-NonCommercial) would not allow such an approach.

With this distinguished approach, open-source can be applied 100% in the non-commercial realm, fulfilling its original intent of distribution, abundance and serving the community. This is achieved by setting it apart from the proprietary world while offering links with like-minded partners. It enables us to work together openly across projects and organisations, while being financially backed by commercial clients. Within the ecosystem, market prices and middlemen can be ignored as if they were one team, where financial flows are transparent and organized to best meet the needs of the producers, consumers and facilitators.

The terms and conditions can be set by each association - not by an external exclusive entity. Overall, this ensures that the aspects of openness, integrity, creativity and agile manageability can be maintained by the contributors themselves. The biggest challenge here is to verify whether licensing conditions have actually been respected when intransparent companies make use of copyrighted works and incorporate them into their exploitation chains.

Three storey vivihouse-prototype in Vienna. 2021. Robert Lichtveldt. Copyright.



Relationships across the open ecosystem and the commercial world (draft). 2021. Nikolas Kichler. CC-BY-SA.

Openness Through Commoning

The biggest mental step for us was to think vivihouse within the framework of the commons. Per definition, “commons refers to resources that emerge from self-organized processes of shared need-based production, governance, maintenance, and/or use”[19]. These overlapping activities are also known as “commoning”. This definition already points out: it is about the whole package: knowledge, natural resources and social processes such as governance, go hand in hand. Many of our concerns can be answered herewith.

Julie Ristau outlines how the word commoning thus brings to life the essential social element that cannot be addressed through licensing conditions. The act of commoning is based on a network of relationships formed under the expectation that each person will care for the other, with the shared understanding that some things belong to all of us. The practice of the commons shows a shift in thinking from the prevailing ethic of “you’re on your own” to “we’re in this together”. Therefore, it is much about co-creating the world we want to live in without being locked into profit-driven mechanisms of the market or depending on government funding (Ristau, 2011).

This would mean for us designers to shift to the needs of the community itself — about what makes us self-subsistent and self-supporting beyond dominant paradigms — whether it’s about food and energy production or mobility. More precisely, the question is: how can we reduce the dependency to outside forces while imagining and pursuing new ways of life?

Commons research became especially known by Elinor Ostrom, an American political economist who wrote the publication Governing the Commons: The Evolution of Institutions for Collective Action (1990). As a result, she identified a total of eight principles that were embedded in all of the successful common pool resources she studied. For example, the need for clear boundaries was one of them - something La Coop de Communs already implemented (Ostrom, 2009).

Much can also be learned from Silke Helfrich and David Bollier about more detailed patterns for commoning. For example, in their newest book Free, Fair, and Alive: The Insurgent Power of the Commons, they point out that these boundaries should by no means be understood as hermetic closures, but rather remain open to the stimuli, interactions and energy flows of the outside world.

Conclusions for vivihouse Project

For now, we are considering creating a vivihouse organisation based on two legal forms. For this, we intend to have a cooperative for the open collaborative ecosystem and a limited liability company as an intersection to the conventional business world. The business model targets customers who want to support the Distributed Design Platform community and ultimately finances actions of the cooperative wherever there is still a dependency on the market economy. These actions include setting up open and collectively managed production infrastructure, and securing access to resources such as forests.

The cooperative works with a combination of fully open-source vivihouse plans and a kind of internal open-source that stays within the community - to prevent a hidden reprivatisation from the proprietary world so that the vivihouse company can safely stay a main provider. Furthermore, the purpose of the cooperative is to connect like-minded peers to collaborate across the Distributed Design Platform ecosystem to become mutually independent: knowledge, risks and infrastructure can be shared, long-term developments can be aligned, projects can be made interoperable, production and purchasing communities can be formed, and so on.

The LLC company, on the other hand, takes care of customers, resource flows and partner companies that currently cannot be provided by and through commoning. We are still in the process of doing the calculations. Probably public support will have to complement this process.

In any case, we believe that such a path is consistent with both the idea of distributed design and commoning. In this regard, we would very much like to continue the discussion - by sharing and developing the patterns of commoning that are specifically relevant in the distributed design world.

From FabZero to FabHero

Maker Education Building Community from Home.

Dr. Maria-Cristina Ciocci and Marieke Deckers from Ingegno Maker Space Belgium, Dr. Benny Malengier from Ghent University, Dept. MaTCh, Faculty of Engineering and Architecture.

Where distributed design does not only refer to bits and atoms, but also the distribution of knowledge and opportunities, the Ingegno Maker Space encourages inclusive programs creating inspiring content and strategies to bridge the gap between science, technology and education. When the COVID-lockdown happened, we realised that even Maker Education in the informal context had to adapt. Now, more than ever, Lab and material-based learning activities have to adapt to the circumstances to keep empowering a generation of future innovators. As a response to the need for high-level inclusive maker training in times of COVID-crisis, we launched the FabZero: Inclusive KETs program, working out a sustainable network between maker spaces and social organisations to fight digital exclusion and promote digital fabrication, (De Creatieve STEM, 2021).

We implemented an adaptive, blended and distributed system that allowed us to not only engage but also retain a diverse and gender-balanced group of makers between sixteen and sixty-five years old and most importantly to explore new ways for inclusivity. The architecture of the system made it possible to focus on helping each individual thrive, to maximize the joy of learning and making and connecting with a group of peers while minimizing the fear of failing or of being excluded. Exploiting the open-source philosophy led to a professional but empathic knowledge sharing system where we could create a sense of belonging for everyone, though the community mostly worked remotely from home.

The Five Levels of Synergies of FabZero: Inclusive KETs

We wanted to create a way to teach making to young people (under sixteen) and counter digital exclusion, which can be triggered by social and cultural barriers such as low education levels, limited access to equipment, gender exclusion or being a non-native speaker. We wanted to reach the so-called unreachable, especially women. The goal was to engage and retain them in a fast-paced, high-level training program inspired by the international FabAcademy program, (FabAcademy, 2021). To do so, we set up a cross-sectoral collaboration between non-profit organizations, makerspace, experts from different fields, and institutions with research labs, to offer a diverse program articulated on five levels.

- A network of makerspace, embedded in local communities and geographically spread out, organizing open labs. An open lab provides free access to tools for all and provides free materials to experiment with. Also during the COVID-crisis, the labs are accessible via reservation, and in case of total lockdown, a service of lending (small) equipment or doing jobs (cutting, 3D-printing, …), on-demand was set up.
- An intensive multidisciplinary modular training program structured in two phases:
  - Four months of intensive learning: 12 modules over 16 weeks with weekly online lessons (live streaming) by experts and weekly open labs to complete the assignments guided by the local instructors and the maker- community.
  - Three months of project development: plenty of time to create an integrated final project according to one's goals and wishes, advised by the expert lecturers and the local instructors.
- Train the trainers targeted to social and youth workers to master a specific digital tool so that they can integrate making into their practices and promote association with makerspace communities.
- Inspiring workshops on Key Enabling Technologies (KETs) to trigger the curiosity of young and old and to help identify highly motivated young adults willing to enrol in the four- month intensive training program.
- Bootcamps for teenagers to let them discover the power of making. These cover a diverse range of topics: hacking fashion (textile & electronics), digimaker (fabrication tools & techniques, see image 1), fashion tech (fashion design & technology) and WiFi robots (Arduino & laser cutting).

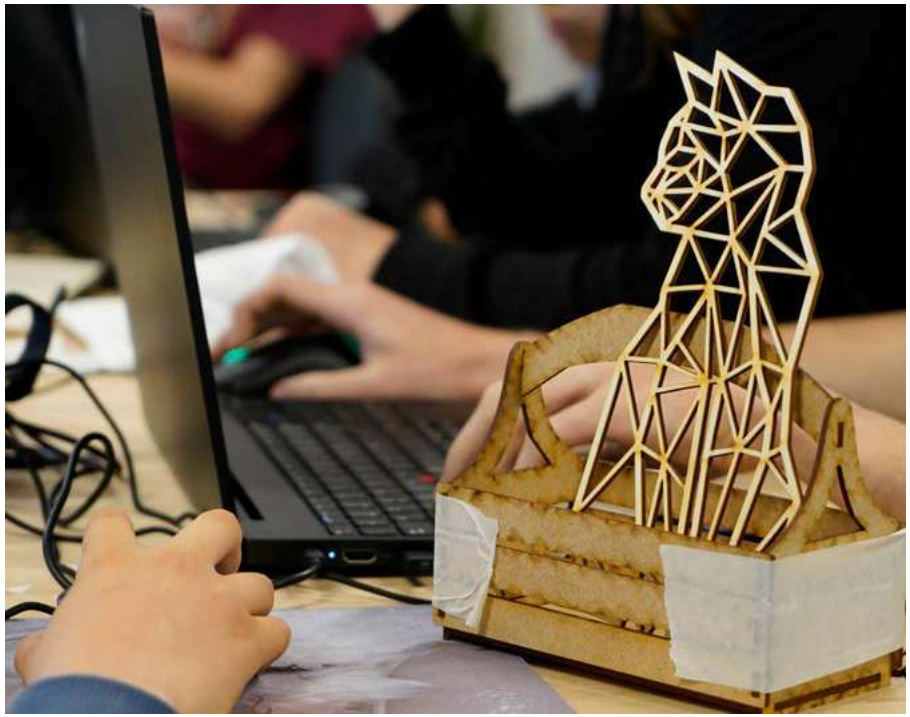
The core is the intensive FabZero training, which forms the heart of a learning community tuned into the philosophy of open-source and of sharing knowledge. In the following section, we explain the core in detail. There is a large group of people who had a good non-related background training, and a large interest in making, but who see too many barriers to start making or to engage in formal schooling. Lack of access, gender unfriendly environments and lack of sufficiently high-level training spread out over a long period allowing a match with work or school situations, holding them back. They could become Fab Heroes inspiring their community, but instead, they feel frustrated and isolated. The FabZero training aims to find them, reach them, and engage and retain them. Also, after completion of the program, those who show interest and capabilities are offered a grant to enroll in the international Fab Academy.

Social workers are crucial in systematically reaching underprivileged groups. This means that activities are widely accessible within local communities, allowing different groups to learn from each other. In addition, ad hoc customized systems are set up, for example, a buddy system, where buddies enroll in the

FabZero training program to become experts in a specific tool/technique and then reach out as volunteers to the youth who, for various reasons, cannot overcome the threshold of engaging in the intensive program.

A key aspect is the passion of the expert trainers. They are specifically selected, based on their expertise and attitude towards open-source philosophy, their teaching qualities and readiness to engage with the participants in an informal setting. Much is asked from the expert trainers, (online) sessions are done in the evening (18:00-21:00), practical sessions can happen on Saturdays, and everybody is encouraged to use social media for quick feedback. The FabZero training thrives on passion and sharing.

We truly believe that when open-source and sharing become a way of life, the unreachable becomes reachable.



Bootcamp partipant creation (2020, MaM, Bruges, De Creatieve STEM, cc-by-sa3)

Adaptive Training: When Zoom and Open Labs are Combined in Distributed Blended Learning KETs

The intensive modular training is organised according to an adaptive, distributed, dual and blended learning system in which the enrolled participants, from all over Flanders, connect globally by online, weekly Zoom live-streamed classes, taught by experts, but are also followed-up onsite or online in local makerspaces with hands-on practice on the various aspects of digital fabrication and their class assignments. For Flanders, this means, for example, collaboration with labs in Bruges, Ghent, Kortrijk, Antwerp, Hasselt, Brussels and more, creating a distributed network where participants can hone their skills.

A dedicated chat group on Signal and an informal weekly online Talking Café, Kerre's praatcafé, were set up so that the enrolled participants could easily reach out with questions, share results and inspire each other. The combination of the two resulted in a powerful tool creating a very accessible way to information, advice and support. In addition, everyone could indulge, deepen and broaden themselves during the open labs located in their neighbourhood. Despite COVID-19 restrictions, local labs ensured everyone had access to materials, which were distributed through the labs, and could book in-person machine time and borrow small equipment. The making could always go on, thanks to the combination of online and offline.

To encourage participants to not only follow the Zoom sessions from home, FabZero on tour was also started. That is, the livestream coordinator travels weekly from lab to lab, inviting the people of that region to join the live stream from the lab in a COVID-safe way .

This yielded a great boon to the community-forming aspect, as participants were aided in leaving their comfort zone, and overcame their psychological barrier to visit a local lab for the first time.

To provide for a group as diverse as possible, a diverse program was paramount. So, the four tracks within FabZero were born, each with a different focus and each consisting of five to twelve modules and a final project. Also, additional "wild cards" on various topics were offered. Each track had at least 45 contact hours via live streamed sessions plus 40 hours of independent work. For the final project, we provide at least six contact hours and depending on the personal choice, the participant dedicated at least eighteen hours of independent work, (De Creatieve STEM, 2021). The four tracks are:

FabZero basis

Training in basic digital production techniques articulated over a series of fixed modules and choices among three sub tracks: programming for makers, materials for makers, CNC milling. The set-up of this track is given in image three. The list of modules is as follows: M0: Intro & Kick off - Google drive, MIRO and DIY photo studios; M1: Laser Cutting & plotters. Getting started with Inkscape; M2: 2D-digital design with Inkscape; M3: 3D-printing and 3D-digital design with Tinkercad of Fusion 360; M4: Materials & design; M5: Prototyping principles; M6: Basic electronics; M7: Digital Embroidery & introduction to smart textiles; M8: Basis Arduino; M9: Product presentation; M10: Laser Cutting: from 2D to 3D; M11: CNC milling; M12: Programming for Arduino ;M13: Python en Raspberry Pi; M14: App Inventor en AI; M15: Materials for makers.

FabZero IT for makers

Training for those who already have some IT background but want to explore more specialised IT for maker subjects which always make the news, but are

not taught at school yet. This consists of modules covering Linux, Raspberry Pi making, Artificial Intelligence applications, Python and more.

Fabzero Mix and Match

Within this program, the participant could combine modules from FabZero basis, FabZero IT for makers, and Wild Cards according to her/his specific interest, background and level.

FabriZero

With FabriZero, we aim for a digital-making approach within the field of fashion, where many women of our focus group are active in or have such interest. Focus is on fashion technology and smart materials, with modules on digital cutting and design, digital embroidery, e-textile, 3D-fitting simulator and more.

Ongoing openlab in the Ingegno Maker Space (2020, IMS, Ghent, De Creatieve STEM, cc-by-sa3)

Learning + Making + Sharing: The Foundations for a Flemish Maker Community

People participate in the FabZero project for various reasons and are coming from all provinces. Here we present some of them. No actual names are given for privacy reasons. Inspiring final projects realized in 2020 can be found in the online shared publication Inclusive KETs FabZero Graduates 2020 (M. Cristina Ciocci, 2020).

S., K., S., three female participants with immigrant background, focused on embroidery, laser cutting and basic electronics. They were approached by the partner social organisations working in their neighbourhoods and learned about the FabZero project this way. They could be convinced to sign up for part of the FabZero modules and are now actively volunteering in different non-profits to guide digital fabrication activities targeted to children in vulnerable situations.

V. is a volunteer in a social organisation who is looking for a job. He is interested in digital fabrication and understands how important STEM literacy is for himself and the young people he volunteers for. He joined the program in a buddy system for the organisation JES Gent. With the lessons learned, he adapts the program of JES to young people by working out workshops they can attend in their trusted and safe environment. In this way, he becomes a FabHero, multiplying the effect of the FabZero project.

K. and R., male and female participants with an immigrant background, and both looking to reorient their job career for better opportunities, enrolled to strengthen their C.V. We could reach them thanks to the collaboration with a non-profit social organisation in Ghent. K. is now employed by the organisation and is setting up a social inclusive maker space in Ghent. R. now feels confident enough to start his own business.

M. and K. are female participants who work at their 2D-design skills, aiming at setting up an Etsy shop, with a focus on laser-cut (decorative) designs and embroidery. We could reach them thanks to the effort of the networks in Bruges and Ghent.

C., a young mother with a toddler, combines the different tracks with her own distance learning for graphic design at college. Her final goal is to find a job in the creative sector. She joined the program thanks to the effort of the network in Kortrijk.

G., a male participant, started with many doubts about the FabZero adventure. His autism prevented him from daring to take the leap on a whim. Only after a first acquaintance with Ingegno Makerspace and the people behind it, did he dare to subscribe to the program. Quoting him over the experience: “It’s intense, not basic for me, but the assignments after each online class ensure that I effectively go to an open lab to do it in practice. In this way, I get to know other participants and how the Fab Lab works and I feel that the community is growing. And that is what I need to manage with my autism.“

G. female participant: “I enrolled because I hope that going digital will help reinvent myself in my creative job as a self-employed clothing and accessories designer. My arthritis is slowly preventing me from carrying out the craftwork. Learning to work with a laser cutter, plotter and embroidery machine is vital. But I have no background at all in digital design. So FabriZero is just what I need and the community is so supportive. And with the classes online, I can combine it with taking care of my family.”

M. is our youngest male participant: he is thirteen and gifted. He is experimenting with IoT and AI and looking for a welcoming community to belong to. Several gifted people are present in the FabZero tracks, as the standard school has difficulty keeping them engaged and motivated. The maker community and the chance to experiment is ideal for them. Each technique learned can be tackled on different levels of expertise, the only limitation being the effort you want to put into your designs. The open labs and the interaction with the maker community support the intrinsic motivation needed to transcend yourself.

Anthony, manager of Makerspace Antwerpen, is enthusiastic: “We are delighted that women are now also coming to Makerspace Antwerp thanks to the FabZero project. They have completely mastered the laser cutter and 3D-printer. We are delighted that they are going to explain everything to the men afterwards!”

These testimonials show how the FabZero: Inclusive KETs project influences the Flemish Maker community and makes it more inclusive and inviting. A lot of hard work is needed to reach possible participants, to convince them to join, and to have them put in the work required to master the subjects. Everybody can

participate at her/his own pace, as there are no tests and there is no grading. Yet, the goals of the project are reached with a vibrant and inclusive community being formed. This is, in part, due to the way the project is set up with actors from a diverse group of organisations, with high-quality lessons taught by an expert in the field and well-stocked welcoming labs that open their doors, but it is mostly due to the participants themself, who with some peer-pressure, push to obtain the best possible results. No judging is done at the end, all participants are winners, and an expo of the achieved results puts them all equally in the spotlight.

Taking into account only the enrolled for the intensive training, we reached, in 2020, 39 people of which 30% were female. In 2021, we have 60 enrolled participants of which 60% are female. If we account for the train-the-trainers, open labs, bootcamps and one-off workshops, we reached 1,750 people in 2020, of which up to 60% are in vulnerable situations and 45% are female.

Conclusion

We implemented an adaptive blended and distributed system that allowed us to not only engage, but also retain a diverse and gender-balanced group of makers between sixteen and sixty-five years old and most importantly, to explore new ways for inclusivity. Namely, we set up an interregional network covering five regions with eighteen partners to run accessible open labs and inspiring workshops next to an intensive training program. The open-source and empathic approach in combination with the training of social workers in the basics of digital fabrication made it possible, not only to engage a diverse group of participants for the intensive program, but also to work on five strategic needs:

- Sensibilizing young people to (digital) entrepreneurship and ownership of knowledge, specifically those related to KETs feasible without a master's degree, so that they are aware of what these skills can mean for them.
- Offer specific new and relevant attractive medium-term digital courses for young adults, to develop digital technological insights that can be deployed in new markets.
- Create an un-gendered and diverse environment within Fab Labs and Makerspaces (where open labs and local support is given).
- Upgrading the employees on the field and the trainers of the specific courses and employees in makerspaces.
- Accessibility and affordability of labs in one's neighbourhood.

Thanks to the synergetic collaboration with social organisations and the interaction among the three blocks, openlabs-workshops-intensive program, we could focus on three specific digital profiles (Mariën, I. et al., 2019).

- Unexpected digital masters: they are completely digital, despite the social or economic context in which they live. They are ideal for supporting others in their environment, but need a lot of support themselves to take on that role. Even if they want to, there is still a great gap between wanting, being able, and doing.
- Digital fighters: they are highly motivated but they struggle to find the right support to put them on the right path. They can easily get lost if we don't provide enough digital opportunities to support them. Extremely important factors for them are autonomy in use and "soft skills" such as self-confidence or the ability to ask for help.
- Digitally self-excluded: these are the people who choose to avoid all that is digital. You could then ask the question: at what price do we provide them with extra opportunities? But if you also take into account the "digital outcasts" or the "digital fighters", the answer will look different again. By taking local action, including actions that also target children, you can involve them and motivate them to open their eyes to a whole new world.

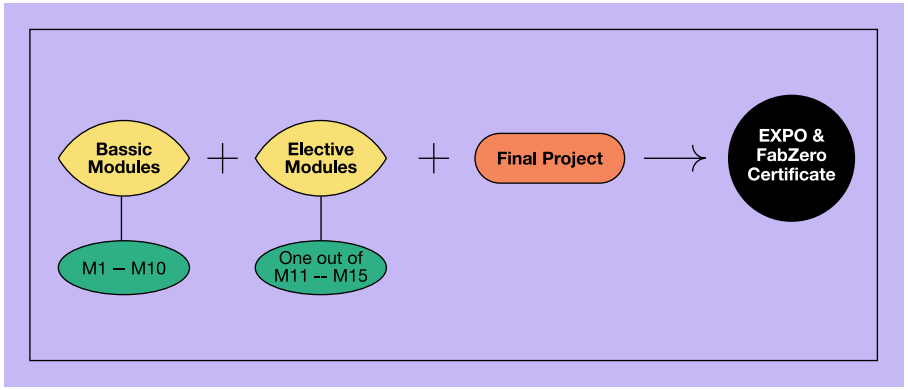
Thanks to the financial support of Digital Belgium Skills Fund in 2020 (Bosa, 2021), the FabZero project is now in its second working year and is becoming ever more distributed and reaching growing numbers of participants.

The adopted strategy reinforced with co-creation, self-management and commitment, let us embrace the objectives of the Digital Belgium Skills Fund (Bosa, 2021) in a structural way. We specifically contribute to the deployment of digital skills, the increase of employment opportunities and/or economic independence, reaching socially vulnerable individuals, and increasing public support for digitization, all core goals of the Digital Belgium Skills Fund.

Usable outputs of FabZero 2020 and partially 2021 (still ongoing) are:

- The Inclusive KET's FabZero Graduates 2020 booklet.
- The end report in Dutch and video's.
- The book Codename:Nanodrone II.
- The easy overview of inclusive open labs in Flanders The PCBs design in KiCad video lessons and the Basis Electronics lessons, both in Dutch

All stakeholders together form a dynamic network with dynamic pathways to inclusivity based on: establishing a sense of belonging, empathic leadership, maximizing joy of learning & making, focussing on helping each individual thrive. The open-mindedness, trust and equality as co-creators brought diversity to the whole, with lasting positive change in the Flemish maker community.



Overview of the setup of the Fabzero Basic track (De Creatieve STEM, cc-by-sa3) Creatieve STEM, cc-by-sa3)

Subjective Machines: Distributed Design Across Oceans

Clément Rames, Francisco Flores, Inés Macarena Burdiles & Verónica Agreda de Pazos, Master in Design for Emergent Futures at IAAC Alumni.

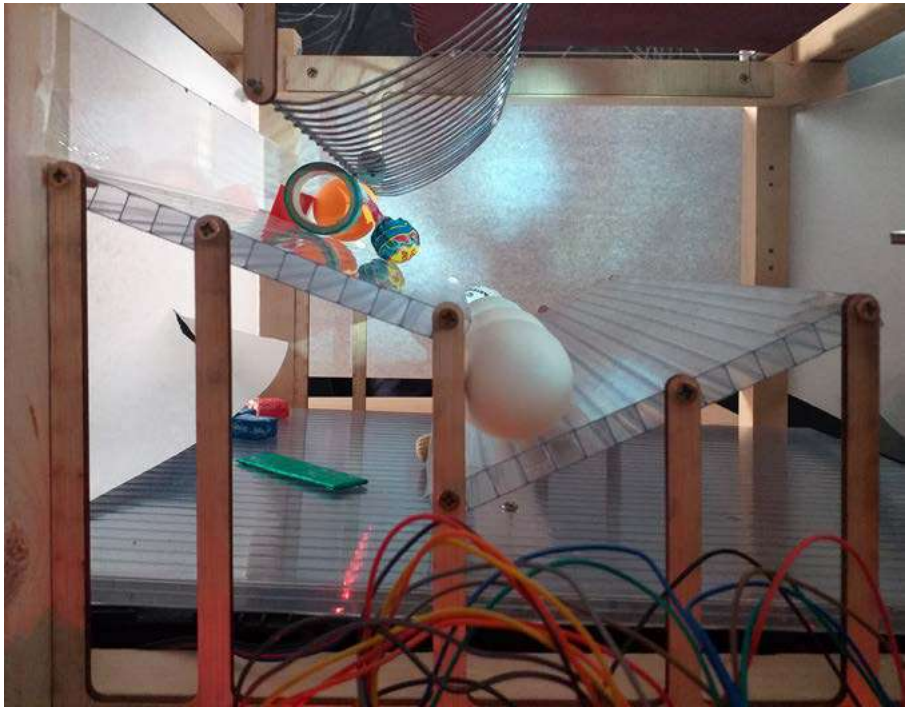
Introduction

The Subjective Machine is the fruit of a collaborative hands-on learning experience of distributed design in the Master in Design for Emergent Futures (2020-2021). The story of the Subjective Machine started when the Fab Lab Barcelona team challenged us to build an "Almost Useful Machine". Since one member of our team was living in León (México) and under virtual education, we decided to prototype and build the machine simultaneously in Barcelona and in León.

Using the verse form of a Haiku (short Japanese poem), we brought to light the essence and characteristics of our Subjective Machine. Writing it, we discovered that the objective of our project was twofold: designing a functioning machine effectively, embodying the concept of subjectivity; and building it on both sides of the Atlantic using e-waste as raw materials. On that basis, we realized that we were going to raise twins, with the concept of subjectivity as its common core, the code as its DNA, yet with distinct organs.

The Subjective Machine asserts that while technology is often thought to be neutral or objective, it is always culturally and politically situated. Any product or service reflects the identity and worldview of its designers. As "things" become increasingly "smarter", we believe it is essential to acknowledge their inherent subjectivity. Besides, the tools and devices we use on a daily basis deeply influence how we live and work. The Subjective Machine was born out of these collective reflections.

At the same time, the rise of open-source software and distributed version control systems have enabled large-scale distributed collaboration in the software world. The saying "one hundred thousand heads think better than one" is widely accepted amongst software developers: global collaboration has become the norm. Distributed Design is aiming to bring this paradigm to the physical world. In the face of the environmental emergency we are facing, this transition is not only desirable: it is necessary.



The subjective machine, Barcelona version. 11/2020. Barcelona. Inés Macarena Burdiles.

Background: Almost Useful Machines

Access to technology has been greatly democratized, yet the inner workings of our devices are increasingly concealed. The average user experiences technology as if looking at an iceberg: the tip is visible, but most of it remains unseen. A large part of the operation is conceived, designed, controlled and optimized under the hood and hidden in a "black box".

In addition, most parts of contemporary consumer electronics are made of casted plastic and their electronic components are mass-produced and sealed. This makes it difficult to buy or replace parts; or sometimes the replacement parts are not available in the market. Typically, it is more expensive to repair a machine than to buy a new one. This generates tonnes of e-waste every day, harmful for humans and the environment alike.

The hands-on learning methodology of the Almost Useful Machines workshop pushed us to expose the "black box". We performed a post-mortem autopsy of discarded electronic devices. In Barcelona, we chose the devices and materials from the Fab Lab's trash and we exchanged some components with other teams (a printer-scanner, a Mac computer tower, a landline telephone and a video projector). In León we had to work with the available devices and materials (a stereo sound system, tape recorder and CD player).

During the exploration, we discovered the mechanics, dismantled the electronics, and researched the characteristics of the encoders and controllers. Even if the available components in León and Barcelona were completely different, our concept, the sketches and the design process gave a sense and a functionality to the dismantled parts. We had what we needed to start building a new machine: the Subjective Machine.

The Subjective Machine

We wanted to create a machine conveying a feeling of surprise and fun, that does not have a clear function, that instead of interpreting logically, its inputs would return an unexpected output. If you give the machine a candy (input), it could give you back a ping pong ball, a lollipop or a coin (output). The concept should be open to the spectator-user's interpretation and experience.

Tangibilizing the concept of subjectivity was a great design challenge. To accentuate the feeling of surprise, the fun and the logical and functional disruption, we built a mise en scène with four components: shadows theatre, mechanics (inspired by kinetic-art), colour and code.

To recreate the Distributed Design version of the Subjective Machine in other latitudes, we just needed to materialize the concept and replicate the code. We can build one using local e-waste, available tools and the same code. Nevertheless, it is desirable that the machines share an input and output mechanism, a series of trays to trap the entering objects, a structure for the mise en scène to adapt a translucent envelope and changing coloured lights or an enlightened prism if we want to create the same effect.

A Circular Vision for Electronics

The cost of e-waste is enormous towards the environment: it is the result of hyper- consumption. A circular economy is a system in which all materials and components are kept at the highest value at all times, and waste is designed out of the system. To build a circular economy, electronics products need to be designed for reuse, to be durable and apt for recycling.

We decided to embrace durable design to ensure that the electronic devices will be kept in circulation for longer. While designing the Subjective Machine we used a "system and subsystems approach". In the design, we revealed the electronics and we kept the circuits and components apparent. We used discarded wooden sticks and a detachable building system with bolts and screws. The machine can be disassembled and all the components can be reused.

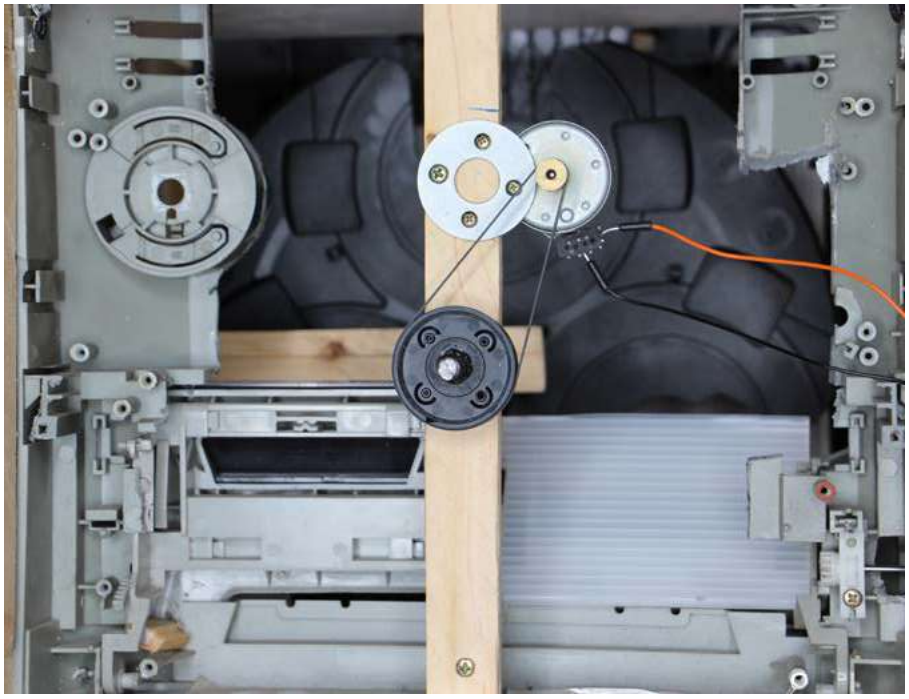
The Barcelona's Subjective Machine works with three different motors obtained from the dissected inkjet printer-scanner. The first one drives a rotating belt to receive and drop the incoming object inside the machine; the second one, enables a moving tray that hands a different object; and the third one, rotates a glass prism creating the color and light effects of the shadow theatre.

The León Subjective Machine is made of a stereo radio tape and CD player. Locally, the available mechanisms were the CD and the tape-loading docks, some gears, plastic belts and motors. Both machines share the system and subsystems: the input mechanism, the output mechanism, and a structure that places these in space with a series of analog trays that trap the objects inside covered by a translucent envelope lit from the inside with changing colors while the machine is working.

While constructing the machine in León, we needed to trade parts with a person from an old, humble repair shop. Thinking collaboratively crosses borders. We realised that he had — by his background and experience — empirical knowledge analogous to our tutors'. He helped us locally to understand how the energy, the motors, and all the parts of the stereo worked. He traded with us the circuit boards of a broken voltage regulator for a homemade one and a colorful LED strip.

This shop was located in difficult social conditions due to violence and poverty. Repair shops like this are the cheapest and most reasonable option for people to keep using their domestic appliances without having to buy another one and discarding the old one (programmed obsolescence).

These almost extinct repair shops could serve as an important role in the Circular Economy model and enhance social mobility. For example, we could replicate the Almost Useful Machines methodology in collaboration with such repair shops. They could help their local community gain technological literacy, and awareness of hyper consumption and e-waste production.



The subjective machine, Barcelona version. 11/2020. Barcelona. Inés Macarena Burdiles.

Crossing Borders: Diversity, Creativity and Technology Enabling Distributed Design

Embracing diversity was central to our team. We are three women and two men, and come from different professional backgrounds: architects, designers and engineers. We belong to different cultures - Latin America and Europe - and different generations: X, Y (millennials) and Z (centennials). We speak two different native languages - Spanish and French - but use our own version of English to collaborate.

´Creativity, working in multicultural teams, empathy, cognitive flexibility and communication skills were key elements throughout the process.`

Most importantly, we had varying levels of experience, so, all united, we had expertise in the topics and the skills the project required: design, building, electronics, coding, prototyping, fabrication skills and project management. Design, and in this case, coding, are universal languages. By embracing our affinities and valuing our differences, we brought a wealth of complementary perspectives to the table.

The overall concept of the design was continuously discussed between all the members of the group, and was developed day after day accordingly. Creativity, working in multicultural teams, empathy, cognitive flexibility and communication skills were key elements throughout the process. We created a common ground of terminology for understanding and transmitting ideas.

An interdisciplinary team is a fertile ground for collaborative learning. The specificity and variety of knowledge that each one had from a former professional background enabled cognitive flexibility and an organic process of design and prototyping. In the workflow, the engineer of our team had the enthusiasm to share his knowledge on the development of the code to control the actuators in the machine; and the designer of the team edited the video for the Barcelona´s Subjective Machine in an open online class for the team, streamed from León.

During the design iterations, the team converged to deploy the needed resources: sketches, poetry, modeling, prototyping, 3D-design, optics, shadow theatre, kinetic art, mechanics, electronics and coding.

Becoming Bits

Digital communications and technologies became our default mode of interaction during the recent pandemic. These technologies have, without doubt, opened opportunities for global collaboration. However, they can also generate feelings of alienation, and can never replace in-person interactions. For example, explaining how to wire a relay board between the arduino microcontroller and the motor took a three-hour long video call.

Online education and hybrid education was mediated through different cameras located all over the room, a monitor speaker and a 50-inch TV screen with wheels. We even had this inside joke about the “Pacobot” where our remote team member was projected all the time, as a reference to Sheldon Cooper’s robot Shelbot from TV series The Big Bang Theory.

Depending on the stage of the process, he migrated between different screens. He felt like a disembodied ghost trapped in the digital world, travelling between computers, listening and interacting with humans across the world. Yet it also made him feel disadvantaged, due to the inherent technological limitations of cameras, microphones and headphones.

This summarizes our difficulties with technological limitations of the hybrid learning model and the imperative “hands-on” methodology. These needs must be addressed for hybrid education to succeed in the long term.

The Almost Useful Machines was the first learning experience of online education and hybrid education methodology for our team - and for our teachers. A challenge still unresolved is how to work synchronously across different time zones. The morning workshops in Barcelona took place at night in Mexico: this disrupted the sleep cycles of our remote team member.

It is also important to have access to the appropriate equipment and tools to fabricate the Subjective Machine. While part of the team in Barcelona had access to the Fab Lab, the member who was in León had to be resilient - since there is no Fab Lab in the city. He set up a home-lab equipped with tools, lights, a soldering station and working tables, and for the wood structure he worked for limited time at a university’s carpenters’ workshop.

Since open-source is becoming the new norm, we created collaborative files, documents and templates — our workflow is available in the Miro platform, while the whole design process is systematized and available in the Git Lab platform. Both are essential pieces for asynchronous learning systems. The video of the twin machines is freely accessible for future references and new collaboration opportunities.

Conclusions

Our experience of distributed design illustrates the importance of local knowhow. Whereas in theory digital technology enables designers to “make almost anything, anywhere”, we realized that being surrounded by experienced makers was key to learning new techniques, hacks, and best practices. Conversely, the absence of tutors for our remote teammate forced him to get outside the lab, and seek expertise where he could - i.e. in the local TV repair shop.

Distributed Design is bound to the availability of materials and machines. While 3D-printers have become very accessible in the last decade, several machines remain expensive and inaccessible to many areas of the world. For example, in León, we had a very hard time finding adequate facilities due the lack of Fab Labs (there is no current Fab Lab working in the city anymore).

In this emergent paradigm, it becomes essential to acknowledge and embrace our position as designers. Distributed Designers root their design in their context and lived experience. Working in a multicultural team (Mexico, Bolivia, Chile, Spain, France) was a profoundly enriching experience. Each team member brought their own cultural prism to the shared vision for the Subjective Machine.

We hope that our experience of building the Subjective Machine will provide an interesting example of developing technological literacy through making. While our machine was intentionally useless, the process of designing it in a distributed manner was rich in learning.

IDDEAS

Research and Development in Distributed Design of Food and Packaging Solidarity

Denisse Díaz Sagredo
Project team

IDDEAS Project
Name of the project

Santiago, Chile – Latin America.
Location

Pontifical Catholic University of Chile
Organisation

Packaging prototype development (May 2021. Santiago, Chile. Photography: Denisse Díaz).

Project Type

Collaborative model that seeks to propel local production of food, by means of a capacitation system and toolkit of resources to guide the development of packaged food products and their implementation in circuits of economic solidarity.

Project Description

IDDEAS emerges as an initiative to contribute to the growth of small businesses within the food industry in Chile. The project proposes a new model for food development based on four axes: the political proposal of food sovereignty, the circuits of economic solidarity, the technologic proposal of digital manufacturing, and the contribution of distributed design for the transformation and social autonomy. Aimed at designers, small producers and other agents relevant to the value chain of food products, IDDEAS offers a system that allows strengthening skills, as well as generating local networks in which designed products can be developed and implemented.

Context and History

The project began halfway through 2020 in the framework of a final graduation activity in the UC's Master's of Advanced Design. The principal motivation for its development emerged as a critical reflection of the current food system, which is composed of large companies which control the global industry, based in development strategies which prioritize the economic benefits over human necessities of nourishment. From this perspective, the project was created with the intention of being part of productive transformation, to generate new manners of production with the help of design, technology, as well as other political and economic perspectives which protect our environment and restore social and cultural dignity to our foods.

What is the Need it Tackles?

Nourishment is a basic need for human subsistence (Max-Neef 1998, 42), and for this reason, factors such as: availability, access, nutritional and organoleptic quality, just as sustainability and the patrimony are indispensable in considering development strategies. However, the current food system provides us with an increasingly less healthy, uneven and sustainable design. In this context, IDDEAS seeks to propel collaborative and local food production, to contribute to the self-sufficiency of nourishment, focused on the necessities of people and their environments.

What is the global-local relationship of the project?

Despite Chile having great natural wealth and the necessary resources to diversify its production matrix, it lacks connections between the different agents

within the food system. In this context, the project seeks to promote food production through the articulation at the local level of the different agents involved in the process, in order to stop relying on centralized production. Therefore, IDDEAS opens channels for the community to have more autonomy in the market, generating distributed productive nodes, which in turn, can be interconnected to generate a global network that facilitates the distribution of resources and knowledge in this area of interest.

How was the Development Process of the Project?

The IDDEAS development process was guided by the methodological framework of the Design Council's Double Diamond model. Therefore, the project began under an applied research that included various experts from the areas of design, economic solidarity, food development and digital manufacturing, which contributed to the collection, reflection and validation of information relevant to the project. Likewise, a large part of the findings were collected from the follow-up and collaborative work with a small prosumer (producer and consumer) of bread from the Nodo de Trueque Florido, a space for exchange with social currency, located in Cerro Florida, in Valparaíso, Chile.

For the development of the design tools, the validation of the potential users of the project was very important. In this context, other professionals, producers and representatives of key institutions for the development of food products were involved, in order to generate networks and new product ideas for the local market in the Valparaíso region.

What Results did your Project Accomplish?

The main result of the project is the creation of the conceptual model and toolkit for the collaborative development of packaged foods and their implementation in circuits of economic solidarity. In it's application, this system accomplished the capacitacion in four thematic axes (Food Policy and Development, Economic Solidarity, Digital Manufacturing Technologies, and Design) as well as connecting more than ten people from the various areas of food development (prosumers of the Nodo Florido, food engineers, nutritionists, designers and anthropologists), therefore collaboratively designing five conceptual proposals and a product prototype, thus diversifying the bread prosumer's offer of at the Nodo Florido.

Why is This Distributed Design?

Tim Ingold states in his book Environments for Life that "designing is shaping the future of the world in which we live" (Ingold, 2012, 19). With this statement, he invites us to keep life moving through changes that obey to human needs and those of the environment in which we live, always from an open and collaborative perspective, because design, beyond being a profession, is the essence of everything we do when our actions are guided by hope and dreams of a better world.

Case analysis: Productive packaging at a small scale. (January 2021. Valparaíso, Chile. Photography: Denisse Díaz)

This project is a part of that, since through the conceptual model and toolkit of resources, the project seeks to promote change in a sector where the dominance of neoliberal capitalism has had a negative impact, generating great inequalities around resources, impoverishment of sociability and social life, uncontrolled exploitation of the land that has come to endanger the conditions for survival (De Sousa Santos, 2011, 364-367). In this context, IDDEAS is an initiative that strives for the consolidation of a system that works for: food as a right for the population, a reindivication for sustainable development, access to other economic alternatives, impulse of the development of productive nodes, and that supports the bases to obtain food sovereignty through distributed design.

From this perspective, the project offers the possibility to all people and institutions that wish to participate collaboratively in the creation of a new model for the production and consumption of solidary food and packaging, where technological linkages, new business models and manners of facing the current reality close the gap between what is possible and what is not possible, creating bridges between the needs of people and the means that we have in our context to generate change from a local to a global scale.

Modular and Open-Source Machines

Modular and open-source machines aimed at empowering a decentralized and more resilient production

Martin Duchêne, Maxime Gravet & Roldan Descamps
Project team

Mekanika
Name of the project

Product
Project type

Mekanika
Organisation

Evo CNC milling machine in a wood workshop, 2021, Brussels, © Mekanika

Location

Brussels, Belgium - Europe

Project Description

The maker's dream of a decentralized production has so far struggled to make a real change in the way we produce goods. But today is different: the climate crisis is bringing pressing challenges, and people want jobs that fulfills their values. On the other hand, the machine industry is still destined for technical people. There's a clear gap to fill to provide creative people, with values, with machines they need to create their own job or company.

And that's why we created Mekanika, with the objective to develop a full library of open-source machines. As of today, we've already created two ranges of machines and supported more than 450 creators across Europe, and we're currently experimenting to find our way to build a profitable open-source machine company.

Context and History

Martin and Maxime started a prototyping business in 2015. Like a lot of makers, they quickly faced the need of machines to produce goods for their clients. At the time, however, accessible CNC routers and other specific machines were hard to find and they decided to build several machines themselves, using the help they could find online and learning a lot in the process.

Mekanika started at the end of 2018 when Roldan joined them with the goal of developing professional open-source machines that would be easy to use and affordable, using distributed design principles to make them as accessible as possible.

What is the Need it Tackles?

Reducing the entry barrier for artisans and entrepreneurs to produce goods locally, on a small scale. This is a need for individuals to develop professional activities that make sense, and for society to access more responsible and locally adapted goods.

What is the global-local relationship of the project?

When designing machines, we work with:

- A maximum of standard components that are available and identical everywhere in the world.
- A minimum of specific components that can be produced with Fab Lab technologies.

This means that, based on our original designs, one can build a machine locally anywhere in the world and start a business. This also means that it is easy for the community to start from a design and modify it for more local and specific needs.

On top of designing machines like this, we spend extra time on the content to present the blueprints of the machines: we make them universally understandable with great quality videos, sketches, files and even tutorials on how to use the machines.

How was the Development Process of the Project?

One early part of the project was to find a way to make it financially viable and sustainable in time. In that perspective, we went for a for-profit organization, seeking external investment and proving that we can build a profitable business out of open-source values.

The business part of Mekanika is to sell the machines we design as kits. This is also a way to lower the entry barrier to those machines: someone without technical background can just purchase our kits and follow our instructions to be able to use a machine.

From the beginning, we've had a community of both clients and non-paying users of Mekanika, giving feedback on the machine, suggestions on updates or add-ons and perspective for future machines.

So far, product development is made internally - but based a lot on the community input - in order to follow both our core design principles and user experience standards. Our future objective is to be able to transfer our knowledge learned along the journey to help others design machines or products that way.

Packshot of Evo CNC milling machine, 2021, Brussels, © Mekanika

Mekanika team working on a new machine design, 2020, Brussels, ©Maurine Toussaint Photography

What Results did your Project Accomplish?

As of today, we've sent more than 450 machines in kits across Europe, helping people to launch businesses or side projects. Our Pro-CNC milling machine is one of the most upvoted open-source projects on Wikifactory and we have makers that have built and use our machine as far as India or South Africa. In the last few months, we've developed Evo, our new CNC machine range, with the goal to further push our ideal by making this machine evolving and following the needs of users through upgrade kits, like a software would do.

Why is This Distributed Design?

We think that manufacturing capabilities are the key to distributed design: for ideas and digital files to be translated in atoms locally, we need means to work on those atoms. Fab Labs play a very prominent role in helping local communities to learn and access manufacturing capabilities, and our role is to generalize the benefits even in remote areas. We want to support creators and entrepreneurs from the very beginning of their journey, and accompany them as they scale, because we believe makers start to have a real impact when they reach a critical size of production, enabling their own profitability. Only then can they become a sustainable alternative to mass production.

The Emergence of the Liquid Circular Maker Space

Making in a community of practice for equitable solutions

Jessica Guy, Xavier Dominguez & Alessandra Schmidt
Project team

The Liquid Circular Maker Space
Name of the project

Circular Maker Academy
Project type

Fab Lab Barcelona
Organisation

Precious Plastic community workshop. 2021. Fab Lab Barcelona. Milena Calvo Juarez

Location

Online in eight cities: Barcelona (ES), Istanbul (TR), Kaunas (LT), Leuven (BE), Piraeus (GR), Santander (ES) Thessaloniki (GR), Venlo (NL)

Project Description

The Liquid Circular Maker Space emerged from the Circular Maker Academy. The academy programme was conducted by Fab Lab Barcelona (at the Institute of Advanced Architecture of Catalonia, IAAC) during 2020 in the framework of the EU Project Pop-Machina. The aim of the academy was to equip maker champions from six different countries with the skills and knowledge, following the training the trainer approach. With the objective to support the holistic establishment of Circular Maker Spaces in their respective cities. Due to the COVID-19 pandemic, the programme was transformed to a 100% online immersive learning experience. Pop-Machina is a Horizon 2020 project that seeks to highlight and reinforce the links between the maker movement and circular economy in order to promote environmental sustainability and generate socio-economic benefits in European cities.

Context and History

Increasing numbers of different types of creative and productive spaces are being established around the Globe. Even though their terminology and focus of work may differ, they share many things in common. Makerspaces (for the sake of simplicity the term “makerspace” will be fused from here on) are often community-led spaces in which individuals and groups of people have access to machines, tools and can share resources. Collaboratively they can work on commons-based projects, using rapid prototyping techniques, open-source software and hardware. Whilst makerspaces intend to be openly accessible for citizens, democratizing access to machinery and tools, enabling collaborative making processes, they do also face limitations. They currently lack strategically implemented material flows analysis, life cycle assessments, social inclusion methods. Also due to the notion of being strongly connected to technology, makerspaces often appear to be exclusive for civil society. While the apparent limitations may seem daunting, makerspaces may also be the most suitable to actively incorporate new strategies and practices.

In the 20th century, the circular economy was previously seen as a delusion, and returned to the surface as an admirable symbol for big corporations in the 21st century. One of the drivers for this was the Ellen MacArthur Foundation. Unfortunately “circular economy” now shares similar notions as “sustainable” and “green”. Buzzwords which are being used by corporations with only limited implementations. Makerspaces, however, are platforms in which new practices, open design and innovation are taking place. Most importantly, the people within, share a similar mentality to creative problem solving and have a profound connection to collaborative thinking and making. Some

makers and designers gradually emerge from this sense of agency, shifting away from linear production and “throw away culture”. Possibly leading as community champions, shaping a pathway for more circular making practices. The champions support the development of communities of practice. Together they share the same admirable and ambitious duty to change the status quo on a local and global scale. Which leads to the idea of how this revised approach of making practices may formulate. The Liquid Circular Maker Space is a call for a reflective approach to take systematic action as individuals, groups and institutions to support each one another to enable equitable futures.

What is the Need it Tackles?

The Emergence of the Liquid Circular Maker Space (LCMS) in Pop-Machina

The terminology “Liquid Circular Maker Space” emerged from the Circular Maker Academy (CMA), conducted by Fab Lab Barcelona in the year 2020 and, due to COVID-19, adapted to a fully online immersive learning experience. The CMA is part of an EU funded project called Pop-Machina. Pop-Machina aims to support city ecosystems by highlighting, reinforcing and linking the maker movement to the circular economy.

On a practical level, the development of LCMS is established with the people: there is an individual with an interest in circular making practices. This individual, or Circular Maker Champion, cultivates different types of activities in which citizens can participate. While doing so, a group of people who share similar interests start to manifest around the Circular Maker Champion. Eventually, depending on the size of the group of people, areas of interest may start to differentiate, articulating in areas of expertise. Together these groups can be seen as a community of practice. Throughout this whole process, there was no need to have one specific makerspace. Activities could have been in community centres, at home or in repair cafes. However, when this community of practice has the resources and support from e.g. an institution, a dedicated physical space (the LCMS) may be established in which they reside.

Drivers for Equitable Learning Environments

With a people-centered approach, the LCMS sees people as agents of change, re-thinking and re-inventing solutions. Hence, the terminology “liquid” is based on the idea that a LCMS is just as adaptive as the people within, supporting resilience in times of rapid change. Interests of people change as a function of time. This is part of human nature. Hence, in this respect, the liquidity of the space plays an important role. The LCMS is a multi-dimensional living system, composed of everyone who wants to partake. It explores the development of, and interconnections between the individual, groups of people and the larger ecosystem. Social inclusion should actively be part of the implementation strategy of a LCMS. Making tools and information accessible for an equitable environment. Having a democratic approach in which community members and citizens are part of decision making processes, to ensure a shared responsibility. Acknowledging the differences, characteristics and cultures which exist within the communities. And with this, the LCMS takes the shape of the community, reinventing itself through iterative and agile cycles by continuously evaluating its needs and function within its community. This may mean adapting everything from the LCMS´s physical layout to how it is governed and used.

Making in the Liquid Circular Maker Space

Makerspaces are being challenged for their use of supposedly energy intensive machines. Often being compared to large scale industries, the actual benefits which can be accomplished in makerspaces are often forgotten. LCMS’s work in their local context. It is the role of the community champions, and individuals themselves to ensure that local challenges are being addressed holistically. Sharing their insights and best practices on a global scale - a common ideology in the maker movement. However, not only the choice of machinery and tools play an important role in the circularity of makerspaces. Rapid prototyping techniques and many academic programmes which take place in makerspaces still use the same materials as many years ago. These materials are increasing in their scarcity. Which means products or projects emerging from makerspaces may have a heavier impact as assumed. It is about time to find valid material alternatives especially for young makers, and participants of educational programmes to ensure that experiments and exploration can take place in a more sustainable way. Using materials which can be fed back into the material flow, for example bio plastics. Or having machines and tools available which ensure that plastics can be recycled. Giving materials, electronics, and other discarded items which may be forgotten in our basements a new life. Rethinking new

Hybrid biomaterials session during the Circular Maker Academy. June 2021. Fab Lab Barcelona. Picture by Santi Fuentemilla.

applications, remixing and reinventing to not only fit personal needs, but collective ones. One person's trash is another person's treasure. Eventually there would be no more "waste", only materials and products in different stages of their lifecycle.

What is the Global-Local Relationship of the Project?

The LCMS serves as a site in which equitable, circular solutions to local and global complex problems can develop, mature and scale. In this space, citizens and local communities are engaged to take part in circular making practices, co-creation and co-design of circular solutions for dilemmas which the local communities face. However, LMCS is more than just its physical space and its machines. The aim is to work collaboratively, experimenting and fostering new synergies with surrounding or encompassing ecosystems. The people who engage with the LCMS can distribute their locally gained knowledge of circular making practices beyond neighbourhoods and cities, considering intersectionality and the cross-pollination of ideas in already established, distributed online platforms. The LCMS is adaptive and iterative by nature, with low barriers for participation and an empowering environment.

How was the Development Process of the Project?

The Circular Maker Academy (CMA) gave us the opportunity to explore, together with the Circular Maker Champions, what a LCMS could be, how the academy itself should be designed,how the approach to local challenges should be addressed, and how people will be engaged. The CMA actively co-designed the curriculum with the participants. Through continuous feedback loops, the needs of the participants were addressed in inspirational talks and hybrid hands-on learning experiences. Basically, the CMA itself was merely the supporting framework for the journey of the participants on an instructional, guided and ultimately autonomous path to develop their own communities of practice locally.

What Results did your Project Accomplish?

The learning curve was, and is a steady one, in which we (Fab Lab Barcelona) continuously learn about our Circular Maker Champions and the LCMS. The Circular Maker Academy gave us the opportunity to explore, together with the Circular Maker Champions, what a LCMS could be. How the approach to local challenges should be addressed and how people will be engaged.

An extraordinary example are the makerspaces established in Leuven and Istanbul. In Istanbul we were able to follow the processes of a Circular Maker Champion which enabled us to engage within their neighbourhood, and slowly start their own local community of practice. Now, in the year 2021, we are excited to see the opening and the activities being established in Döngüsel İşler Atölyesi (Turkish for Circular Maker Space), the Circular Maker Space in Istanbul. The prior established community of practice will finally have physical space to meet

Hybrid biomaterials session during the Circular Maker Academy. June 2021. Fab Lab Barcelona. Picture by Santi Fuentemilla.

regularly. After completing the academy, all Circular Maker Champions shared a similar sense of belonging and sense of community. We are collaboratively trying to keep our community from a distance via monthly online meetups in which we share updates and continuously have peer-to-peer workshops. We are still exploring how a distributed Circular Maker Champion network may articulate.

Why is This Distributed Design?

To be able to fully "close the loop" we have to equip makers / young designers with the skills and tools that enable them to manifest and develop ideas that can be upscaled in the market. Whilst continuously having activities and learning experiences which offers citizens to take a glimpse of possible actions, they easily incorporate them into their everyday fabric. An open-source mentality indicates that designs, code and how-tos should be shared online and for free, globally. The same goes for the guides to establish Liquid Circular Maker Spaces that adapt to the local context. We should bear in mind the socio-enviro-economic context in which makerspaces can contribute to the local ecosystem. With this, we can incorporate a sense of agency by design for a caring circular economy.

CHAPTER 6

Realising Distributed Design

Distributed Design aims to empower designers and makers to shift the global paradigm, from one that relies on complex global supply chains, to one that is supported by local manufacturing. By employing global networks to move design and manufacturing data, not products, emerging creatives are given the opportunity to engage with new local and global markets which are emerging. Locally, makers are able to collaborate with craftspeople, material designers or curricular economy practitioners. Globally, they use their knowledge to contribute to diffuse their own work or contribute to open designs developed by someone else. This chapter looks at emerging real-world opportunities for makers and designers to participate in local and global design and manufacturing.

Making Distributed Design Work, Work

The What, Why and Wow of Implementing Distributed Work and Operations

Allan Yde & Alex Kimber from Hangpod

Design is a job. It is not a hobby, or an art or a craft. It might be for some people, but for most industrial designers, it is a job. It is about working creatively to a deadline and fulfilling other people's needs rather than your own self-expression.

Design is also collaborative. You need to be able to connect in teams, work with suppliers, partners and stakeholders. Designers have to pay the bills and trust me; the landlord does not work pro bono. So, how do we make this design thing work for us? How do we make distributed design work for us? Can we even do distributed design, professionally? We must get to grips with distributed work. We need to understand the meaning of working distributively, the tools needed to do it and how it changes everything you learnt in that internship you took fresh out of school.

This essay examines distributed work vs. remote work, in the context of design and productivity. The scope is delimited to private firms that execute and produce hardware design goods and the challenges that presents. This is because fundamentally, public sector funded projects can afford to be more experimental and community driven in nature, whereas entrepreneurial endeavours must be more agile, competitive and economically sustainable. Here we aim to probe whether distributed work stacks up against this real-world challenge. We use our own company, Hangpod, as an example as the company originated in a makerspace and has lived as a distributed organisation from its very conception. We address what it takes to pull it off, what we stand to gain and what we risk losing, and what the future of distributed work could look like.

'We need to understand the meaning of working distributively, the tools needed to do it and how it changes everything you learnt in that internship you took fresh out of school.´

What is Distributed Work Anyway?

You may be forgiven for thinking that distributed work is something like what we have recently experienced with the Coronavirus lockdowns. For those of you reading this essay 100 years in the future, ask your grandparents about COVID-19, they will have a ball telling you how medieval it was to communicate via Zoom, rather than the direct brain chip link you probably have in your time. But for the more temporally recent, you may recall team meetings, .io games and wearing pyjama bottoms at hours of which your mother would not approve - the world of remote working. Many people saw working from home as a new paradigm and a shake up for old institutions to "get with it". The reality is that there is nothing new about working from home, only that more people do it now. People have been working remotely, in much the same way as we experienced during the lockdown, since mobile phones, laptops, the internet and Facetime came out. There is very little conceptual shift between office and remote work, in terms of the relationship between the employee and the firm, compared to distributed work.

Remote work suggests there is a central location from which to be remote, whereas distributed work conceptually detaches the firm from time and space. The office is not made from bricks and mortar, but text channels and cloud storage. The factory does not have huge, vaulted ceilings occupied by vast machines with a single purpose, rather localised workshops with tools so flexible their limitation is only your imagination. The commute is not dictated by what is convenient for the company at the expense of the employee but directed by where the worker wishes to work and complied with by the organisation. Distributed work suggests a new paradigm of forming a company analogous to a network or an ecosystem and putting an end to regimented rows of factory workers clocking into the same building at the same time.

It is hard to give a concrete definition of distributed work, since the needs, scale and operations of every company are different. One definition might be that the day-to-day running of the business, by most of the workforce, is done from no central or regular place, typically distributed geographically.

Another way to view it might be as an organisational structure that better suits and maximises the potential of the means of communication. If the purpose of the office is fundamentally a hub for information flow, where people who need to speak and work together can do so verbally, then remote working is really an extension of the senses and not much more. It is no more revolutionary than a cup on a string. We have at our disposal powerful tools for data sharing, data storage, real-time collaboration, version control, 3D-visualisation and design tools, and with exponentially growing processing power, broadband width and networking we have to ask ourselves are we making the most of it? Applying these technologies to connect with teammates who live just up the road, because they are a commutable distance away is a bit silly. Distributed work is a structure that fits with the technology that enables us to connect with anyone, decoupling us from the idea of geographic remoteness and leaving behind the hangover or anchor of a centralised hub for information flow.

This model of structuring and undertaking business operations has many interesting benefits and challenges.

Why Do It?

Surely, it is easier to work from one place? Well, the trends say otherwise. By 2025, remote working is set to overtake fixed offices (Kennedy, 2020), which has implications for how companies should structure, hire and organise themselves.

One potential benefit of going distributed and affording your team global flexibility, is to tackle the same challenge that open innovation strategy aims to solve - knowledge retention. We live in incredibly mobile times, geographically and socially, making it harder to pin down the brains of our time. A buzz word in innovation management circles is “open innovation”, essentially meaning that the development funnel of the firm, through a combination of open-source IP and acquisitions, contributes to and benefits from an ecosystem of product development. This way, it does not particularly matter if half of your R&D team will move on within six months, because the knowledge and progress is still available to continue development. This is a brilliant and modern strategy, but distributed work has its place within this paradigm too. By being so flexible, if the talent you work with decides to move, have kids, change lifestyle or whatever else, you are allowing them to make their life choices and keep their jobs, and their brains. This also works in the sense that you have access to a larger, worldwide, pool of talent, rather than hiring locally and working remotely.

This also connects with the idea of diversity in teams, which can be seen to boost productivity (Hunt et al., 2015) and is supported by distributed work. Distributed work is not only more environmentally sustainable, by reducing flights and office running costs, but also more socially sustainable, by connecting and offering work opportunities to anyone who has the talent and an internet connection, not just the industrialised global north.

The Hardware Problem

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Tools and Processes

At Hangpod, we are trying hard to use as few project management tools as possible, and the closest we have come to a platform that does it all is Discord. One platform to rule them all. So, what is Discord one might ask.

Discord is a community management tool with integrated chat and video call capabilities. Initially it was built for gamers to meet, stream and talk while playing their favourite games. Most companies tend to use Slack instead of Discord, because the gaming part tends to scare the conservatives. In reality, the gaming sector tends to lead innovation before anyone else, so this is where we place our bets. The gaming sector is so highly competitive among tech savvy, that the tools and products to come out of it, from keyboards to communications platforms, are super optimised.

Unlike the standard features of a project management tool like Microsoft Teams and etc., Discord has built a community where it’s easy for developers to make bots that assist with most of the features that we need, including scheduling meetings, to-do lists and even simultaneous music streaming integrated with voice chat. There are a multitude of these bots, that thrive in an open-source ecosystem for developers, that we could easily add to ourselves when we find there is a productivity function we require specifically. This is the real beauty of a platform like Discord - flexibility. But the needs of every company are different. For example, one of the challenges we face is inviting people to collaborate on our server but they do not already use Discord. This for some companies could be too great an issue, meaning they would depend on a more ubiquitous software like Teams. It comes down to, as with most things, a case-by-case basis.

Browser Based 3D-Modelling is the Future!

Ping-ponging your files back and forth for collaborative purposes has been widely adopted by the music industry for many years. Someone records a song and sends it to a beat producer and vice versa it is sent back and forth through a number of iterations before its completion. Similar model in hardware production is rapidly being enabled by the many Fab Labs around the world, not to mention the prices of additive and subtractive manufacturing machines dramatically going down. Right now, a 3D-printer, a CNC milling machine and a laser cutter are a standard set of devices at almost any given Fab Lab. These are the machines that MIT uses as a part of their “How to Make Almost Anything” course. It will not be a surprise if 3D-printers within five years will be as normal as standard

paper printers, and actually could be found in most households. Paper printers are probably not the best example however, because they are soon a thing of the past, but we hope you get the analogy. 3D-printers could be a standard inventory in most households, then it will not be hard to imagine that you simply can print spare parts for your Ikea furniture and buy your files from any vendor.

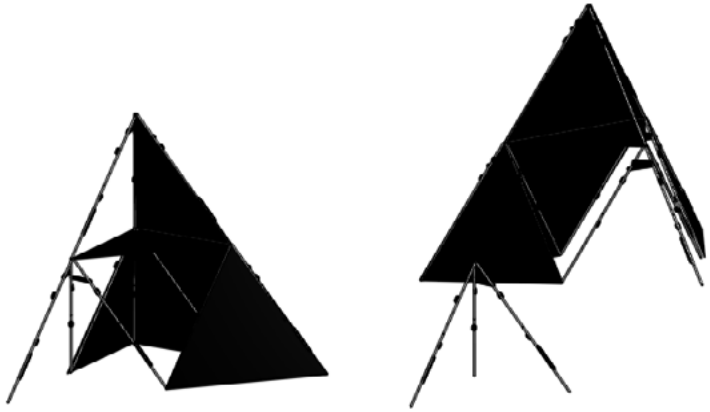
What is crucial for us to collaborate on designs as a hardware company, we want to use a cloud-based, 3D-modelling software. Fusion 360 allows us to sync our files and back them up in the cloud, while working collaboratively and in real-time. Fusion is still a program that needs to be installed locally, but if Autodesk is following the current trends soon it will be in the browser like OnShape, another groundbreaking CAD package. What we also like about Fusion360 is its integrated CAM workspace, meaning that we can generate our CNC toolpaths and export the g-codes directly to your machine of choice. Much like the music industry analogy, a designer in one part of the world can work with another in real time, export to g-code, use rapid prototyping to produce it and test it and get real world feedback. A process of digitisation, realisation and with 3D-scanning technology too digitisation.

Culture and Social: What are we Missing?

Hangpod is doing virtual stand-up meetings daily to maintain and build culture, keep people informed and motivated. Those meetings ideally last ten to fifteen minutes, but as we enjoy the social aspect, they tend to drag out a bit. This is precisely the value of the watercooler chat in the real world.

The founder of GitLab said in an interview that they have been a fully remote company since 2012. The company has now expanded beyond 1,300 employees. GitLab wrote a handbook about remote work and office culture which all the internals can commit changes to. The handbook is still being edited today and can be found on their website. This is an excellent example of democratising and distributing company codes of conduct to formulate culture. In the interview the founder also expressed what the biggest difference between office and a fully remote workplace is, and it is the watercooler/coffee machine talks that actually creates and maintains the corporate culture. What Sid Sijbrandijs solution to this was to schedule weekly 25-minute-long coffee chats. For your onboarding process, you need to attend nine chats, other than that it is a completely voluntary participation (Mellon, 2021). This policy might not work in every context, but however you choose to resolve the social challenges to working distributively, it is something you must be conscious of and purposeful in execution.

To be clear, GitLab is purely a software company much like the developer platform, Github. Hangpod in its essence is different, at least in the R&D department. We make hardware which needs to go through fit testing and much more. The old hardware problem again. In other words, hardware products need more human touch than a python code. Luckily, 3D-printers are slowly being brought to the masses, which means you can probably go to any capital city in the world and join a Fab Lab with ease of making stuff.



A network is a far more robust and effective structure for connecting nodes. (Alina Grubnyak, Unsplash)

So, What Else are we Missing out on?

Body language seems to be another big factor that we are missing by doing video calls instead of physical meetings. Since we are just at the start of the innovation curve, we will likely solve this issue soon, by having a bigger distance to the camera or by using virtual reality. However, hugs and high-fives are going to be very difficult to replace with any virtual solutions. In other words, that means until we all have that Ready Player One suit with haptic feedback, but who knows? The future is a big place.

Motivation is one of the biggest elephants in the room that we are finding challenging by going distributed. We at Hangpod found it extremely difficult to support the self-discipline of the team. Luckily, most of us are proactive folks, so motivation can be found within, or at another co-working space where the community keeps you on your toes. However, the experience of joining a distributed team can be especially overwhelming to interns and new graduates that would often require extra support and guidance in the beginning. In this way, going distributed is an educational challenge too, ensuring that graduates of the future are more autonomous and self-organising, if we are going to do away with line managers peering over your shoulder. At most companies, micromanagement is not something you talk highly of, and this is also the case at Hangpod where we want to build a community of transparency, trust and proactiveness. This we find extremely hard, but we are learning a lot as we go along how we do this while not wasting time, double working or falling behind.

Co-working is certainly not always dancing on roses, and it comes with its

challenges. At office spaces or other co-working spaces, you will run into a few things that can put you off course. Noisy environments are a thing, more now than ever, with everyone doing calls all the time. When the office that you are located in starts to feel like a call centre, it can impact your focus. In physical spaces, it is much harder to be selective than when you are present on a platform like Discord. There is always a guy that likes to present his dad jokes or give you a lesson about entrepreneurship even when you do not want it. Online tools afford you control to switch off notifications, you just need the willpower to resist. Being online offers you the possibility of creating a “Do Not Disturb” label. This is a hard problem to solve in an office space.

What this comes down to is understanding yourself and your own process. Do you thrive from the community environment, or is the distraction just too damn high? No one can tell you what works best for you. It is all up to you to make sure you deliver on the behalf of your company or clients.

What Does the Future of Distributed Design Behold?

Virtual Reality is still maturing, meaning that it has not reached the masses yet. In a distributed design context, virtual reality will eventually prove its worth. Hardware organizations and companies will be able to display and showcase prototypes in a more precise way, since you would be able to feel it and hold the parts in your hands. The dimensioning and tolerancing issues seem to be the biggest rock in the shoes of enabling remote work for hardware designers.

Once prototyping has been resolved and your entity is ready to scale up manufacturing, it can be a little bit tricky. Tonnes of time goes into research and establishing relationships with potential suppliers. Many things can break down in your fragile supply chain. In Hangpod’s case, COVID-19 brought an aluminum shortage, increase of material prices and a major delay in shipping prices. It is not ideal to have many months of production time and your customers especially would agree with that fact. If your promises are too optimistic, it can really damage your reputation.

We believe that the future of the supply chain will be much more distributed and localised. The bonus of this is less C02 emissions. Giants like Amazon have even suggested automating the whole supply chain, which means you just handover your technical drawings, 2D or 3D-files, and they will handle the rest, from production to shipping to the end customer. This will be the holy grail of distributed design, which means that it is probably going to arrive anytime soon.

The only alternative to this model of logistics is open-source, in the sense that by putting your plans out in the ether, others can build it themselves. The challenge here is monetising it and understanding the business model, ie. paying the rent problem. Needless to say, it is not impossible to be profitable with open-source models. A company called comma.ai has in fact open-sourced all of their codebase for self-driving cars, but keeping their hardware closed source. Open-sourced can be utilized to outsource a portion of labour to developers as comma.ai is doing with excellence. So far, we have never encountered any examples of profitable companies with only open-sourced products. However, the open-source operating system Linux, enabled a whole industry of computers.

In the low-level foundation of all Mac computers, you will find Linux code. Linux is often described as the largest open-source project, which is still to this day being developed and maintained by a huge crowd. The management is still partially done, by its creator Linus Thorvald. To this day, more than 1,000 companies have adopted Linux software for commercial products and services.

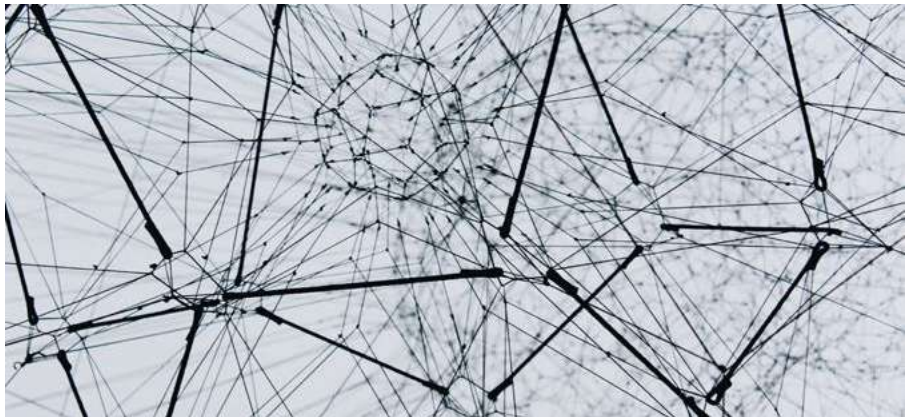
Universities can also be seen as partial open-source institutions that supply research, that you can spin-out companies from, without high level research institutions much innovation would have been stagnated.

For now, let’s count on our peer-to-peer network of Fab Labs and local production facilities.

Summary

Is distributed design right for every company? Probably not. It is hard to imagine how SpaceX could put a person on Mars distributively. But does this mean we should shy away from the complexities of distributed work and seek comfort from the traditional structures of the past? We simply cannot afford to. A distributed model of work is here to stay for many companies across the globe and addresses many key issues, from sustainability to flexible living. To no one’s surprise the future is more about cognition and less about traditional hand crafting. It is entirely possible with the technology of today and the experiences we have gained from Coronavirus lockdowns. For us to realise distributed design in the creative sector, we must realise that the firm as an organisational entity can be distributed, and that this has consequences fo r productivity and workflows. In most entities the rate of adoption is determining your likelihood of success. Afterall, most Silicon Valley based companies have been saving quite some coin by cancelling contracts with real estate agents.

Distributed work can be made to work, has been made to work and to suit the lifestyles, trends and needs of the present and future, must be made to work.



A network is a far more robust and effective structure for connecting nodes. (Alina Grubnyak, Unsplash)

Extended Design?

Forecasting New Forms of Distributed Design Supported by Extended Reality.

Massimo Bianchini, Andrea Ascani, & Stefano Maffei
Polifactory, Department of Design, Politecnico di Milano.

Extended Reality and Distributed Design: A (thus far) Missed Interaction

The current scenario of socio-technical transformation, modified by the pandemic, has highlighted the importance of increasing the use of technologies such as augmented reality (AR), virtual reality (VR) and mixed reality (MR) - all grouped under the term "extended reality" (XR) - that offer the possibility of bridging the gap between the digital and real worlds.

Within the field of industrial design and product design, there has been a long phase of experimentation and reflection on the relationship between the design and extended reality, which concerns the implementation of more interactive, collaborative, and efficient design processes. The diffusion and adoption of practices and tools for augmented and virtual prototyping have been debated for almost twenty years. It is now widely accepted in the scientific community and the industrial world that AR and VR can contribute to increasing efficiency in the user experience, design, production, or maintenance of products. The first boost for the diffusion of extended reality in the industry came when AR and VR were included in the technology landscape of Industry 4.0. Gaming, on the other hand, has been the driving force behind the initial dissemination of these technologies to end-users. The most relevant case being Facebook, and what they did with Oculus , a device released during the pandemic and ready for large-scale adoption by both the general public and developers.

The pandemic, which required the sudden introduction of drastic social and organizational changes, has increased the average level of digitization of people and organizations. More people now own appropriate devices to interact with AR and VR. Meanwhile, more and more organizations are designing or configuring digital social platforms to support and democratize — from gaming to education and healthcare — the use of these technologies. Also during the pandemic, especially in the initial emergency phase, a population of makers and designers with the support of Fab Labs and makerspaces was the protagonist of mobilization on a global scale, aimed at designing and manufacturing personal protective equipment and parts or components of respirators. It was based on the use of traditional technologies for digital manufacturing. Any experimental approach to the use of such technologies as extended reality (the most accessible in the technological landscape of Industry 4.0) would have allowed interactive design operations in virtual environments within a context of physical and social distancing.

A search of scientific databases reveals a lack of literature on the relationship between Distributed Design and extended reality, while Industry 4.0 paradigm is increasingly interested in considering the Fab Lab operational model in two ways: i) to create digital twins of the Factories of the Future and increase their resilience (Bécue et al., 2020), ii) to experiment with the use of immersive technologies to increase the potential of human-centered manufacturing systems (Ramalho et al., 2020).

It emerges that makers and Fab Labs have not yet explored the potential of extended reality. The reasons might be different: historically, the extended reality is not part of makers' repertoire in terms of Fab Labs practices and equipment. Moreover, open-source software and hardware for virtual reality, which is more compatible with the philosophy and principles of making and distributed design, has only recently been implemented. Finally, before the pandemic, AR and VR were technologies that played a secondary role in the design, prototyping and manufacturing processes that were mainly carried out in the presence of people, especially in Fab Labs and makerspaces.

However, if we try to relate the practices of Distributed Design with the extended reality, we can identify three potential areas of experimentation:

- the first level concerns the virtualisation of Fab Labs and makerspaces as places where immersive processes of conception, materialisation, sharing and learning of distributed design take place. The focus here is on the creation of the digital twin of these labs, which until now has been little or not at all investigated or experimented.
- the second area is about the theme of virtualization of distributed design processes, ranging from the initial design phase to the use of machines, through the collaborative experimentation processes dedicated to immersive prototyping practices.
- the third area is about the virtualization of distributed design outputs and therefore everything that concerns the virtual or augmented user experience of the artifacts deriving from digital fabrication processes, especially for documentation of their use, and customization.

Extended Reality for Digital Creative Processes: What's Happening?

In the stage between design and fabrication, designers and makers typically spend a considerable amount of time during the prototyping activities, in order to understand the complex geometry necessary for fabrication operations. Extended reality practices could help designers and makers to limit time-consuming tasks, in favour of a more streamlined production process of

an artifact. We have selected some best practices regarding the use of extended reality connected to the different possibilities of the XR through the various stages of the design process: concept developing, prototyping, fabrication, and output validation.

´An interesting direction of development concerns the evolution of the role of Distributed Design in relation to digital technologies´

The first stage might be a problem when the users cannot simultaneously share the same physical space. The difficulties to show and explain a simple concept could be avoided through a series of steps that goes from drawing sketches on paper, showing a 3D representation, or a rough mock-up. Transferring these operations in a virtual collaborative environment could mitigate those drawbacks. Still, a lack of defined standards and tools, combined with rapidly changing hardware and software platforms do not facilitate this phase (Krauß et al., 2021). Nowadays, numerous solutions are coming up: already established VR software such Gravity Sketch and Tvori are demonstrating features such as the involvement of multi-users at the same time, while Facebook Reality Labs is working on its own VR collaboration experience.

Further stages of prototyping find a better way to implement XR application. VirtualComponent is a mixed-reality tool that allows users to digitally place electronic components such as resistors and capacitors on a custom breadboard, tune their values via software, and see these changes applied to the physical circuit in real-time. The research team behind this idea questioned the common difficulties behind circuit design and discovered that their pool of users spend a considerable portion of the circuit-debugging time working on topological aspects of the circuit and trying to select or tune the values of specific value components. We found that their solution is a good execution of MR integration with a prototyping technique (circuit design and physical computing) widely spread in Fab Labs. However, the result lacks universality and scalability because the team designed the system around a custom breadboard and a digital application that require specific skills to let everyone implement them correctly.

The application of the extended realities comes at the end of the fabrication process in the case of “Earthen Shells Digital and Manual Fabrication” (IAAC, Barcelona, May 2017), where it does not influence the design of the shelters, nor the prototyping stage. It is, indeed, an additional validation phase that brings a more valuable, intuitive, and quick look for the user. It was a seminar where thirteen students built three earthen vaults in their first master year. The students used clay deposition through a robotic arm and 3D-scanner to generate an AR analysis system of the structures by superimposing the virtual model passed to the robotic arm and the actual mesh generated from the scanning process. The AR application aimed to visualize the changes happening to the structure during the various fabrication stages, and thus enabling the user to understand the effect of their actions on the structure.

Extended Design? Experimenting Extended Reality for Distributed Design

The hypothesis emerging from the case studies outlines some themes concerning the potential interaction between extended reality and Distributed Design. More precisely, this hypothesis is that XR can support and foster the enhancement of Distributed Design practices in different ways. It can increase the potential of collaborative and participatory processes - from co-creation to co-production - that are already a heritage of Distributed Design. It can extend the possibilities of access and inclusion to the world of Distributed Design through the virtualization of spaces, equipment, and practices. It can technically expand the potential and scope of open and distributed systems. Finally, it can accelerate work on the circularity principles of Distributed Design, working on simulated innovation processes that can prevent or reduce errors in creative and manufacturing processes.

For these reasons, does it make sense to talk about Distributed Design also in terms of Extended Design? If we assume that Extended Design is a potential field of practice that expands the principles, practices and processes of Distributed Design into a virtual dimension, the challenge then becomes to understand how, pragmatically, extended reality can respond to the needs and potential of Distributed Design.

Starting from these reflections, Polifactory - the makerspace of the Politecnico di Milano - developed “CTRL+” in 2021, an experimental initiative that stimulates designers and makers to explore the potential of extended reality for Distributed Design in terms of co-creating and prototyping solutions that can enable innovative practices of Extended Design within the Fab Labs and for their communities of users and innovators. To support this purpose, CTRL+ experiments with the use of different software and tools for AR and VR involving companies like TVORI, scholars and technology experts in this field. In practice, CTRL+ supports designers and makers in the use of extended reality, to expand or augment the features of open-source artifacts created by Distributed Design processes and to explore the use of digital fabrication in the creation of tools to augment or expand the use of virtual reality. Finally, the scope of CTRL+ is to explore innovative ways to expand the potential of Distributed Design within the society.

Distributed Design is a magmatic area. Primarily, Distributed Design is characterized by a systemic dimension towards innovation and a human-centered approach in the relationship with technology. Moreover, Distributed Design conceives design and production processes as open and inclusive, and it is interested in the circular transition of the contexts in, or for which it operates. Finally, an interesting direction of development concerns the evolution of the role of Distributed Design in relation to digital technologies. In this sense, the body of technologies for extended reality can support Distributed Design to make a disciplinary scale shift, extending its scope and cultural sphere of influence from digital fabrication to digital transformation.

Digital Biofabrication Node

Toward a Network of Flexible Technologies, Creative Citizens and Endemic Matter

Danisa Peric, Joakin Ugalde, Joaquin Rosas, Victor Contreras, Gonzalo Olave & Mercedes Baldovino from Fab Lab U. de Chile

Despite the quarantines and the global deceleration of human activities, for the Maker Movement, 2020 was a full throttle experience. With the shortage in medical supplies and devices generated by the border closure and stock breaks due to the pandemic, different nodes of the global Fab Lab network orchestrated the design and local production of these scarce items, through the coordination between makers, organizations of diverse nature and industries in every size, generating a serendipity about the maker present that we want to build from the world's south.

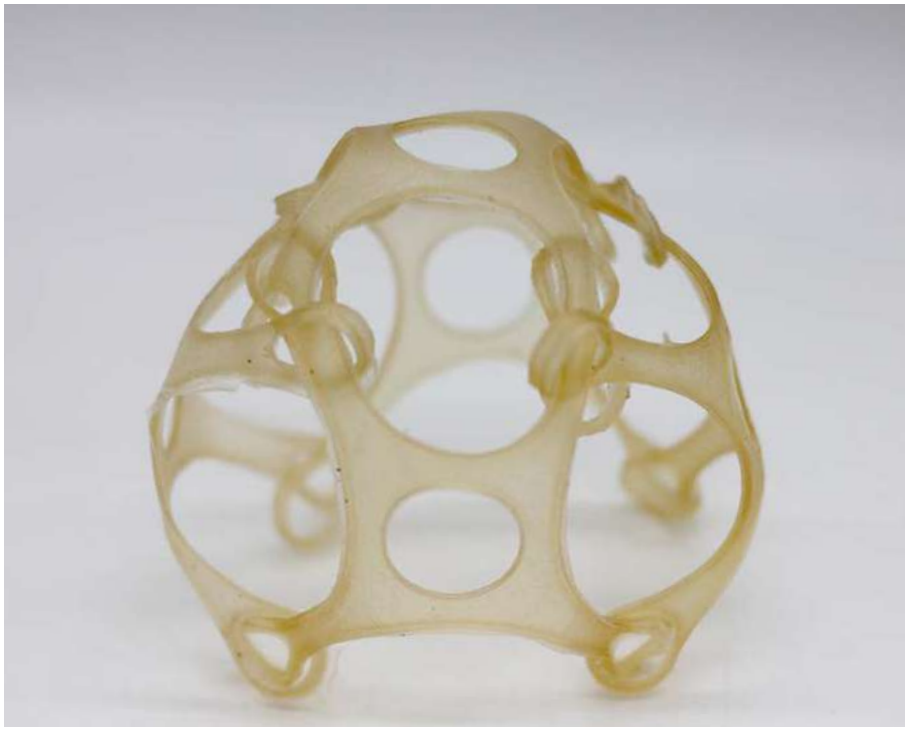
Simultaneously, and from these synergies, different open-source instructives and 3D-models started to flow around the world to fabricate medical supplies of urgent need; mechanical ventilators, hygienization systems and personal protection elements, just to name a few. The fabrication files of these models were downloaded, adapted and materialized around the world using local technological infrastructure such as 3D-printers and laser cutting machines. To achieve these results, this network not only designed the products, but also created the platforms that allowed them to collaborate, organize and transfer, taking a second step in the global distributed fabrication effort. Although there were previous global experiences of collective intelligence based on open-source projects, like the Smart Citizen Kit, the speed, fluidity and scale of this experience has never been seen before.

In Chile, in the extreme south of Latin America, while the traditional industry kept exporting fruits, copper and salmon, self-managed makers networks successfully delivered thousands of face shields in record time to healthcare professionals. The initiatives even influenced the creation of a local temporal certification system for the medical supplies and devices, something more than interesting in an extractivist and non industrialized country like ours.

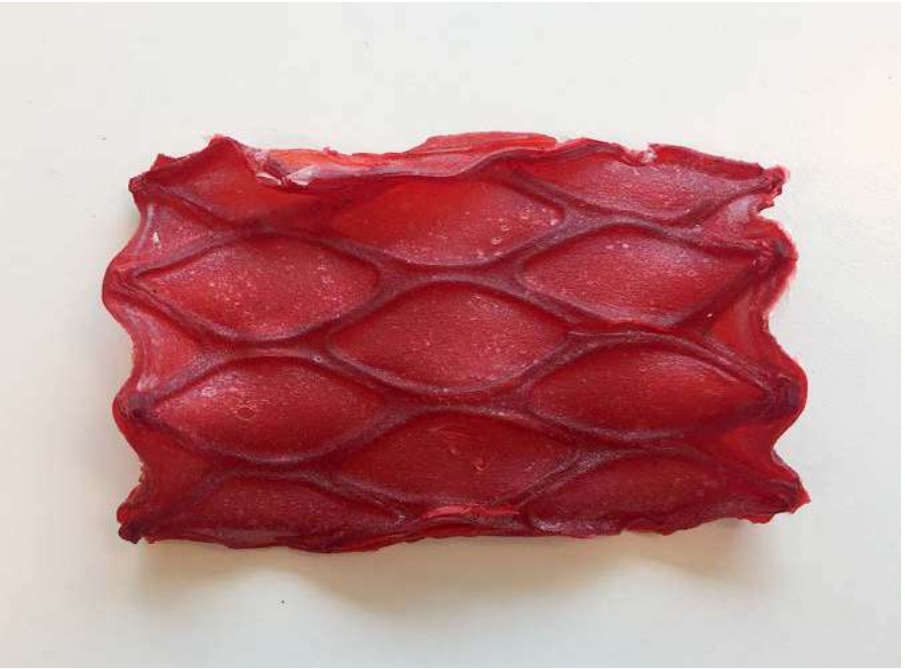
AFES CHILE, the "association of manufacturers for the sanitary emergency", in the first weeks of the health crisis gathered more than 60 partners of medical organizations, developers and manufacturers to the joint effort. The organization designed and spread protocols, standards, and co-design processes with the purpose of transferring high quality open-hardware designs. In a couple of months, AFES managed to develop solutions under Creative Commons licenses and transfer them along the national territory implementing Distributed Manufacturing models. What was needed was made where it was needed, almost in real time, showing the greatest value of the socio-technological distributed systems: resiliency (Manzini, 2015).

Through this experience, we believe that besides the epic of "life and death" during the crisis, the work was stimulated by shared principles, like the vision of knowledge as a public good and the assessment of cooperation as a solution strategy for social problems. This experience of joint effort has promoted an internal movement that is making us move from being a network to forming a community, even with the current physical distance imposed in the awakening of this new era.

In these months, here in the periphery, we live in a brief but profound illusion of change, where this collaborative experience makes us ask questions to keep growing.



Researching assembly modes with same molds but progressive variations of the biopolymer formula (2019, Santiago de Chile, Fab Lab U. de Chile + students Macarena Inostroza and Dominique Barros)



Researching assembly modes with same molds but progressive variations of the biopolymer formula (2019, Santiago de Chile, Fab Lab U. de Chile + students Macarena Inostroza and Dominique Barros)

Local Infrastructure, Foreign Materials

After these experiences full of positive findings, there is a B side that we have to rethink. As a direct consequence of our hyper-dependence (as a country outside the walls) of the supply chains, in the case of face shields and other 3D-printed medical items, by midyear, the good quality PLA was scarce in Chile. This was due to our reliance on foreign suppliers to obtain 3D-print filament and the closed border, so the stock broke on a national level. Thus, we started to use lesser quality filaments to fabricate and we also started questioning about the effectiveness of using the available PLA to produce, instead of dedicating the efforts in propelling the traditional industry to manufacture the face shields. Under this logic, the PLA would be used exclusively for prototyping, iterations, and improvements in the design solutions, and not to produce the end products.

In the context of this emergency, the life cycle of the products was not a priority. We develop short life products with non-biodegradable materials. The best case was the 3D-printed PLA, as it is compostable under very specific industrial conditions that are not common in Chile. The effort was centered in generating intelligent design and manufacturing, along with an efficient use of the materials, but with just a few alternatives available and running against the clock, we used what we had.

Endemic Matter, Development Drivers

What could have happened if Chile knew its materials and potential uses? In a country with a low industrial diversity, as an agricultural country, it is one of the top exporters of fruits and vegetables in the world, which travels as fresh fruits and frozen vegetables, and processes products such as dehydrated, canned, pulps, and juices. A high percentage of those tonnes remains in the country in the form of garbage, most of it is finally thrown into landfills. Considering this large amount of material that is decomposing in our country and the recent experiences of networking for the design and distributed manufacturing of medical devices with imported materials, could Chile use waste as material for 3D-printing instead of chinese PLA? Could this approach be a new way of thinking about productive and social development?

From its practical dimension, a key aspect to enable a distributed production model is to develop the capability of digital fabrication tools to work with local materials. Commonly, in digital fabrication, the more homogeneous and standard the material is, the more successful the result. That could be one of the reasons why it's more common to see plywood, MDF, and PLA in Fab Labs, rather than natural powders, fibers, or pastes. Is it possible to make digital fabrication technologies more flexible so that they can adapt to diverse and heterogeneous materials? That's our challenge.

Flexible Technologies, Endemic Materials

As Fab Lab U. de Chile, we are currently working on the "Digital BioFabrication Node", a project supported by the Ministry of Cultures, Arts and Heritage of Chile, the international biofabrication platform Materiom, and students and researchers from Universidad de Chile. It consists in the design, documentation and dissemination of an open-hardware creative laboratory for upcycling, capable of transforming local organic waste into biomaterials and bioproducts. Each laboratory integrates a set of low-cost, desktop-format tools and technologies to address different biofabrication processes, combining analog and digital processes, and sharing information through its use with other nodes distributed throughout the territory. The node is projected to be located near the waste generation zones, integrating the social and natural environment, also the creative and productive fabric of each place, showing the territorial diversity and sharing knowledge with other distributed nodes.

To nourish the Digital Biofabrication Node, we have been studying the organic waste of six Chilean agroindustries of different sizes in Chile's central zone (where our Fab Lab is located), to understand their life cycle, their environmental impact and their relationship with local communities. On the other hand, we have researched organic waste to reveal its intrinsic qualities. In this process that combines very methodic and also experimental phases, we are amazed to discover everyday, the potential of these despised matter.

An example is the cherry pit, gathered as waste of its industrial processing. In an initial study phase, we associated with an enterprise with 40 years of trajectory, that currently works with the packing and processing of cherry in

different formats. One of them is the maraschino cherry, from which 1,000 tonnes are produced yearly. To get the raw material, they work with a network of 500 people that do the cultivation and harvest of the cherry. In that sense the production of cherry, as many Chilean fruits and vegetables and seeds, is a distributed and networked production, mainly promoted by commercial relationships. Around 40 people intervene in the whole marrasquino process. The pit (15% of the whole fruit) is gathered after a seven-stage process. After the interviews and registration, the company sent us a sample of its waste to the Fab Lab to start our work.

Once we get the waste, we approach the experimental phase of biofabrication from three dimensions:

- Altering mechanical, chemical and sensorial properties of biomaterials generated with the waste.
- Exploring and exploiting formats due to the possibility of cooking the material.
- Discovering and studying innate properties of the waste tacitly in the Fab Lab and in scientific labs.

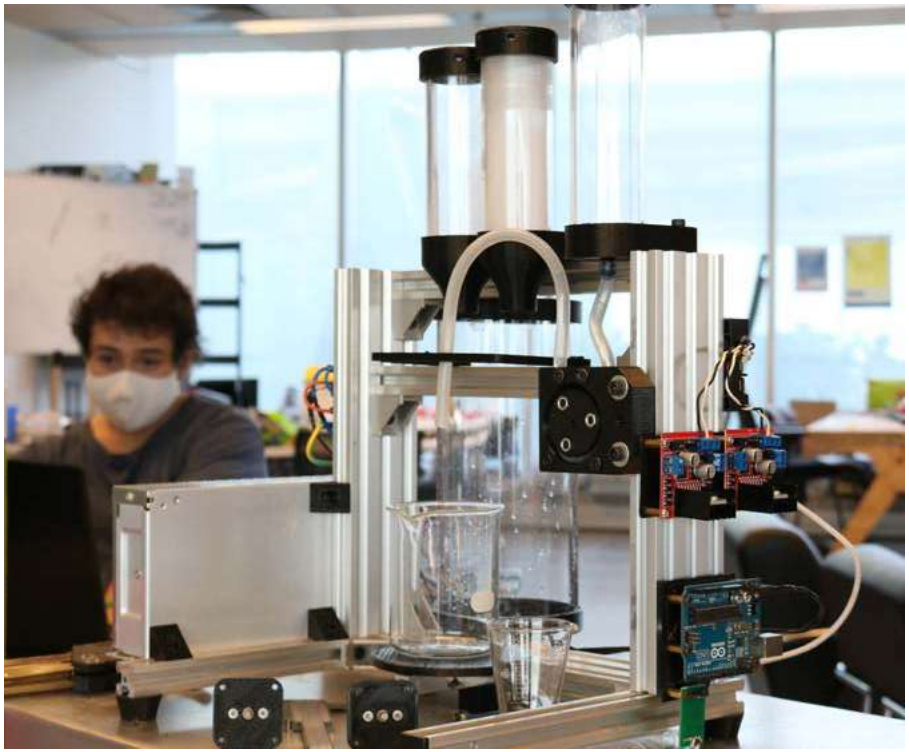
In some cases, we approach the fabrication of biomaterials from the extractive phase, gathering our own hydrocolloids: some gelling agents like agar agar or carrageenan from the red chilean algae, or thickeners, like starches extracted from potato or corn. This allows us to generate a very intimate approach with the origin and obtaining of the ingredients and, at the same time, give an explicit signal of the urgent need for the use of natural local ingredients that do not have to travel hundreds of thousands of kilometers to be used and then dumped in landfills on the other side of the world.

In a first approximation, we generated a biomaterial with a high percentage of crushed cherry pit, a lignin-packed residue that grants rigidity similar to wood. Due to the COVID-19 and the quarantines we experimented in a distributed way, and we realized that varying and controlling natural light and heat produced different colour tones on the surface of the material due to a natural oxidation process. This type of findings opens new possibilities in the design field. In this case, one of the novelties is the capability to “print” geometries on surfaces with low energy-means and without adding inks, and also, it is possible to project design and manufacturing processes that involve territorial variables such as light and temperature of the environment as inputs to the morphogenesis. In this case, we are also using in our favour, the dehydratation process of the biomaterials to generate object families, that are differentiated in terms of geometry and colour, allowing that the material express itself in a process of collaboration with the natural processes, in a constant dialogue between the natural and artificial.

As to the technologies that are part of the Digital Biofabrication Node, one of them is the Biomixer, a machine that integrates five different tools to digitally dispense and mix ingredients in different formats: pastes, powders and liquids, to make precise mixtures and sheets. Currently, the machine can create mixtures with high precision, and uses a software that calculates quantity and percentages, executes and stores recipes. During the process of biofabrication, it combines analog and digital operation, with the purpose to coordinate the stages precisely, but without pushing away the maker, as it happens with 100% automatic technology. In a second phase, the software will allow nodes to share recipes with other nodes to generate a network of knowledge with interconnected technologies.

We are currently working on a next version of the Biomixer, to grant it intelligence that allows users to choose material properties (such as flexibility, porosity, rigidity, etc) and that the machine acts consequently varying in real time the proportions of the recipe. To do this, we are implementing a neural network with the database from the research group of the Materiom.org platform, and more data generated in different labs of the Faculty of Physical and Mathematical Sciences of Universidad de Chile from biomaterials fabricated at the Fab Lab.

Other technologies that integrate the Node are 3D-printing, roto molding, vacuum forming and technologies for pre and post processes, as a digital drying and dehydration station, and a digital composter to measure and accelerate the process of biodegradation. Thanks to the integration of physical and digital technologies, the nodes share data and know how with other nodes. All the documentation of the first development phase of the digital fabrication node will be launched at midyear through the platform Materiom.org



Second Iteration of the Biomixer, assembled with durable and market-available materials like standard aluminum profiles, acrylic tubes and machined parts, projecting its replication. (2020, Santiago de Chile, Fab Lab U. de Chile + students)

Creative Citizens

The development of manufacturing processes, experimentation aimed at revealing chemical, mechanical and sensory qualities of the waste, plus the local extraction of ingredients, have allowed us to generate a more systemic approach to bioproducts design, placing the territory and its relationships at the centre of the distributed production potential.

´These projects illustrate how biofabrication excels when it integrates a territorial narrative and also contributes to solving local problems.´

A project in this line is the Didymo Lab (www.didymolab.org) which consists of the local application of the Digital Biofabrication Node in Puelo, an area in southern Chile that bases its economy on tourism and has been highly affected by the microalgae didymo. This is a highly contagious diatom that inhabits fresh waters and creates a mucous-looking mantle that destabilizes ecosystems.

The project consists of co-creating and transferring creative tools and methods that can be used collaboratively by local communities to counteract the ecological disaster produced by didymo. The purpose is to value the algae as a raw material that allows the development of bio-craftsmanship and thus become a source of income for the communities that have been harmed by the advance of this highly contagious plague; it is a very interesting material with high levels of silica. These projects illustrate how biofabrication excels when it integrates a territorial narrative and also contributes to solving local problems.

Flexible Technologies, Creative Citizens and Endemic Materials

The horizon of the project Digital Biofabrication Node is to contribute to generate a global network of design and distributed manufacturing based on connected flexible technologies, creative citizens and endemic materials. The purpose is to collaboratively promote, through technologies and collective intelligence, a new material culture for the self-sufficiency of the territories, once again endowing objects with a local narrative and promoting regenerative models of global innovation. The role of design, technology and biofabrication then, go from being partners of the prevailing economic model, to being tools to imagine possible futures.

Faced with a new health crisis in Chile, instead of applauding the special arrival of each roll of PLA for 3D-printing, could we transform our own olive pit into compostable Face Shields from the north of Chile? or in the south, to use corn leaves for biodegradable medical gowns? Or thinking of new scenarios, use them respectively to develop DIY water filters or suits with high UV filters? Is this a utopia? We think it's worth trying to find out.

Observing how a biopolymer sheet is deformed by its natural environment during dehydration, as a form of self expression (2018, Santiago de Chile, Fab Lab U. de Chile + students Macarena Inostroza and Dominique Barros)

Grinded Agar agar based biopolymers and other biomaterials mixed with organic waste to analyze how these biobased materials react to compost in a certain period of time. (2020, Santiago de Chile, Fab Lab U. de Chile)

Digital Complexity for Digital Factories

Extending Distributed Entrepreneurs' Cognition

Antonio Esparza Ph.D. from The Firm and The Product

A cornerstone of the transition to a more sustainable and fairer economic model is the substitution of conventional supply chains with distributed design and manufacturing. While a distributed manufacturing model can allow a reduction of the environmental impact of global transportation, a Distributed Design Network is necessary to create products that incorporate local resources and knowledge. Accordingly, distributed design and manufacturing are essential to the creation of circular economies that account for their peoples and territories without sacrificing economic development.

The main tools of the distributed model are the digital technologies that allow designers the incorporation of more product features without increased costs. Fundamentally, these technologies have changed the affordability of highly complex products that otherwise would have needed long fabrication processes composed of many small sub-processes. Each with its own environmental impact. Differently, digital manufacturing machinery, such as CNC milling, laser cutting, or 3D-printing, is able to manufacture these complex geometries without incorporating more machinery, more resources, and more personnel. Moreover, the cost of these technologies fell sharply in the last ten years making them accessible to organizations not related to manufacturing such as schools and public libraries. Therefore, proponents of distributed design and manufacturing highlight the potential in the diffusion of these technologies to create fabrication networks that translate blueprints into locally sourced products despite its nature and complexity. It is suggested that successful implementation can empower entrepreneurs to upset the economics of global supply chains and ease the urgent transition towards circular economies.

'Distributed design and manufacturing are essential to the creation of circular economies that account for their peoples and territories without sacrificing economic development. ´

It is worth noticing that back in 2005 MIT Professor Neil Gershenfeld, founder of The Center for Bits and Atoms, released FAB, a book that compared the development of computers, from mainframes to PCs, with the development of digital fabrication technologies (Gershenfeld, 2005). Gershenfeld uses this comparison to foresee a coming age of Personal Fabricators (PFs), that just as PCs, would revolutionize the world by allowing the distribution of fabrication and in its way, would change the way we do business. Gladly, this invitation was accepted by a widespread population of researchers and enthusiasts who, in the years that followed this publication, created many tools in this direction powered by Web 2.0. Examples include: rep-rap printers, wikis, creative commons licences, etc., universities, organizations and events followed by creating papers, degrees, research conferences, contests, maker fairs, and programs for financing these projects.

Considering that the principles of the distributed model were planted sixteen years ago and that infrastructure has been developed for entrepreneurs to use in the creation of circular economies, the expectations for distributed design and manufacturing projects are high. Yet, it is disappointing to see that the amount of projects that capitalize on the existing tools and explore the boundaries of circular economies are scarce. Furthermore, most have a speculative nature or have research purposes. On the contrary, manufacturing incumbents seem to better incorporate the benefits of the distributed model to their already established supply chains .

Some incumbent examples show business models where digital fabrication experiments are used to optimize temperature diffusion of injection moulding via 3D-printing (Mischkot et al., 2017). Others show data driven parametric models that simulate digital twins of complete building sites (Wessel, 2020; Per Aarsleff A/S, 2021). Even if arguably these examples only incorporate the distributed manufacturing side of the model, it is clear that incumbent products and business models exploit the benefits of distribution in a more complex fashion than the entrepreneurs who can better exploit both distributed design and manufacturing.

The examination of the differences between incumbent and distributed projects is necessary, especially considering that the transition towards a more sustainable economy requires the latter to substitute the former. In that regard, conventional models of entrepreneurship would suggest that the unsuccessful application of design and manufacturing distribution is just a reflection of a deficient dissemination of information or a misfit between opportunities and entrepreneurs' backgrounds (Shane and Venkataraman, 2000). This would mean that entrepreneurs are not able to see the opportunities that the social and technological landscapes offer because they are just not prepared for the task. Either because they have a background that does not match the field the opportunity lies in, or because they are not experienced enough. On the other hand, organizations that are successful are more prepared to see the opportunities and have more experience to react when needed.

This explanation is difficult to accept in view of the diffusion of digital manufacturing tools mentioned above developed since the first edition of FAB. This article would argue that it is not that entrepreneurs and makers are ill prepared to ideate, but that we as promoters of the distributed model

have ignored the role of organizations, as networks of collaborators, in the ideation of complex projects. Instead we have focused on the technology itself, based on an assumption that has been present in design engineering theory: that ideation processes are individual. In such a way we have packed complex manufacturing processes in portable factories such as 3D-printers but have forgotten to pack the structures that help organizations ideate complex products collectively.

Complexity Matters

In an article written for Foreign Affairs, Gershenfeld mentions: “The aim is to not only produce the parts for a drone, for example, but build a complete vehicle that can fly right out of the 3D-printer” (Gershenfeld, 2012). The statement, which he repeats often, highlights one of the main points of the comparison between PCs and PFs, the fact that the miniaturization of machines should allow them to build more machines by themselves just as PCs are able to make software. Conventionally, machines are described as assemblages of components that perform a specific task. Thus, Gershenfelds comments suggest that the concept behind PFs is not to produce anything even if a facility such as a Fab Lab can produce almost everything. PFs are thought to produce systems.

It has been well documented that technological innovation is embodied in systems that incorporate other systems to perform new functions (Anderson and Tushman 1990; Murmann and Frenken, 2006). This means that entrepreneurs that innovate, usually bring solutions that are already available for them in the market to build combinations that have never been seen before. The result of this process is the construction of nested systems and subsystems where the combined performance of each contributes to the emergence of innovative functions for the overall product (C. M. Christensen and Rosenbloom, 1995). Therefore, it is possible to say that technological innovation is no other than the way entrepreneurs compete, by introducing different configurations of components to fulfill performance requirements in a better and more efficient way. When seen from this angle, more innovation usually requires more complexity.

Professor Cesar Hidalgo explains that this complexity can be understood as information kept in the configuration of the products we design (C. Hidalgo, 2015). He demonstrates it by comparing the cost of a car versus the cost of the raw materials that are used to create the same car. If there was no difference, an expensive sports car would cost the same even if it crashed. However, we all know this is not true. The work made by Hidalgo and colleagues at the Observatory for Economic Complexity (OEC) uses the complexity of products to predict the macroeconomic outputs of countries like income, growth, or CO2 emissions (Hausmann and Hidalgo, 2011; C. A. Hidalgo et al., 2007; César A. Hidalgo and Hausmann, 2009). What makes this possible is the same nested nature of systems because the same complexity is reflected in the supply chains that are needed to build such products. The fabrication of products that are rich in information requires access to the networks of other products that carry information with them. At the same time, that network is also supplied by another network of products and so on. The research of the OEC weighs the complexity of imports and exports in a country to see how much information a country produces through its economy. Their results show that more diversely complex economies insert more information to its products, thus they create more innovation and economic growth.

In the light of information, it makes sense to say that the purpose of Gershenfeld’s machines that build machines is to enable the creation of products made of complex systems. Because in addition to sustainability benefits, this would foster technological innovation and economic development. A product designed for and manufactured by these machines could afford this complexity by incorporating information digitally that otherwise would be brought by a network of suppliers. Moreover, if the product is thought to use a distributed model, the complexity of the design has more impact the more nested systems are incorporated in the products architecture. From a design perspective, these products also have the potential of incorporating local systems, and the knowledge that comes with them. All these benefits can be contrasted to the fact that producing products of low complexity, even if produced locally, cannot compete economically with the capital and the economies of scale that global supply chains master.

A critical review shows that even when the complexity of the projects that give birth to products is high, entrepreneurs fail to transfer such complexity to the fabricated products. The winner projects of The Distributed Design Awards 2020, can be cited with the purpose of contrasting the complexity of projects against the allocated complexity in products. The Distributed Design Awards is a yearly competition organised by the Distributed Design Platform (DDP), that calls for design projects that exploit distributed design and manufacturing under seven categories: future thinking, cultural significance, circular design, adaptable and open design, sustainable production, design for emergency, and project excellence (Distributed Design Platform, 2020). The collaboration between DD Platform and the Index Project, a foundation that supports design led change, summons design projects that have the purpose of tackling urgent problems of large scale. Therefore, it is possible to say that the problems addressed by these projects are always of great complexity, involve a great number of stakeholders, and interact with many technical variables. Using the problems as a starting point, it becomes evident that despite the complex nature of the problem space, the resulting objects rarely present a great number of components or interact with other networked systems in a distributed fashion.

With few exceptions, the presented projects lack complexity in the architecture of products and do not guarantee that the implementation of the solutions fully exploit a distributed design and manufacturing model. This is not to say that the projects are not complex in nature but that the fabricated results do not incorporate nested systems. In such a case three scenarios exist for the implementing design venture: conventional manufacturing

Award category	Project	Problem	Designed product	Components	Site
Future Thinking	Waste Lab	Agricultural waste	Compostable composite that can use plastic manufacturing technology	Sugar beet leaves (fiber), Beet pulp (matrix	waste-lab.com/
Culture Significance	Plæntr	Gardening, sustainability, and mental health	Ceramic planters	Planter, dish	www.haenke.cz/
Circular Design	MY-X	Textile waste	Statement	Garment	https://nataliabarankova.gitlab.io/natalia.barankova/masterthesis6.html
Adaptable and Open Design	Otto DYI	Programming education	Educational kit	Visual programing software, 3D printable accesories, micro controller set	https://www.ottodiy.com
Sustainable Production	Cooling Bricks	Food refrigeration	Ceramic cooling vessel	Vessel, lid, water container, inner separators	http://helenelauppe.de/
Design for Emergency	Personal patient pack	Clinical single use plastics during COVID 19 pandemic	Patient pocket for personal	Strap, tubing pouch, canula pouch, bag valve mask pouch, RFID housing	https://www.instagram.com/maire_design/
Project Excellence	Core Relief	Humanitarian relief and plastic waste	Education program	Adaptable 3D printed furniture joint	https://www.latra.gr/

Summary of Distributed Design Award 2020 winner projects

scaleup, niche production, or complexity transfer to a program. First, in conventional manufacturing scaleup the solution has the potential of being better implemented through partnerships that have a good understanding of the supply chain needed. An example of this would be the Cooling Bricks, which in case of an increase in demand, the number of components makes manufacturing easier through conventional ceramic manufacturing, instead of technologies such as 3D-printing.

The second scenario would be an organization that produces a curated solution for a niche. Such can be the case of MY-X which aims to design “new wardrobe statements” that require the customization of all the supplies for each garment. It is easy to imagine the future of the venture serving a specific niche of customers that look for these statements and are able to participate in the curation and design of their own garments.

Finally, the transfer of complexity to a program means that even if the product is not complex as a system, it can enable the interaction of people in complex organizations. Core Relief clearly exemplifies how even if the product is 3D-printed, the complexity of the project lies in the implementation program. Core Relief uses designers and innovators next to digital manufacturing to teach and empower people in the Lesvos refugee camp in Greece. The program has the purpose of creating solutions to raise the living standard of refugees. In these three scenarios there is no doubt of the relevance of the addressed problems, or the competence and merit of the designed solutions. Nevertheless, neither ceramic coolers, parametrized wardrobe statements, nor 3D-printed joints for furniture have the potential to substitute complete unsustainable supply chains.

Cooling bricks (Lauppe 2021)

Origins of Complexity

To bridge the gap between distributed and incumbent models, it is necessary to understand how information is embedded in conventional product design and development. Evidence of the ideation processes in technological development suggests that conventionally, entrepreneurs engage in resource bricolage (Baker and Nelson, 2005; Sarasvathy, 2008). The term bricolage describes the process in which entrepreneurs recombine the means at hand (knowledge, products, partnerships, etc.) to find innovative solutions despite resource restriction.

The lack of resources in entrepreneurial projects is an innate condition in innovation, and an important motivator in this process. It is suggested that it forces entrepreneurs to find new ways in which their limited resources can be used since they cannot afford to acquire more or better ones. This means that entrepreneurs are forced to incorporate "off the shelf" systems that already perform functions that are needed as part of a new solution (C. Christensen, 2013). Likewise, if an entrepreneur is to design a machine she is not to redesign existing components that are not the focus of the innovation. This might be the case of standardized components such as motors, bearings, nuts, and bolts. Instead of engaging in redesign, the entrepreneur re-interprets how they work together in order to support the innovation at the core of the venture. By doing this, the entrepreneur offsets the cognitive load of redesigning multiple systems and focuses on the core of that which will develop competitive capabilities.

The way entrepreneurs tend to focus on the core of their innovation reflects the restrictions and strategies of human cognition. Different from other problems humans face, innovation and entrepreneurial ventures are affected by a multitude of factors, from the characteristics of the product and the actions of competitors, to macroeconomic phenomena. Understanding the cumulative effect of each factor would require the computation of convoluted models. Additionally, the way that the same factors interact among themselves makes the problem space "wicked" or "dynamic" meaning that it hardly presents the same conditions after each interaction. Thus, the creation of entrepreneurial ventures is often described as uncertain because the necessary conditions for predicting future venture performance are not available (Sarasvathy, 2001a, 2001b). As a result, it is problematic to assume that an entrepreneur or group of entrepreneurs with limited resources can afford to predict rationally how products, markets, and environments interact.

Instead of rationalizing each aspect of uncertain problems, it has been long established empirically that humans cluster information in "chunks" using rules of thumb (Norman, 2013; Simon, 1991). Chunking information creates structures that can be processed hierarchically by analyzing each cluster at a time. Using off the shelf components is one way of chunking information that lets innovative entrepreneurs reduce their cognitive load. Information chunking is also used to grow the venture and scale up production.

A large number of published studies document that once entrepreneurs start settling crucial details in the configuration of products, they form teams that specialize in the further development of each as if it were a chunk of information (Colfer and Baldwin, 2016; Querbes and Frenken, 2018). Moreover, when these clusters become fully developed, they become detached from the original team and form separate firms. Each fixated on the full production and development of the component and its interfaces within the system. As a separate organization, the detached team develops specific capabilities and resources, it moves to a location where their production is more effective and develops knowledge of its own. This model describes the way global supply chains can produce highly complex products. Established supply chains that produce automobiles, mobile phones, and computers, are the result of a long process of chunking and detachment that has shaped the global economy.

The introduction of digital fabrication technologies creates the physical infrastructure to incorporate complex systems with chunks of information similar to a supply chain. Yet as demonstrated above, the use of the technology alone does not support the cognitive processes that give birth to innovative and complex products. The study of product development with digital fabrication shows that even when the tools used to fabricate a product are complex, entrepreneurs are not able to think of complex products by themselves (Esparza, Sosa, and Connor, 2019). The evidence suggests that entrepreneurs start by chunking the venture problem thinking in symbols instead of making an analysis of the possible resulting systems. This conclusion is supported by the study of the differences between industries that produce products with similar components but different functions, such as helicopters vs airplanes. In such studies the differences originate in the very early stages of technological development where entrepreneurs think of the principles that define the solution (Murmann and Frenken, 2006). In other words, how the solution will solve the problem, not how it will be built.

The results of these studies suggest that if the problem requires displacing a heavy weight across a certain distance, an entrepreneur might start by thinking in the principle of “rolling”, “hanging” or “sliding” the weight. Whether the entrepreneur uses wooden logs under a platform or uses existing technology to build a complex crane or a rail system, seems to be a question of being able to process and incorporate these subsystems in the design.

Origins of Complexity

The gap between distributed entrepreneurs and incumbent supply chains is created by a reinforcing cycle of information processing present in conventional industries but not in distributed ventures. As discussed above, conventional supply chains are able to provide systems for entrepreneurs to incorporate in their ideas. What is more, the way entrepreneurs process information creates new subsystems and in the long run provides the economy with new supply chains. Additionally, this model of production provides mechanisms for entrepreneurs to process and govern the creation of products within itself. For instance, processes of business model and organisation design prompt the creation of hierarchical structures that favor the creation of complex products. Hence, a traceable path exists from firm, to divisions, to departments, to teams, each focusing on specialized functions that all together construct a competitive value proposition regardless of the technology used (Augier and Sarasvathy, 2004; Zott and Amit, 2010).

Organisational structures are easy to navigate and manage because they are also governed through contracts. Contracts in a conventional supply chain model define the chunk of information that each individual or organization is responsible for and how both sides will cooperate even if they do not belong to the same organization (Hart, 1988; Tadelis and Williamson, 2012). Hierarchies and contracts make product development complex and manageable at different scales.

Unfortunately, the way complexity is managed is not recognised in the literature and practices of distributed design and manufacturing. Instead, tools and programs are designed as if complexity was a matter of individual creativity. Open-source innovation platforms are a good example where unstructured information is presented as if the entrepreneur could afford the cognitive load to process everything by herself (e.g. Thingiverse, Instructables, Fab Academies, etc.).

At the same time these platforms fail to acknowledge that the cooperation between people who design and produce different systems is a process governed by contracts. Distributed Design and Manufacturing programs rarely acknowledge transaction costs and intellectual property, making cooperation between partners unpredictable and difficult to remunerate. This lack of cognitive processing aids and governance makes distributed ventures unable to create complex products. It seems to force designers and entrepreneurs to settle simple and manageable product architectures which cannot scale nor compete as conventional supply chains do. Thus, in order to substitute conventional supply chains with distributed ones it is necessary to supply devices that help entrepreneurs process and govern complex ventures.

First, it is necessary to support the creation of technical complexity in the same way off-the-shelf market components and organizational structures do. What we often forget is that markets and organizations are in essence artefacts that extend the entrepreneur’s cognition, that in this case, are artefacts designed to chunk information. Thus this means finding alternative artefacts to classify and manage technical operations and standards in a way designers can interact and build upon. The purpose of this article is to propose generative design as a tool to offset complexity that otherwise would be supported by industry standards and organizations. Generative design is a term that gathers different digital tools used in the exploration of the design space (McCormack, Dorin, and Innocent, 2004; Nagy, 2017).

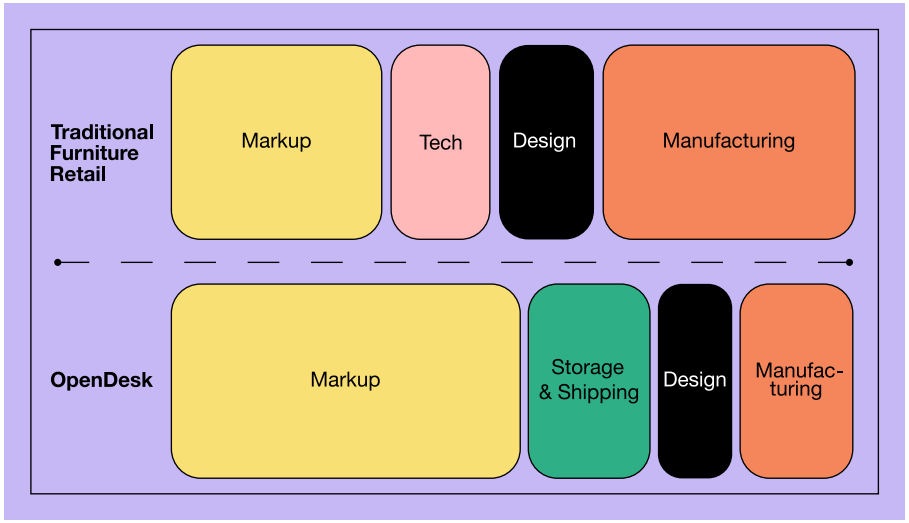
Parameterization of 3D printable furniture using generative design.

The use of generative design allows the designer to open up the scope of the process from the design of each component, to the design of the relationships that make them work together. Generative design works by defining these relationships as rules that the design process must follow even if the design parameters change. Designing a ceramic mug through generative design would mean to shift the focus from designing the shape, to the design of the rules that will create such shape under different circumstances. It would mean defining a goal like “holding warm liquids safely from the hand” and defining all the properties of the mug according to how “warm” the liquid is and how “safe” the hand can hold the object. Changing the temperature of the liquid would indicate the program to thicken the walls of the mug. While changing the “age” of the hand would indicate the shape and size of the handle. Through generative design, the designer compartmentalizes the design in functions in the same way a department would break up complexity in teams of designers. Generative design allows the distributed designer to absorb more complexity and manage the venture more strategically.

The use of generative design allows entrepreneurs to develop “artificial product development units” that can adapt complex architectures to local resources. A great example of their implementation is Stykka, a Danish brand that focuses on the digitalisation of furniture design and manufacturing. Starting as a laser cutting company, Stykka developed knowledge around the efficient use of cutting digital manufacturing in flat materials. The company used this knowledge to develop digital tools that reduce waste, making it more sustainable and cost effective. The generative design strategies used at Stykka compartmentalize the problem of building furniture in relationships that make digital fabricated furniture more effective even if the required result changes in complexity and size, from a chair, to furnishing a floor for a company downtown. Generative design allows Stykka to compete effectively against incumbent companies such as Steelcase or Ikea without having to develop a global supply chain.

One of the greatest advantages of generative design is the fact that operations that create components and interfaces can be shared in the same way off-the-shelf components do. Generative design tools can be shared and bought in gits, the same way programming language libraries work. The challenge in the implementation of generative design lies in changing the focus of design education to incorporate programming languages and strategic thinking. This, without losing touch with the relevance of user experience and perceptual aspects of product interaction and function. Likewise organizations and programs that support distributed design and manufacturing should focus on the diffusion and categorization of generative design operations in the same way industrial chambers promote industry standards. Such measures would help designers incorporate existing nodes of information as subsystems without depending on global supply chains.

Secondly, supporting cognition of complex product architectures needs the diffusion of alternative contract mechanisms. The purpose of contracts in economics is to fixate transactions between partners instead of negotiating conditions everytime goods and services are exchanged (Coase, 1937). It can be argued that firms themselves are artefacts composed by contracts that direct the behavior of the people within it (Esparza, Sosa, and Connor, 2017). Many of the functions of the firm itself are concentrated on the surveillance and fulfillment of contracts. Working in a distributed fashion requires tools that surveil and enforce cooperation between entrepreneurs who work together but do not belong to the same organization. Just as in the case of generative design, the digitalization of contracts has the potential of compartmentalizing information for entrepreneurs. Digital contracts have been common practice since the appearance of Web 2.0 business models that allow micro transactions, especially the ones that power the gig economy.



OpenDesk business model (Opendesk 2021).

Digital contracts set in code the surveillance of the fulfilment conditions creating an advantage over supply chains that use traditional contracts enforced by employees. A successful example of digital contracting in a distributed model can be found at OpenDesk. Founded in 2013, OpenDesk connects designers and cnc workshops with consumers. While most of the media attention highlights the design perspective of their open sourced products, the sustainability of the model rests on the contracted network of suppliers. The contracts provided by OpenDesk fixate the product’s design and profit margins for designers. This lets fabricants compete by making manufacturing more efficient without worrying about distribution and design activities. When ordering a piece of furniture, customers request a quote from OpenDesk suppliers. Once an offering is accepted, the payment is distributed according to OpenDesk business model sparing transaction costs for all parties. This model also allows manufacturers to produce on-demand, which means that other ill-structured costs such as transport and storage are also skipped.

Plantoid instance (De Filippi et al. 2015)

Smart contracting based on blockchain is a new and interesting direction to explore in distributed design and manufacturing. Different from online business models, smart contracts are able to automate every aspect of the transaction in code without any organization owning them. This is possible since the validation of each transaction is distributed through the blockchain. The Plantoid, an art experiment by Primavera de Filippi, is a hybrid of a sculpture and a smart contract that self replicates using a blockchain wallet. The Plantoid receives payments from the public that attends its exhibitions and stores them in a bitcoin wallet. When the artwork gathers enough funds, it calls artists who wish to create a reproduction of the plantoid with a separate copy of the bitcoin wallet. The process creates contracts with rights and obligations for funders and producers that interact with the sculpture. Funders earn rights to participate in the way the sculpture evolves and reproduces. Producers get credited for the construction of the artwork and earn a remuneration for their participation. The smart contracts in the Plantoid distribute and settle decision making across stakeholders that are not part of an organization in a way that could be translated to distributed ventures.

Conclusion

Enough evidence exists to demonstrate that a full implementation of a Distributed Design and Manufacturing Model requires the development of cognitive aids that match the affordances of the available technology. A quick survey of open-source platforms will confirm that the complexity of a majority of products is low and can be better reproduced by conventional supply chains. The purpose of this article has been to shift the focus of our discussions from design concerns and individual creativity to the development of cognitive aids that facilitate the incorporation of more subsystems in entrepreneurial ventures. It has been proposed that the development of tools for distributed design and manufacturing can exploit two avenues: the promotion of generative design and the implementation of digital contracting. Both avenues require that promoters of distributed design and manufacturing develop capabilities beyond design itself and venture into the technical aspects of digitalization of design, and the design of market institutions. The focus of our efforts shall expand to the design of organizations and standards that uphold information in the same way conventional supply chains do.

Enough examples can also be found to suggest that facilitating the incorporation of technology builds competitive business models that are not less interesting than the ones we see today. With this perspective change it is possible to foresee future scenarios where entrepreneurs ideate a solution such as the passive cooling principle behind Cooling Bricks. Yet, instead of being limited by the lack of complexity that surrounds them, they could incorporate algorithms for the design of cooling channels in modular components.

It is possible to imagine a venture that establishes a solid competitive position on the knowledge of thermal diffusion and fluid dynamics in ceramic structures. The mix of digital aids could bear the cognitive load needed to design a system that matches the size and capacity of a fridge. The firm could hire local suppliers and incorporate their knowledge of local clays and processes in their generative algorithms. Then, a venture that can produce a food cooling device using digital manufacturing and locally-sourced clay can be a match to a very effective but unsustainable supply chain that produces refrigerators.

A venture like this would enable the already creative design population to exploit digital fabrication and produce machines instead of simple components as envisioned by Gershenfeld in FAB. Like this example, it is possible to find many that have the potential of disrupting established industries sustainably but are inadvertently limited by forces they fail to recognize. It is our duty to expand our vision of product design and venture in other areas to challenge industry incumbents if we ever want to accomplish economic change through distributed design and manufacturing.

RE_label

Vincent Guimas from Ars Longa

Reuse, a Common Idea for the Territory.

On January 1st 2021, a major new law came into effect in France. The Anti-Waste for a Circular Economy (AGEC) framework has already been applied in many sectors impacting single-use plastics, lengthening the life of products, preserving resources, and increasing recycling. RE_label responds to this context by facilitating the implementation of ecosystemic practices for a circular economy approach at the territorial level, starting with small-to-medium-sized manufacturing workshops.

Over the past ten years, dozens of manufacturing workshops in Northeastern Paris, from third places to small businesses, have been establishing a territorial approach to sharing services, skills, tools and training. The social mission beyond their productive, manufacturing function, is to demonstrate that practices with less ecological impact are also more energy efficient and distributed. However, their activities are currently non-formal, inefficiently coordinated and in many cases invisible in the classic economy. RE_label proposes a scheme to formalise the actions of such local ecosystems and to provide tools and methods to connect the workshops, storage facilities, designers, manufactures. It is their aim to formalise territorial reuse practices by making them visible and able to be replicated in other localities.

About Re_label

RE_label is driven by the Ars Longa association, a member of the Distributed Design Platform, based in the North East of Paris. It is partly funded by the REFLOW Horizon 2020 project (reflowproject.eu) which brings together universities, associations, companies of different sizes and nationalities in six European pilot cities. In Paris, the pilot seeks to understand and transform urban material flows, co-create and test regenerative solutions at business, governance, and citizen levels to create a resilient circular economy focusing on the events sector and more particularly the flow of wood. RE_label has been developed in this context based on the work and expertise of local partners Fab City Grand Paris association, the Volumes Coworking company and the City of Paris.

Over a year, the team investigated the material reuse practices of designers, craftsmen, workshops, storage places, temporary places, resource centres and wider community. The information collected over this time offers a reading of the existing strengths and weaknesses of reuse practices between actors on the ground, for example how materials are being circulated or upcycled locally. Research found that the most necessary task to facilitate local circularity is qualifying and reintegrating materials from a “first life” into a new project. This work can be taken on by designers or makers in addition to their work. It often goes unpaid and is under-appreciated by the local ecosystem, so the Ars Longa team focused on the potential of streamlining this task through Re_label.

‘Re_Label promotion in Paris, via Ars Longa

How does RE_label work?

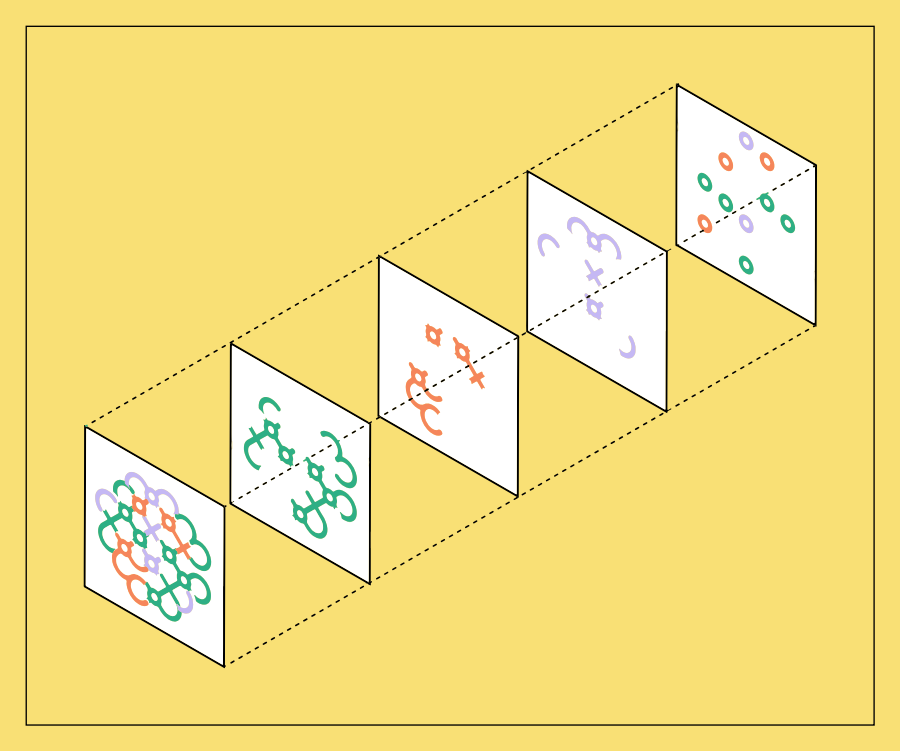
RE-label is a toolbox made up of a map, a form and an online generator made freely available and collectively managed by the community. RE_label proposes the three key functions as an ecosystemic approach to implement local material reuse strategies with small-scale workshops and their makers and designers.

Firstly, an observation period is required by workshops to develop a map of the existing local effort across human and material resources and their quality. This is mapped and catalogued, becoming the first entry in an evolving database that collects the efforts of all participating spaces in the territory. The cartography becomes a visual representation which can be updated monthly (by default) to track the basic and extraordinary activities in the territory. This intends to make the individual actions of each workshop visible

while potentially streamlining their interconnections and enhancing their reuse practices between local actors.

RE_label also proposes to certify products based on qualitative and quantitative characteristics. This is of special interest to designers, who are developing products that incorporate reused or recycled materials. During a sale, a project or an object, which is either unique or part of a series, receives a special “certification” of its provenance, linking the product to the workshop and/or creator. At the same time, the certificate can document details such as the origin or previous “life” of the materials or their qualitative characteristics or resource input. The digital certificate is signed by the designer or workshop where it was made, and can be accessed in the event that the materials of the product are recirculated back into the local circular material economy.

Thirdly, in the RE_label approach, each ecosystem has the possibility to build up an online catalog of RE_label objects. This can be a powerful tool to boost collaboration between workshops by sharing and optimising design information including cutting files and allowing access to a standardised library of “spare parts” that can be used across multiple design functions and cut from workshop waste.



Anatomy of the generator : successive layers giving information about the reuse level of a product (management, production, materials, partners). Thibaut Louvet, Ars Longa, 2021

Initiating Re_label

Re_label presents an opportunity to raise awareness of reuse in any local territory. Key to the implementation of the approach, is the activation of the community, in particular local facilitation. This is undertaken by one of the local stakeholders, who can come from the private sector (association, cooperative) or public institution (local authority: city, urban community, department or region). The coordination role may be undertaken according to the governance tools used in the territory. It has not yet been a focus of the research to understand if this role could be fulfilled by a large company.

The coordinating entity initiates the project, ensuring a common commitment between the actors to develop an integrated practice for reuse in local design and making. Based on the experiences of the Paris pilot, it is necessary for the facilitator to organise one or more workshops to get the system up and running, ensuring that the first results are well coordinated and there is local communication around the project. The role as orchestrator must facilitate the initial input of data from participants, report collectively on developments, welcome new actors and encourage trust between participants for a peer-to-peer collaboration.

The coordinated activities of RE_label aim to collectivise and distribute the tasks of material sourcing, analysis and processing materials from “first” life to “second” life through heightened efficiency and cross-sectoral collaboration. The Re_label pilot in Paris, revealed new material and supply variables such as the quantity and quality of an ephemeral material or fluctuations in material quantity or quality. Makers and designers working with local territorial reuse are subject to such additional constraints within their design process. In Paris, these new parameters offered local makers and designers an inspiring framework for their creations, encouraging a new way of thinking about design.

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From Distributed Design to Participatory Production

Building an Internet of Production

Andrew Lamb & Barbara Schack from the Internet of Production Alliance

The Missing Internet

Anyone, everywhere should be able to participate in production. The open infrastructures of the Internet (protocols, data standards and data systems) rapidly gave the power to create digital content to anyone almost everywhere. They connected the means of production of digital content that we are all so familiar with now – our computers, cameras, phones and microphones.

Meanwhile the open infrastructures needed to distribute the power to create physical things have been slower to emerge. So while the means of (participatory) production of physical things certainly do exist (digital fabrication machines, open hardware, makerspaces and Fab Labs, etc.) and are spreading across the world, they just aren't connected together yet. Yet open hardware could be likened to building blocks that should serve as a public resource. (Dosemagen et al., 2021), (Austic, 2021)

These infrastructures are emerging now in what is being called an "Internet of Production". Indeed, they are already being put to good use by enabling Distributed Design to become Participatory Production. They are opening up the power to create physical things to young people in Nepal, refugees in Uganda, start-ups in Kenya and makers in makerspaces across industrialised countries. These people are participating in production and competing in the marketplace alongside globalised mass manufacturing.

Consumers are not Participants

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It Starts with an Alliance

The Internet of Production Alliance brings together individuals and organisations with a shared mission to enable anyone, everywhere to participate in production.

The thinking of this group aligns closely with the thinking that underpins Distributed Design, re-distributed manufacturing and initiatives such as Fab City. Generally, rather than emerging from within industry or the maker movement, its participants are tackling diverse problems from sectors or countries with immediate needs and where the solutions take inspiration from the promise of open hardware, the maker movement and digital fabrication. What brings them together is their common need for "ecosystem innovations" that should reach far beyond their domain of action; in short, they need the Internet of Production to exist, so they work together to build it. This means collaborating in the creation of open digital infrastructures that together will underpin the Internet of Production. Currently, this takes the form of establishing five families of data standards covering the five elements needed to make anything: designs and documentation; machines and tools; people and skills; materials and components; and contracts and business models.

Open digital infrastructures for Distributed Design to go global

The Internet of Production Alliance has released its first two open standards: 'Open Know-How' for the discovery of designs and documentation online, and 'Open Know- Where' for the geographic location of machines, tools and manufacturing facilities. A participatory process was used to design these two standards. Desk research and interviews were used to bring together open collaborative working groups involving many stakeholders of distributed manufacturing who would use, or have themselves already created through their work, similar relevant datasets and structures. The intention

was not to reinvent the wheel but to look for what all the existing initiatives had in common, or wished they had in common. This was supported by an online platform (based on Git) and technical authoring. This approach is deliberately different to the prevailing method for establishing a data standard in the tech sector – which is often for everyone to adopt whatever the biggest player in the market uses – because of the need to live up to participatory values. The needs of a start-up in Kenya are different to the needs of a major online design platform or a group of scientific researchers – but they should all have a voice. A key challenge throughout the work for the Alliance is to determine where to draw the line between what should be built-in to one of its standards and what should be left for others to build on as they customise their standards to their own use cases, processes and platforms. Standards shouldn't be too customised or complex if they are to be useful to everyone.

Open Know-How [20]

An open standard for sharing "know-how" was released by the Internet of Production Alliance in 2019. It is an open data model for sharing metadata about hardware designs and documentation, aimed at significantly improving the discoverability of hardware designs online (future standards in this family will focus on portability and interactivity of hardware designs and documentation). With more than 80 hardware-hosting platforms, thousands of open hardware initiatives alone and millions of designers sharing hardware designs, there is little consistency as to how know-how is documented or shared. Makers struggle to locate what they need, not knowing which platform to best find other people's prior work and what the intended use really is. Whilst designs and documentation may be available, it can be impossible to find and (re-)use. The Open Know-How standard supports the discoverability of open hardware regardless of where it resides on the World Wide Web – personal websites, organisation websites or online platforms. One example application of it is in enabling online hardware search engines to encourage design publishing and re-use, and the ability to filter search results by, for example, whether the design is open hardware, whether the hardware has already been made or the availability of operating instructions / user manuals.

Open Know-Where [21]

In 2020 the Internet of Production Alliance released the Open Know-Where standard. This standard helps to share data on the geographic location of machines, tools and manufacturing facilities: so people can know where something can be made. Digital maps have made it possible to quickly find stores, restaurants and libraries nearby, as well as details of their contacts, opening times and reviews. In many places, they have replaced the telephone directory and offer better functionality too. The objective of an open standard for locating machines is simply to add machines to the map. Open Know-Where allows maps to be searched for, say, "3D-printers near me" – with data to be drawn from a huge variety of platforms, projects and self-reporting. When more detail is added, specifications of nearby plastics factories can be matched up with hardware designs, or makers can see the status of machines in a local makerspace.

What will this mean? It means that, in addition to the functionalities of maps that use Open Know-Where, there is an awareness-raising impact because people can see the manufacturing capabilities that exist in a place. This changes attitudes. The idea that products have to be made elsewhere and shipped is quickly challenged when people can see what exists in their local area. Picture the humanitarian health worker preparing for COVID-19 response in a refugee settlement in northern Uganda; by mapping sewing machines using this standard, the possibility of procuring locally made face masks from refugees with sewing machines – rather than importing them from Turkey or China as usual – becomes very apparent. (The Open Know-Where standard is being used by the Humanitarian Open Street Map Team in Uganda, in partnerships with Field Ready and the Ugandan Manufacturers' Association, to map manufacturing capabilities in and near the enormous refugee settlements there).

"Laisa, from Field Ready, checking the Face Shield's Dimensions", 2020, Field Ready, Creative Commons Attribution 4.0 International CC BY 4.0

What's next? The Internet of Production [22]

In the 2020 Distributed Design book "Viral Design" it was noted that "an inventory of local materials and manufacturing capacity could (...) serve as a tool for designers, manufacturers and others that play an important role to revitalize local economies" (Diez, Baeck, 2020). Open Know-Where helps to address the question of manufacturing capacity. In 2021, the Internet of Production Alliance began scoping exercises for standards on materials and components that will support participatory production. As always, the aim is to enable and harmonise inventories – to allow datasets to talk to each other, in the same way that data standards allow data to be shared on the Web. If you have the designs, machines and materials you need to make a product then you'll need the people to make it – and people with the right skills to deliver the appropriate quality. Makers all over the world want to earn livelihoods through making. Most makerspaces have skills or training recognition systems – no matter how informal or formal. Technical education, training and professional institutions award qualifications based on learning and experience and engage in national or international mutual recognition protocols to enable mobility.

The Internet of Production Alliance is starting a project in 2021-22 to scope out and develop a data standard in this space that would become an open digital infrastructure for recognising and finding people and skills. The process will begin by inviting a range of visionary stakeholders, existing solutions and need-knowers together to collaborate on this challenging endeavour. Finally, but for many, most importantly, the Internet of Production has to enable new contracts and business models for distributed, participatory production. Since 2015, members of the Internet of Production Alliance have been exploring this Issue. Manufacturing Change has undertaken research on the business models of makers (particularly in less industrialised countries); MakerNet.org has explored data systems for payments to participants in distributed production; MakerNet.work has developed concepts and prototypes for economic eco-systems within and around makerspaces. In 2022-23, The Alliance will publish the results of its research in these areas and find opportunities to apply learning through more production contracts, start-ups and projects.

Making it real by addressing challenges

There are three practical challenges that are driving the building of an Internet of Production today: open hardware, design re-use and quality management. To make Distributed Design and participatory production real, members of the Alliance are spending significant time and effort to address these challenges in their daily work. Progress on overcoming these challenges has been accelerated by the response to the COVID-19 pandemic because, in short, obtaining PPE and other supplies has become more urgent and alternative means of production are generating more interest than ever before.

Open Hardware

A main focus of work to date has been around the distributed design of open hardware and its documentation. Creating new open hardware designs, checking them, documenting them, improving them, publishing them, sharing them and certifying them – and the systems and tools to support all of this – are daily tasks for many members of the Alliance. The Internet of Production, like the Internet, will be built on open standards. But the Internet of Production isn't just for open hardware in the same way that the Internet isn't just for open-source. To reach its full potential, the open infrastructures for participatory production must enable distributed teams of designers and manufacturers to collaborate together to produce proprietary products, including using patents, as much or even more than it supports open hardware.

However, the full potential of participatory production is best expressed through an understanding of open hardware because of the freedom to use and reuse other peoples' designs. Complex design processes can be significantly simplified and accelerated, so that they are produced and can have an impact sooner and more efficiently. Open hardware means that the embedded energy cost of design processes does not have to be incurred over-and-over again wherever an item is made – this is vital for the effectiveness of business models built upon economies of scope. Of course, it means that a participating producer does not necessarily need to fully understand the details of a design, or to repeat design steps or a design compliance process, because they can just choose a design based on how well its form and function align to their local market. They can follow the documentation and know that it works. While this risks turning producers from active participants into passive consumers of designs in a distant future, that is not the reality today. Open hardware designs are also life-saving in disaster response, where having designs ready to go means the production of aid supplies can begin well before traditional international supply chains are put into action.

Though there are an increasing number of open hardware licenses in use, a technical challenge remains in actually discovering designs that already exist, in sharing, using and reusing digital designs and documentation. This is what the designs and documentation family of standard, starting with the Open Know-How standard seeks to address.

But the bigger challenge today is the paucity of Open Hardware designs. Members of the Alliance usually have to use distributed design to create useful products their markets need for the first time.

The shortage of "'useful"' open hardware designs, whose purpose is positive social impact, compares poorly against the easy availability of novelty items. Particular areas of focus are Open Hardware designs for medical devices, scientific research, aid supplies, spare parts and repairs, prosthetics and orthotics and indeed high-quality, affordable machines. The COVID-19 pandemic has seen a surge in new designs for Personal Protective Equipment.

Design Re-use

We must learn to celebrate the reuse of existing designs.

Today we tend to honour and reward people who design something for the first time – a new product, a new way of doing something – when actually the world has a much larger problem of the distribution of what already exists.

The cult of the inventor is far more prestigious than the narratives that surround the re-user; such as those of copying, plagiarism and theft. Publishing a patent is held in far higher regard than using a patent. Happily, the narratives around repair and maintenance are slowly improving. The open science hardware community is also a source of inspiration, where attribution has been likened to citation, which, along with repeatability and replicability, are identified as essential pillars for quality science and open hardware, honouring the capacity to replicate. (Gibb,. 2021)

In the maker movement, makers are prone to their first step being the design of something for themselves rather than looking to see what designs are already exist. This is because of the sheer joy of making and the expression of the power to create.

Creation is celebrated amongst Internet of Production Alliance members today. For example, Field Ready has an indicator on its annual global dashboard measuring the number of new designs of Open Hardware aid supplies it has published. This is because it is filling gaps. But when it comes to responding – and now with so many designs of hand-washing stations, face-shields and assistive devices to choose from – a harsh new mantra has been introduced to Field Ready's engineers: "if you are designing you aren't making, and if you aren't making you aren't helping people".

It is intended to trigger a change in the learned behaviours of makers and engineers to automatically design, rather than to automatically see what has already been designed. Unfortunately, so far, no meaningful way of celebrating design re-use has been found. In the future we must celebrate the re-user just as we celebrate the designer today. As more and more designs are opened up, published or shared, it is almost as if we need to celebrate people not designing things.

This will take an enormous shift in the engineering, technology and maker cultures. But it also has to be far better supported by the open digital infrastructures that make up the Internet of Production – and all the tools and platforms that are launched on the Internet of Production.

Quality Management

The challenge of distributed manufacturing is the challenge of distributed quality control. Internet of Production Alliance members have a range of ways of supporting distributed quality control today.

Good quality documentation: Systems to check the quality of designs and documentation, such as: internal peer review; internal review by more experienced engineers; publishing openly online and asking informed communities for feedback; pro-bono or paid external expert review; direct requests to interested organisations (such as Fab Labs) to make the product using the designs and documentation and to give feedback; asking volunteers and interns to follow the documentation and make the designs; establishing best practice or good practice guidance for documentation, and; rating systems for how complete or ready the documentation and the designs are for Production.

Certification

Certification of designs and documentation and their manufacturing processes in accordance with applicable standards set out by national or international standards bodies.

For example, a crucial standard is ISO 13485 for medical device quality management systems. Currently very few Open Hardware designs are certified and those that are tend to be for the more simple, high impact medical implements such as the Glia stethoscope or the Helpful Engineering face shield.

Certification of Open Hardware through initiatives such as OSHWA certification scheme or the adoption of the new DIN SPEC 3105 for Open Source Hardware are vital for building trust with (re)users of designs.

These two particular schemes are free to the designer, but most certifications have very high costs and represent significant barriers to participatory production – though several efforts are underway in light of the COVID-19 pandemic to address this.

The Internet of Production Alliance will support the development of ISO standards for Open Hardware and similar initiatives in the future.

Quality of materials: The quality of materials and components has to be assessed. This is often done by the designers, the producers and the users, or indeed combinations of all three. Often the assessments are not based on primary materials and components testing but rather on the performance of prototypes and sample products from small production runs.

This is partly because, in many parts of the world, regular supplies and components cannot always be relied upon (so need to change frequently or material recovery and recycling is needed) and materials datasheets are not always truthful. Inspections and capacity building:

Increasingly, we are seeing that Alliance members have dedicated staff who work on capacity- building and quality management as participatory production scales up and out.

These staff are engineers who conduct visits to local manufacturers, rather than directly making things themselves. This tends to only be viable in circumstances where the cost of supply chains is enormous relative to the cost or complexity of the product. It builds on economies of scope, meaning that engineers doing the visits oversee the production of a huge variety of different products by a large number of local manufacturers. Such work calls for very high levels of technical skill, professionalism and empathy. These skills can be hard to find locally in many parts of the world, but the situation is changing fast.

What's Next?

What has not yet been done amongst the Internet of Production Alliance membership is the distributed production of proprietary hardware. It is also difficult to internationally license hardware patents at the speed of participatory production, so new ways of recognising and securing intellectual property will need to be explored. Scaling up and scaling out participatory production calls for automated contracting and payments along the chain of designers, producers and suppliers that are involved in producing a product.

What tends to happen at the moment is that such payments are done manually, where the designer might pay a producer and the producer pays the suppliers for the relevant materials and labour.

However, in many parts of the world, this causes not only enormous difficulty in international transfers but also difficulties around cashflow. People don't always trust that they are going to get paid.

In traditional approaches with large, centralised manufacturers, customers do not usually pay the producers until after the product is handed over. This approach is not viable in most participatory production.

For small producers with little access to financial capital, customers must get involved in purchasing materials and restructuring production contracts to enable production to begin. What is needed is a series of open infrastructures around payments – covering designs, materials, components, labour, quality control, machine access and last-mile delivery – and proven, trusted contracts that are based on business models that are better suited to participatory production. Establishing these infrastructures is one of the ultimate objectives of the Internet of Production Alliance.

"Manufacturing Change workshop", 2019, Kenya, Manufacturing Change, Creative Commons Attribution 4.0 International CC BY 4.0

Pioneers of Participatory Production

Field Ready has pioneered the use of digital fabrication, local manufacturing and distributed production in humanitarian aid. It works to enable the local manufacturing of aid supplies in disaster response, preparedness and recovery. In eight years of activity in the field, its work has developed from deploying and manufacturing aid supplies itself using digital fabrication tools to mobilising networks of local makers and manufacturers to respond. It increasingly engages in developing makerspaces or Fab Labs, and the communities around them, in difficult environments – and delivers training and capacity building covering topics from design to digital fabrication to electronics to business skills. In 2020 Field Ready directly assisted 103,000 people and supported 1 million people indirectly through its work. It helped to locally manufacture over 100,000 items of PPE in the response to the pandemic, 22,000 items for water and sanitation in response to crises in the South Pacific and repaired hundreds of medical devices in Syria. It trained 4,885 young entrepreneurs, makers and manufacturers at 113 training events, mainly in Iraq. Meanwhile, it has been developing innovations in plastic recycling, distributed design, consumer protection and the governance of distributed manufacturing.

In 2021, a major focus for Field Ready has been responding to the COVID-19 pandemic by locally manufacturing items that reduce the transmission of the virus in conflict affected communities. This response is a major step in scaling out Field Ready's work – because it is not, itself, making a single item. It is enabling networks of local manufacturers to use Distributed Design and participatory production to make them instead. By working with partners from NeedsList and Humanitarian OpenStreetMap Team, the approach is to match verified needs (demand) with local manufacturing capabilities (supply). A key output will be to present these on digital maps, using the Open Know-Where data standard. So far, its work has delivered 150,000 items of PPE by engaging 50 local manufacturers – Field Ready provides the digital designs, the quality assurance and the interface to the humanitarian aid market. Its order book currently stands at 450,000 items to be made by the end of 2021. This work is transforming the traditional paradigm of humanitarian aid where supplies are mass produced and shipped. It is giving the chance for, for example, refugee-led groups with access to sewing machines in settlements in northern Uganda to make and sell products on contracts with the United Nations World Food Programme.

Another example from Bangladesh is mobilising small businesses to engage in the distributed mass production of face shields for the Rohingya refugee crisis to supply local implementers of large aid agencies, who are often poorly equipped with PPE.

These types of manufacturers would usually be overlooked in aid supply chains but this work is proving that participatory production can provide aid more cost-effectively and locally – with more aid money going into local livelihoods and resilience.

Wikifactory

Wikifactory is the world's leading social platform for collaborative product development. Their platform enables individuals or teams to share innovation more efficiently, prototype faster and manufacture smarter – from wherever they are in the world. Its tools are helping to scale up distributed design and participatory production. In 2021 Wikifactory has over 100,000 users and hosts 5,000 varied projects of collaborative design, many of which are being manufactured around the world. 52% of the Wikifactory community is based in developing countries including in Latin America, India, South East Asia and Africa. Project downloads (re-use of designs) are constantly increasing; a project initiated in Berlin might be elaborated and activated in Addis Ababa, and vice versa.

Wikifactory is also working on a manufacturing marketplace. This will support designs being produced with multiple manufacturers in multiple places. Their tools aim to make this process, which is currently manual, far easier. They are working on defining the core tools that will remain open source, and they are initiating a sponsorship program for paid-for elements of their solutions to make them more affordable.

Wikifactory is making distributed design real by widening participation in production. As a collaborative social platform with a global community, Wikifactory is in a unique position to facilitate useful technological and industrial participation worldwide.

Manufacturing Change

Manufacturing Change's work helps make manufacturing local and circular and focuses on parts of the world that have the most to gain from participatory production – places where you can't get anything you want delivered within 24 hours. It is driven by a question: what if every community – whether it is in an informal settlement, a town in a landlocked country, a village in the mountains, a refugee camp – had businesses able to make a large part of what they need? Manufacturing Change develops and shares business models to enable distributed design and participatory production to grow as an ecosystem – business models where many different entrepreneurs and small businesses can participate. It looks at the resources (machinery designs, product designs, template business models, funding sources, ways to plug into both local and global support and supplier networks) that would make it easy for entrepreneurs to set up profitable businesses making products needed by the local population.

Collaborations with entrepreneurs, businesses, NGOs, academics and other groups are used to bring the right set of people to the table to work on different challenges. A current initiative is a survey of Open Hardware businesses to understand more about their business models in different parts of the world, with a view to being able to codify and share them.

Business models for small-scale plastic recycling are also being developed, so that locally available plastic waste can be turned into a useful new products.

"Activities of Daily Living Boards made by Kijenzi: an occupational therapy device for a Kenyan therapist (in blue) to use with their patient (in white)", 2021, Kenya, Kijenzi, Creative Commons Attribution 4.0 International CC BY 4.0

Makernet.org

Makernet is a marketplace platform that brings together designers, manufacturers and customers. To compare how it works with popular mainstream platforms: for designers it is like a GitHub for hardware; for manufacturers it is like an Uber for manufacturing; and for customers it is like an Amazon for customised, locally made products. Makernet's platform makes use of the Open Know-How and Open Know- Where standards.

Its day-to-day work is enabling participatory production by selling hardware products. For example, a new industrial 3D- printer called Cosmyx has been sold through its platform. Customers place an order for a printer, then documentation and designs are distributed and an appropriate manufacturer makes it.

These 3D- printers also come with a connection to Makernet so that, when an order is placed from a nearby customer for a 3D- printed product, the owner of the printer can accept the order and the printer receives the product's design files from MakerNet – and the owner gets paid.

In 2020, in response to COVID-19, MakerNet developed a network of manufacturers across France and organised the distributed manufacturing of 1.5 million face shields by an estimated 10,000+ manufacturers who worked on a voluntary basis.

The Makernet platform distributed orders that came in from hospitals, community groups and so on to local manufacturers near them. Once the face shields were produced, volunteers transported the finished products to where they were needed.

The platform also has been used by a group of 20 designers working in a distributed manner to design an Open Hardware respirator solution.

CHAPTER 7

The Future of Distributed Design

This final chapter presents scenarios and works-in-progress that are contributing to the future of the field of Distributed Design. It covers promises, complexities and hopefulness to explore what's next for this field which is being established by a wide community of makers and designers across Europe and beyond.

The Distributive Nature of Design

Tomas Diez from Fab City Foundation and Fab Lab Barcelona at IAAC.

Design decisions behind our sociotechnical development model of the last two centuries have enabled a series of ecological dynamics that previously did not exist in our global economy. Behind every technology, service or interface designed to address specific needs, many externalities derived from them affect ecosystems, communities, and define growth models for regions and countries. We could find some examples in products consumed by millions and their effect in local economies, platforms that only live in the digital world but have a massive physical footprint, and national-scale infrastructures such as a country's electricity grid based on fossil fuels; all of these define long-term relationships between human settlements and their context. These relationships are shaped by a global model of production and consumption that operates following economic principles based on extraction and competition and pursues growth and profit. For instance, pesticides in industrial agriculture, fossil fuels as the primary energy source in transportation, or plastic and polymers for packaging products for human consumption are systemic design decisions that affect our everyday lives and compromise our very own future. Every design decision generates economic, social, ecological, and even geological changes on a planetary scale. The construction of cities demands certain materials (sand, cement, marble, glass) to shape entire coastlines and mountains. The dependence on polymers in the industrial design sector could endanger the whole food chain for any given region. We managed to build an advanced global civilization capable of observing the universe with high precision thanks to a series of technological progress. However, we still cannot find ways to detach from oil as a primary energy source and plastic as the main material used in our everyday life. However, our challenges are not only technical but mainly philosophical. In the current moment of transition, some profound questions need to be formulated, such as: what it means to be a planetary community of multiple species? Where do we come from? And where are we going as humanity? We need to reformulate outdated social agreements and cultivate new efforts to transform our current mode of production and consumption. Design can help, but it won't be enough to reshape the relations between humans and humans and humans and the other species part of planet Earth.

'Every design decision generates economic, social, ecological, and even geological changes on a planetary scale.'

Master in Design for Emergent Futures, picture by Fab Barcelona

We, Designers

Designing is not just about creating present realities but also is about enabling consequences for the future. Take, for example, the Gross Domestic Product of a country, the budget for a city or region, the dividends paid to shareholders of a private company, or the income statement of the entrepreneur who starts developing a business. Each of those has social, ecological, and ethical variables that impact all living systems on our planet. Under our current model of production and consumption, these collaterals or other variables are secondary to monetary profits. Yet a healthy economy is supposed to generate jobs, and better products and services, stimulated by competition and the free market. We have learned that there is nothing like a free market, and there is no dictatorship greater than our economy based on infinite financial gains. In this context, it is imperative to rethink and redesign the principles that fuel "progress" in our current globalized economy and incorporate a holistic view that considers other variables and consequences that are not only monetary. Design can be the engine to enable the transition to transform our production systems, not only to imagine and conceptualize them but to put in motion a distributive model of production and consumption based on experimentation and prototyping in the "real" world. By iterating design interventions within communities and real-life scenarios, we create the path to a global economy that cares for life. Interspecies collaboration is the driving force towards a regenerative, inclusive, and fair model for humans and the rest of the living systems that make possible the existence of our civilization on this planet. We need a planetary design approach to Design.

Each action we take is an act of design—both on a personal and collective level and within organizations or institutions. On the one hand, the design of bureaucratic processes at local, regional, and national governments look after fulfilling the purpose of making us part of larger organizational structures. On the other hand, and personally, when we decide on certain consumption habits, we consciously or unknowingly contribute to reinforcing the production systems behind each service or product we consume. For example, the frequency with which we consume food coming from the mass extermination of natural ecosystems defines our relationship with the planet we live on. How we design our lives affects our relationship with the communities we belong to and the ecosystems we depend upon. It also reflects our relationship with ourselves, our digestive system, and its subsequent impact on our organs, nervous system, and emotions. Our existence happens thanks to a series of design decisions at a personal and collective level on a larger scale. These decisions or agreements create the balance between living systems at the planetary level and are related to the context in which we interact, both physically and digitally. We articulate these relationships to design our life experiences. The latter is something that becomes a limitation for a growing majority of the world's population, which is intentionally positioned in a mode of survival to sustain systems of extraction and exclusion from our colonial past. Still, the same system creates the convenience in consumption (the world at your fingertips or your screen) that fuels the economic growth we keep being after.

We can say that we are all designers of our life, but there are also Designers. Designers generate ideas, services, or products used by other living things, which means their responsibility towards society and ecosystems is more significant. Acquiring the Design skills to influence and transform the reality of others also entails accepting a series of duties, or at least being able to consciously understand that when we design, we distribute values associated with said design, just like when we consume. A Designer can conceive the growth strategy for a company or an organization that will affect all the systems that interact with it, from its clients, suppliers, or team members, since it will create relations between them. Likewise, the design of a new technological device such as a pocket computer (or mobile phone) has implications beyond consumer use. Its design implicates supply chains, labor, and distribution mechanisms of the physical product and its life cycle once it reaches its end of use. The commitment to developing products and services capable of reversing the effects of the industrial extractivist model and responding to material reality amid the climate crisis is no longer an option but a necessity to face the collateral impacts of linear thinking behind the Western-led progress of the last few centuries. Economic growth cannot be infinite, as the planet is not. The scarcity of raw materials is a reality, as is the injustice of cheap labor behind many products we consume or the ecological disaster that advanced technologies can create. We have the imperative need to reduce the collateral damage behind all the products and energy we consume. Design should help us move towards a production paradigm that favors local material circularity, including the consumer actively in production cycles while contributing to social welfare and ecological compensation through regeneration. Since the beginning of the industrial revolution, critical voices have been trying to create awareness on a model contributing to planetary deterioration and the breakdown of social structures in communities of the world. The interconnection of planetary systems is no longer natural but created (or designed) by humans, and we have the power to update and upgrade these connections. Design can build bridges and make better relations between the environment, technology, and society. This new way of designing responds to our current local and global contexts, given by two convergences typical of the beginning of the 21st century:

- The convergence of multiple crises
- The convergence of transformative technologies.

Technological revolutions have brought about significant changes in society. However, their benefits have been obscured by their use to acquire political power (significant advances of the early twentieth century occurred in the military industry) and economic power (as we have seen in the last two decades with the emergence of platform capitalism). Behind these principles are the ideas of scarcity and control, which belong to a generation that has seen one of the most peaceful but radical transitions in recent centuries. It is necessary to generate mechanisms to test and experiment with new models of designing products and services and distributing its consequences in new ways. We can evolve how we create value and exchange it, reformulate the relationships between human beings in our current socio-economic model and other species on planet earth. We can enable a different distributive nature of Design by evolving from Megatechnics to Biotechnics, proposed by Lewis Mumford decades ago.

Distributing new principles

Distributed Design allows us to bring the principles of digital revolutions in communications and computing to the production and consumption of products. The digital revolution in manufacturing allows manufacturing to be less polluting, flexible, and adaptable. Adding digital fabrication knowledge to existing local capacities through artisanal and industrial production processes can contribute to skills development and resilience. Thanks to these three digital revolutions (computation, communications, fabrication), we can imagine new scenarios and narratives for a globally connected society capable of generating value and distributing it locally while taking care of each community member, coming from any species. Distributing design means designing a democratic and conscious tool to empower innovators, creators, citizens, and people with ideas to make their individual and collective dreams come true. Design is the most powerful tool we have as a human species, and it must be accessible to all. That is why the Distributed Design Platform's mission is to empower, support, and promote creators, makers, and designers who represent design talent with ethical and planetary values that respond to the needs of our time.

Design allows us to distribute precariousness or abundance, exploitation or regeneration, selfishness or collectivism, exclusivity or inclusion, to name some of the values opposed to each other, at different scales, without further polarizing an already polarized society. That is why it is necessary to design innovative learning

Remix the School, Workshop Dhub. Photo by Fab Lab Barcelona.

spaces and opportunities for experimentation to contrast ideas, models, products, services, and other interfaces that allow us to co-inhabit a territory. These learning spaces are essential to prototype and test new production models, generate new material ecologies, emergent consumption patterns, and other products and services without ties to the tyranny of the traditional economy and the industrial extractive model. This effort needs to be collective, and it does not necessarily have to exist on a large national or regional scale. It can operate on a hyper-local scale of neighborhoods or small rural towns. That is the scale on which Distributed Design can work through initiatives such as Fab Labs or maker spaces since they are part of communities and infrastructures embedded into a given context.

The current technological convergence is different from the previous ones (15th century or early 20th century) since it is born under the distributive and collaborative principles of the networked society powered by the Internet. However, actors can capture these values with comparative advantages within the system (computing capacity, or access to energy sources and cheap labor), such as large platforms that dominate the World Wide Web. Together with digital manufacturing, other technologies open tremendous possibilities for the democratization of production, such as using biotechnology to reconfigure our material ecology and the extraordinary capacity of connected computing that we currently have. New incentive models for the generation of value can complement "traditional" money, including more complex ways of recognizing individual and collective effort and designing regulatory models to limit the exploitation or perpetuation of a linear and colonial extractive model in communities and ecosystems (using smart contracts and programmable money). While blockchain-based technologies promise to solve some of these technological challenges, we cannot rely on the same technology-centered solutionism of earlier times. Again, we must bet on a series of strategic actions on a small scale, but with great global articulation, which allows us to:

- Invest heavily in developing a production and consumption model that is regenerative and distributive with all the planet's species. Inclusive by design.
- Disassemble the intellectual property protection system globally to open technological and scientific knowledge with principles of equality between north and south. Open by design
- Disconnect the models of production and consumption of fossil fuels and reduce the distances that products need to reach consumers. Green by design
- Promote a model of education in design that allows us to generate new learning spaces. Design education can reinterpret the relationships between consumers and products and the habits associated with the extraction of natural resources. Curious by design
- Support initiatives as alternative ways to traditional innovation and business development systems without condemning itself to purely economic success. Holistic by design
- Support and encourage designers who operate within these new productive logics locally, showing emerging models around the generation and circulation of multiple types of values. Exemplar by design
- Generate opportunities to experiment with new regenerative and inclusive production models that evaluate their impact within local contexts in urban and non-urban environments. Experimental by design

Transition periods require interaction with hegemonic models and evolve them towards a desirable stage. We have to create the conditions for the obsolete model to learn new ways of collective organization and inhabiting our planet. The paradox is a critical component of this transition process since it requires using the best tools of a previous system to create a new one. There is sometimes confrontation to give birth to new models of production and consumption. Within this vision of Distributed Design and productive society, we must include diverse perspectives from previously silenced collectives and communities to do justice to the historical debt generated by the violent relationship with these groups. It is essential to reinterpret models that allow us to relate more harmoniously between human beings with fundamental differences. We will build the design requirements for future generations to thrive from the diversity of ideas and the global collaboration between living systems. We need to design a meaningful practice of everyday life and distribute emerging futures for a planetary society. Let's embed a new distributive nature in Design and let it propagate through our networks.

Attempting to Fab in Rural Areas of Japan

From Fab Cities to Fab Villages

Kazutoshi Tsuda from Kyoto Institute of Technology, Yamaguchi Center for Arts and Media

Since the city of Barcelona, Spain declared itself Fab City in 2014, the number of cities declaring themselves as such has now grown to 41 cities worldwide. In Asia, Shenzhen of China and Kerala of India declared Fab Cities in 2015, Thimphu of Bhutan in 2016, Seoul of South Korea, and Kamakura of Japan in 2018. In July 2018, the first Fab City Summit was held in Paris, France, at which Kamakura City also declared itself a Fab City. The concept of the Fab City is based on the premise of a global network of Fab Labs that promote digital fabrication. One of the characteristics of digital fabrication is that it utilizes the mutual conversion of information (bits) and matter (atoms) from digital information to physical matter and from physical matter to digital information. It is expected that the summit will actively apply the characteristics of digital fabrication to the transition to a circular economy at the city level. In other words, various digital information will be shared by facilitating cooperation among the global Fab Lab network, while physical materials will be circulated within the city. In this way, we can move from the traditional urban model of receiving products and discharging waste (Product-In, Trash-Out) to an urban model of exchanging necessary data between globally connected networks and utilizing local resources (Data-In, Data-Out)[23]. The Fab City aims to realize a self-sufficient city, where the city can produce the things needed by itself.

This idea of the Fab City is attracting attention in Japan from the Fab Lab community and people in urban planning. This idea is also attracting attention from both rural and urban areas. The population scale of the cities that have declared themselves Fab Cities varies from more than 10,000,000 in cities in China and India to 1,000,000 like Barcelona, to tens of thousands. In Japan, in addition to the city of Kamakura, which has a population of approximately 170,000, the Fab Village initiative, which was influenced by and derived from the Fab City Initiative, has begun in rural areas with population scales of a few thousand to less than a thousand.

In this paper, we will introduce the Fab Village Initiative that has begun in two regions at the same time. Before that, to understand the movement, we will explain the spread of Fab Labs in Japan and the issues and possibilities that Japan faces. First, we will summarize the process of the spread of Fab Lab and Fab City in Japan. This process includes collaboration with maker culture, co-creation with the manufacturing industry, the nursing and welfare fields, and the agriculture, forestry, and fisheries fields. Then, after briefly summarizing the issues and possibilities Japan faces, we will introduce the Fab Village initiatives and their ongoing implementation, which is expected to be an initiative for making use of local resources such as wood and lacquer. We are also addressing regional issues such as depopulation in regional development and the building of a decentralized society.

The Decade of Fab Labs in Japan

Spread of Fab Labs in Japan

In Japan, Fab Labs were introduced around 2010 and have a decade-long history. In 2010, Fab Lab Japan (later renamed Fab Lab Japan Network) was established by volunteers consisting of university faculty and others. Fab Lab Japan Network is a voluntary organization, but it has played a role in revitalizing the domestic Fab Lab community and connecting it to the global network. In 2011, the first Fab Labs in Japan were simultaneously established in Kamakura and Tsukuba in eastern Japan. It was followed by the establishment of a Fab Lab in Shibuya Ward of Tokyo in 2012. Following the establishment of Fab Labs in the Tokyo metropolitan area in eastern Japan, moves to establish Fab Labs in western Japan also began. In 2012, Fab Lab Japan members, university faculty members, and other volunteers, especially those living in the Kansai region (including Osaka, Kyoto, and Kobe cities), held monthly meetings under the name “Fab Foo Kansai” to discuss the possibility of a Fab Lab in the Kansai region. After much deliberation, a Fab Lab was established in the Kitakagaya area of Osaka City in April 2013.

In August 2013, FAB9 (The 9th International Fab Lab Conference) was held in Yokohama City. Since 2013, Fab Labs have spread to regional cities from north to south, including Sendai, Hamamatsu, Oita, and Saga, in addition to the metropolitan and Kansai areas. In 2014, Fab Labs were also established in smaller cities such as Dazaifu in Fukuoka and Akitakata in Hiroshima. In 2017, Shiwa Town in Iwate Prefecture, which has a population of about 33,000, established a Fab Lab. Suppose we rephrase this trend in terms of population size. In that case, we can say that the establishment of Fab Labs has gradually spread to areas with low population density, from metropolitan areas with a population of several tens of millions to regional cities with a population of several hundred thousand and towns with a population of tens of thousands. Currently, more than twenty Fab Labs have been established in Japan, and several more are in the process of being established. For example, in Kuriyama, Hokkaido, which has a population of about 12,000, human resource development is underway in preparation for the establishment of Fab Lab Kuriyama in collaboration with Fab Lab Kamakura.

During the past ten years, in addition to the permanent Fab Lab activities, Fab Labs have been operated on a trial basis for a limited period. For example, Fab Lab Kitakagaya in Osaka has stayed for a limited period on a remote island

with a population of 1,000 (Shodoshima, Kagawa, Prefecture, 2014) and in a mountainous area with a population of several thousand (Ato, Yamaguchi City, 2014 and Totsukawa Village, Nara Prefecture, 2018) to explore the possibilities of Fab Labs (Tsuda, 2015).

Fab Labs in Japan are operated by various entities, including voluntary organizations, sole proprietorships, NPOs, general incorporated associations, stock companies, and university laboratories. However, to prevent other companies in Japan from monopolizing the name “Fab Lab” for commercial purposes, they have obtained the trademark rights for the name “Fab Lab”. They are also proposing the Open Trademark License (OTL) as a flexible licensing format that allows the use of the trademark rights free of charge as long as certain conditions are observed. The conditions include openness to the general public, operation based on the Fab Charter principles, commonly recommended equipment, and participation in international networks.

In addition, the professional backgrounds of the managers of Japanese Fab Labs vary. Still, one of the characteristics is that a certain number of them are from universities where they can study engineering and design, or from the National College of Technology, which has over 50 schools throughout Japan. Examples of universities running Fab Labs include Kanagawa University and Shinshu University. Even if they are not running a Fab Lab, some laboratories have joined the Fab Lab Japan Network and conducted fab-related research. In addition, as Fab Labs spread across the country, more and more universities, especially technical universities and universities of design and art, have established spaces equipped with digital fabrication equipment such as KYOTO Design Lab, Kyoto Institute of Technology. In this way, Fab Labs of various management bodies are spreading in various regions of Japan. Next, we would like to talk about the spreading communities in conjunction with and derived from the Fab Lab movement.

Planting Urushi lacquer saplings in Keihoku area (April 2020, Keihoku area in Kyoto City, Photo by Hironori Fukumoto).

Working with the Makers Culture

The 2010s was when the maker movement spread in Japan, and not only Fab Labs but also facilities called makerspaces, and fab spaces have been expanding. Currently, the number of facilities that any individual can access and where users can operate tools such as digital fabrication themselves has increased to over 100. Among them, Fab Cafe is a business model originating in Japan, a Ffab Sspace that combines a cafe with a coworking space and event space, and is expanding both in Japan and overseas. Currently, there are four Fab Cafe locations in Japan: Shibuya, Tokyo; Kyoto City; Hida City; and Nagoya City. In Asia, they are located in Taipei, Hong Kong, Kuala Lumpur, and Bangkok, and in Europe, they are located in Barcelona and Toulouse. Many collaborative projects between Fab Labs and Fab Cafes have been held so far.

The Fab Lab community in Japan also collaborates with the Make community and actively holds booth exhibitions and talk events at Maker Faire in Tokyo and Kyoto. The Maker Faire in Tokyo and Kyoto has 500 exhibitors, but the Institute of Advanced Media Arts and Sciences (IAMAS) in Gifu and the Yamaguchi Center for Arts and Media (YCAM) in Yamaguchi is also involved in organizing the event, which has 100 exhibitors. In addition, Mini Maker Faire has been held in local cities. Furthermore, in Sendai in 2020 and Hamamatsu in 2021, Fab Labs in each region will be involved in the operation of Micro Maker Faire, which will be held with fifteen to twenty groups. In this way, Fab Labs are spreading across the region, and in conjunction with this, domestic Maker Fairs are also spreading on a smaller scale.

Co-Creation in Diverse Fields

A book titled “Fab ni nani ga kano ka (What’s Possible for FAB?)” was published in 2013, mainly by members involved in the Fab Lab Japan Network. At the time, due in part to the influence of Chris Anderson’s book “Makers: The New Industrial Revolution,” there was a strong tendency to believe that the Fab Lab would change the manufacturing industry. However, the book suggested that Fab Labs would not only change manufacturing, but also connect regions and transcend national borders, and that Fab Labs have the potential to change not only the industry, but also education, art, economy, circulation, and many other fields. In fact, it has had an impact on a variety of fields. Below, I would like to introduce some examples of competition in manufacturing, nursing and welfare, agriculture, forestry, fisheries, and international cooperation.

First, regarding the manufacturing sector, for example, a course of training for Factory Scientists has been developed and launched in 2018 for small and medium-sized manufacturing companies. This course is designed to train engineering personnel with knowledge of sensing and data analysis using IoT devices, and several Fab Lab operators in Japan are cooperating in the activities.

Next, in nursing, for example, the FabNurse Project: Informatics and Media Communication for Care are being developed as a research project that aims to solve problems in care through the creation of tools and service design. Furthermore, in 2020, as an initiative related to COVID-19, Fab Lab Hiratsuka,

which was one of the first in Japan to develop a face shield that can be printed out on a 3D-printer, and other collaborators are releasing guidelines for the production, provision, and use of face shields on the Fab Safe Hub website (Tsuda, 2020). In the field of welfare, there is an initiative called IoT, Fab, and Community Well-being, in which engineers familiar with IoT and Fab, including those at Fab Lab, and staff at welfare facilities are working together to promote experiments and practices. Fab Lab Shinagawa also has a 3D-model data-sharing platform for assistive devices that is available online.

Cooperation with the Agriculture, Forestry, and Fisheries Sectors

Next, we would like to introduce Fab Lab's collaboration with the agriculture, forestry, and fisheries fields. In agriculture, Fab Lab Tsukuba has been conducting research and development of the Open-Field Server (Open-FS), a device for monitoring the growth of crops. At Fab Lab Kitakagaya in Osaka, a workshop was held in 2013 with participants from the nearby urban farm Minna nouen to make the necessary items for the farm by themselves using Fab Lab equipment. The method of making Minna Cargo, a kit of wooden storage tools to sit on when farming, is available in open-source. Fab Lab Hamamatsu held a workshop in 2016 to develop the Open-Source Aigamo Robot for weeding in natural rice farming. Core members are currently developing it into start-up projects in other regions.

As for the fisheries industry, in 2016, several Fab Labs in Japan gathered at a facility where fishing gear and folk tools are stored in Himi, Toyama Prefecture, and held a training camp. There, they held a make-a-thon to develop new fishing gears and workshop programs using the gears.

In forestry, Fab Lab Kamakura has been holding FUJIMOCK FES continuously since 2012 in collaboration with Whole Earth Nature School and lumberjacks. That is a workshop program in which participants go to Mt. Fuji to thin the wood, and then experience prototyping using digital fabrication in Kamakura. At Fab Lab MinamiOguni in the town of MinamiOguni in Kumamoto, a local lumber mill is taking the lead in developing a project to create things using local cedarwood in collaboration with a nearby university.

In forestry and architecture, the start-up company VUILD is actively engaged in projects using digital fabrication, derived from the Fab Lab concept. While introducing ShopBot hardware, a large CNC router for woodworking, throughout Japan, they are also developing EMARF software to support furniture design and Nesting Beta, a platform for designing houses that can be built using ShopBot. So far, VUILD has installed ShopBot in more than 60 locations in Japan, including Fab Lab Dazaifu, YCAM, universities and educational institutions, and private lumber mills.

In addition to the use of wood, some projects focus on bamboo resources. For example, in 2014, during a limited-time experiment on the possibilities of Fab Labs in Ato, Yamaguchi City, artists from Fab Lab Kitakagaya and Fab Lab Yogyakarta, YCAM staff, and local residents collaborated to create musical instruments and tools using bamboo.

YCAM is a public art centre engaged in artistic expression and educational activities using media technology. Still, it is also equipped with a common set of recommended Fab Lab equipment and operates in collaboration with the local Fab Lab Yamaguchi and the global Fab Lab community (Tsuda, 2018). In 2015, they started a bio-research project and participated in the Bio Academy (How To Grow Almost Anything) with members of Fab Lab Hamamatsu and Fab Lab Kamakura. They have conducted field research on various organisms, including fermenting microorganisms such as yeast, plants in forests and gardens, and wild deer, and have developed workshops and presented exhibitions. They also exhibit at Maker Faire Tokyo every year and are a leader in the DIY biotechnology community in Japan.

As for other international collaborations, several Fab Labs in Japan are participating in the Fab Lab Asia Network, a network for information sharing and common problem solving among Asian Fab Labs proposed and launched at FAB9 in 2013. Also, through the Japan International Cooperation Agency (JICA), the members of Fab Labs in Japan are collaborating to establish Fab Labs in Bohol in the Philippines, Rwanda, Bhutan, and Yogyakarta in Indonesia. Fab Lab Nagano has joined Fab Lat KIDS, a network from Latin America, and is working together to develop learning programs for children.

Surfboard making workshop in Keihoku area (September 2019, Keihoku area in Kyoto City, Photo by Masuhiro Machida).

Fab City in Japan

As for Fab Cities, as mentioned at the beginning of this article, the city of Kamakura declared one in Japan in 2018. Kamakura City has one of the first Fab Labs in Japan, Fab Lab Kamakura, and Fab Lab Kamakura celebrated its tenth anniversary in 2021. As for specific projects in the Global Fab City Network, in addition to the aforementioned FUJIMOCK FES, Kamakura is also facing the ocean, and a project is underway to address the problem of plastic disposal into the ocean. In this project, in addition to participating in the Precious Plastic Global Network, they are also working on the development of technology to crush the collected plastic into pellets that can be printed on a 3D-printer. In a project on Urban Farming and Beekeeping, they are working on a home garden with FarmBot, and prototyping Beehive kits to match the size of bees in Japan.

Fab Village Initiatives

The Issues in Rural Areas and the Context of a Decentralized Society in Japan

In Japan, where there are a lot of mountainous terrains, rural areas defined as hilly and mountainous regions, account for about 70% of the total land area. Agriculture in these hilly and mountainous areas occupies a vital position in the food system in Japan, accounting for about 40% of the total arable land area and the total number of farmers in Japan. However, with the depopulation and ageing society, the increase in abandoned land and the decrease in farmers are becoming serious problems.

In addition, about 70% of the land in the Japanese archipelago is covered with forests, and about 40% of the forest area is planted forest. Japan's forestry industry has been facing a difficult situation, with a decline in lumber production and a fall in lumber prices. In recent years, it has been on a slight recovery trend, with an increase in domestically produced lumber and an increase in the self-sufficiency rate of lumber (37.8% in 2019). It is hoped that the cyclical use of forests, such as planting, growing, harvesting, and using suitable materials in the right places, will create jobs and revive the region.

In response to these challenges faced by rural communities in Japan, the potential of Fab Labs and Fab cities for distributed design is being anticipated. For example, in 2014, the Ministry of Internal Affairs and Communications (MIC) held a Commission on the General Planning of Fab Society, and the Fab Society Declaration (2015) issued by the group states the following: "The Fab Society must be developed to release creative potential of localities and prepare ground for revitalization of local societies."

In the forestry sector, in contrast to the traditional forestry industry, which has a system that makes it difficult for local producers to retain profits, technology is being used to directly connect upstream producers with downstream end users, enabling everything from logging to processing to be completed within the region. Specifically, as part of the trend toward open-source, individuals are seeking to access design data, create custom-made

Linking supply chains such as timber and lacquer in order to create a self- sustaining circular economy in rural areas

products with their own hands, and give shape to them using local wood and equipment such as CNC routers installed in the region. Because of these issues and expectations, the Fab Village concept began simultaneously in several mid-mountainous regions such as Keihoku in Kyoto City and Shinjo Village in Okayama Prefecture.

Keihoku Area in Kyoto City

The Keihoku region is a medium-sized mountainous forestry area that was merged with Kyoto City in 2005. More than 90% of the region is covered by forest. The area is 217.7 km², and the population is about 5,000. Its primary industry, forestry, is in decline, and there is a growing shortage of workers in the forest and fields, empty houses and a declining population. On the other hand, the area is only an hour's drive from the center of Kyoto City, making it an easy place to work remotely.

In recent years, young entrepreneurs who have moved to the area and local companies have begun to collaborate to create a Keihoku community, including regional branding and the development of educational programs. The Fab Village initiative in the Keihoku area is being developed by

Perspective, a general incorporated association that is also participating in the projects cited above. The organization was founded in June 2019 by craft culture coordinator Sachiko Matsuyama and Takuya Tsutsumi of Urushi Lacquer Refiner in Kyoto. In the 40 years between 1978 and 2018, Japan's domestic lacquer production declined from 400 tonnes to 36 tonnes, with a self-sufficiency rate of 3%. One of the reasons for this decline is the ageing of forestry workers and craftsmen and the lack of successors, which has led to a decrease in the number of producers, production environments and users due to changes in consumer lifestyles. However, lacquer is a resource that is being re-evaluated due to its excellent durability. For this reason, the organization has started to plant lacquer trees for when it will be possible to collect the lacquer sap, which will be in ten to fifteen years. They are also trying to expand the use of lacquer on surfboards and bicycles, in addition to traditional crafts such as tableware.

Their goal is to create a community of forest creation and craftsmanship where such activities as planting, growing, receiving, making, using, and repairing are in a cycle. Thus, they call it Kogei no mori (Forest of Craft). Therefore, they are building a co-creation platform with local lumber mills, woodworking shops, carpenters, craftsmen, designers, and researchers. From 2020, they are conducting a material flow survey on wood in the Keihoku region in collaboration with the Ethnography Lab at Osaka University led by Atsuro Morita and the Design for Sustainability Lab at Kyoto Institute of Technology. From 2021 as one of the projects of KYOTO Design Lab of Kyoto Institute of Technology, Tomohiro Inoue, a technical staff member of KYOTO Design Lab and also a staff member of Fab Lab Kitakagaya, and others are joining the project. Fab Village in Keihoku is scheduled to be launched by the end of 2021 and is currently being developed with the support of The Toyota Foundation, etc.

'Their goal is to create a community of forest creation and craftsmanship where such activities as planting, growing, receiving, making, using, and repairing are in a cycle.'

Shinjo Village, Okayama Prefecture

Shinjo Village is located in the northern part of Okayama Prefecture, covering 67.1 km², 90% of which is a forested area. It is a municipality that has been operating independently, opposing the municipal mergers that were implemented as a national policy between 2000 and 2010. However, with a current population of about 850, the village is depopulating and ageing, and it is required to increase its self-sufficiency and self-reliance while cooperating with other regions (Tsuda, 2014).

The Fab Village initiative in Shinjo Village is being spearheaded by Ryohei Yamada, an employee of the village office (seconded to the general incorporated association Muradukuri Shinjo Village), who is working with the villagers. He knew about Fab Lab at an event in Osaka in 2013, later moved to Shinjo Village from Kyoto, started working at the village office in 2016, and proposed the Fab Village concept in 2018. In 2019, ShopBot was introduced on a trial basis, and a workshop for VUILD and village residents was held on the theme of Sustainability and Digital Fabrication in the Mid-Hills and Mountains Region. In January 2021, ShopBot was installed, and FabSpace Shinjo was launched.

The flow of the project is planned to include logging, drying, sawing, delivery of planks, processing, finishing details, packaging, and shipping. They are currently building a supply chain that will connect lumber production to processing within a ten kilometre radius. Three product lines are planned: pre-cut orders for EMARF, original product development, and tiny houses. The challenges for realizing the Fab Village concept are material procurement, human resource development, and product development. Regarding material procurement, they are considering strengthening ties with forestry businesses in the village, developing a public wood stockyard, and introducing drying equipment using biomass. In terms of human resource development, they are looking for ways to invite people from outside, collaborate with junior high schools in the village, and collaborate with KYOTO Design Lab.

Conclusion

We have introduced the Fab Village initiatives in Japan as a smaller-scale regional initiative derived from the idea of Fab Cities.

In the paragraph titled the decade of Fab Labs in Japan, we introduced how the idea of Fab Labs has spread through Japanese books, Fab Labs established in various places, and projects in those Fab Labs. We

have introduced the fact that Fab Labs are being created outside of the existing framework of universities, companies, and government and that they are gradually beginning to collaborate with existing fields and industries.

In the paragraph titled Fab Village initiatives, we also mentioned the challenges facing rural Japan and the desire to shift to a regionally decentralized system based on reflection on the concentration on urban areas, and that the region is rich in resources including forests. However, it takes time for large municipalities. Smaller municipalities with smaller populations are able to move quickly, so there may be potential in starting small with such smaller municipalities.

The spread of Fab Labs in Japan and the challenges faced by the mountainous regions that make up the majority of Japan are two factors that have led to the spread of the Fab Village initiatives. Then, we introduced two regions that have adopted the Fab Village initiatives. The possibility of incorporating the ideas of Fab Labs and Fab Cities into efforts aimed at creating forests connected to crafts and creating self-sufficient and self-reliant villages are being explored.

We hope that the accumulation of examples of trial and error, linking supply chains such as timber and lacquer in order to create a self-sustaining circular economy in rural areas rich in local resources,
will serve as a reference for other regions in Japan and overseas. The Fab Village Initiatives are just the beginning. We would like to communicate future developments both domestically and internationally and work together to promote them.

Looking for Sustainability in Distributed Design

A Future Between Rural Communities and Cryptocurrencies

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Distributed Design and Sustainability

Distributed design as a contemporary concept has become widely used after the advent of the ICTs. However, its core philosophy, that of collaboratively developing artefacts, has been around ever since. In that sense, distributed design is a collective process rather than the gift of a genius designer or pioneer to society. We thus here focus on frugal community projects that genuinely create solutions locally on an appropriate scale. We shed light on the sustainability dynamics and approaches used by such communities, elaborating on two cases: rural communities and cryptocurrencies.

Sustainability is a key element of distributed design processes that is embedded in the design of technologies. However, considering the plurality of skills and backgrounds of the individuals usually involved in relevant processes, this design-embedded sustainability in open hardware solutions is perceived and implemented differently by industry-minded individuals and by small, under-resourced communities. It should be noted, though, that all these groups share common principles and values. For instance, collaborative processes combined with human creativity, sharing, and ecological awareness are observed in every context where people gather to produce technologies locally. A unique mixture of these elements in different contexts creates a broad spectrum of "cosmolocal" spirits embedded in the maker culture globally. In that sense, open-source hardware (OSH) solutions are produced on demand and adapted to the local socio-environmental conditions while sharing physical and digital infrastructures.

In this article, we analyse key sustainability features that need to be embedded in such community-based approaches so that cosmolocal modes of production could thrive in different contexts. In an attempt to investigate possible paths ahead following design-embedded sustainability in the field of OSH, we propose the concept of sustainability-embedded design. We conclude with general remarks that could enable distributed design to exacerbate inequalities and environmental collapse.

Two Separated Realities?

Rural Communities

Rural communities globally face a lot of challenges. For instance, they may suffer from fragmentation or lack infrastructures and networking due to geographic isolation. In addition, these communities are frequently compelled to adjust their cultivations to be appropriate for industrially produced and expensive agricultural tools.

In an attempt to increase their autonomy, rural communities often strive to build the tools that best serve their daily needs using minimal resources. Designing and sharing information globally and manufacturing agricultural solutions locally in makerspaces is a possible way to achieve this. In that sense, local communities interact on a global scale through the web, share designs and ideas and build solutions locally in makerspaces. Thus, they can address existing needs by manufacturing, using and repairing their own tools. L'Atelier Paysan in France, Farm Hack in the United States and Tzoumakers in Greece exemplify such initiatives. This is how cosmolocal modes of productions emerge.

Although these initiatives may differ in terms of their vision for the agricultural sector, considering their cultural and political discrepancies, these communities have shared values. Their goal is to move away from the dominant profit-oriented system and global supply chains, utilising technology and prioritising socio-environmental criteria. To this end, they use recycled and local materials to the greatest extent possible, and local infrastructure (e.g. machines and tools) is shared to reduce environmental footprints. They hence follow an alternative technological development path, producing tools that last long and are environmentally friendly.

For such a community to be formed, as a first step, local actors of varying backgrounds (i.e. farmers, academics, activists) usually come together, share and reflect on their common concerns and goals. They discuss specific issues related to technical and organisational elements and explore the achievements of similar communities across the globe. Such an exploration is possible in a cosmolocal context given the openness that permeates such initiatives and catalyses the exchange of resources through the Internet on a global scale (Giotitsas, 2019). A wide network is thus created, consisting of local organisations and makerspaces but also global collaborators that provide their assistance when needed. This cosmolocal network works through information transfer (i.e. blueprints, designs) but also via the participation of experts (i.e. skilled people) in the production of solutions when local technical knowledge is limited.

Such cosmolocal rural communities are still in a seed form, while diverse issues need to be addressed to boost their full potential. Developing the mechanisms through which information related to the manufacturing of agricultural solutions are shared, as well as the business models and protocols needed for relevant internal and external practices (i.e. operational, sharing and institutional) to work is key to promote cosmolocal processes in different contexts. Further, makerspaces are usually hosted by academic institutions or citizen-driven organisations that develop collaborative projects mostly via EU funds. However, the engagement

and support of local authorities and multi-stakeholder associations is highly encouraged to boost the potential of relevant initiatives in various contexts both in the Global North and the Global South.

Cryptocurrencies

At the birth of cryptocurrency (crypto from hence on), Bitcoin early adopters were too eager to celebrate the coming of a new era when everyone would be able to safely transfer value online without the interference of the most tedious middlemen -the state and the banks.

However, Bitcoin is too slow a mechanism for online transactions - but a terrific financial speculative asset. Besides, it is unsustainable: the mining of new Bitcoin tokens consumes the same amount of energy annually as Argentina. Even Tesla announced that they would not accept more payments in Bitcoins due to its high environmental costs, which caused a significant fall in the market value of Bitcoins in May 2021.

Furthermore, blockchain technology seems to be the antithesis of the democratic governance it promised. Blockchains can grow too large for storing in smartphones or laptops, making the costs of being an active node of the community affordable only to a few.

Widely considered a form of financial technology, there are many different cryptos from financial speculative product forms like Bitcoin to other community-oriented cryptos like Faircoin. From its various uses and scopes, we can infer that cryptos are ambiguous and adaptable to different contexts. Bitcoins have chiefly become financial assets. However, other cryptos can opt to disable "by design" the possibility of being used for financial speculation.

Some cryptos are designed for tokens to lose value over time. The effect is the opposite to Bitcoin: instead of instigating the hoarding of tokens for speculation, tokens with decreasing value circulate faster. They follow the same logic as perishable goods like vegetables and fruits: the fresher, the better. Similarly, the rules to generate tokens is a sort of political choice.

Mining tokens (proof of work) observes particular rules of competitive markets: a competition where having the best mining equipment increases the chances of mining new coins. Buying stakes (proof of stake) usually increases the chances of wealthier peers to mint more new coins than the less affluent peers, widening the wealth gap over time: the richer you are, the better chances of minting new coins.

Community-friendly cryptos aim to facilitate the local circulation of value as products (like crafts, tools or agriculture products) or services (like time banks). Besides, blockchain technologies can store information, including programs, into blocks. Like "smart contracts", such programs can be algorithms that trigger pre-programmed responses. These algorithms can automatically calculate how many tokens to generate with each block. And values can be encoded in an algorithm - also in a block or crypto.

Two Approaches to Distributed Design and Sustainability

In crypto, we can tie design and sustainability together. On the one hand, we can use values connected to sustainable practices in design. For example, by using materials with low impact in the environment. On the other hand, we can encode sustainability values into algorithms that automatically evaluate the degree of design sustainability. To have it all, OSH should become standard practice.

OSH is "hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design" (Mies, Bonvoisin, and Jochem, 2019). If everything about a product is open and visible, its impact can be measured and compared against other OSH products. Distributed design allows for every OSH design to be evaluated, adapted, and upgraded, by anyone globally, triggering massively distributed innovation. Similarly, crypto provides the technological means to encode sustainability on massively distributed production.

Advances in OSH may increase the capacities of distributed design. However, there is also a real risk of widening the gap between well-educated urban designers and under-resourced rural communities. Distributed design for Industry 4.0 will probably attract more resources than distributed design for sustainability. Urban areas will likely develop a better grasp of crypto faster than rural communities. But it may be in the rural areas where distributed design for sustainability will be most needed. Isolated communities are weaker, but globally interconnected rural areas co-designing and locally producing their artefacts may fare better.

Design-Embedded Sustainability

Sustainability can be embedded into design. Some design features embody the characteristics of sustainability better than others. We can choose to give prominence to design features that best resonate with sustainability values. Kostakis, Latoufis, Liarokapis and Bauwens (2018) refer to two illustrative cases showcasing design-embedded sustainability: open-source prosthetic hands and open-source wind turbines. For these designs to be produced in under-resourced communities, the authors identify four key features: robusticity, modularity, reusability and repairability.

Robusticity vs planned obsolescence: sustainable design should be robust, endurable. In contrast to the planned obsolescence of products for consumers' markets, design for sustainability should aim for a long utility product life. Robusticity also reduces overall costs of production and maintenance. The longest each produced unit lasts, the fewer units each community should build over time. It demands upgrading of the documentation and derivative designs for a design to be reliable in different local conditions.

Modular vs monolithic: a design divided into different parts that can be produced and evolved independently is modular. Unlike monolith design, modular design enables the continuous upgrading of the performance of products. Modularity is the digital answer to increasing complexity in product development. Simplicity in modular design reduces the pains of replication significantly. Moreover, the fewer and simplest components a design has, the easier it is to document it, hence tracking the design throughout a blockchain. For under-resourced communities, the modularization of simplified components enhances the product's repairability. Each part can be subtracted, fixed or upgraded independently from the other parts.

Reusability vs one-use-to-waste: robust and straightforward modular parts can be used in multiple artefacts. Besides being simple, a reusable part should aim to perform only one function. The extended recombination of simple one-function parts makes designing and building different artefacts with a wide array of uses possible.

Rural communities may lack certain materials that are not available locally. Reusing parts is the safest path towards low-cost versatility.

Reparability vs clients services: parts that are robust, modular, simple, and well adapter for local production conditions would tend to be easier to repair. Reparability provides independence from profit-seeking service providers. It also prolongs the lifespan of products sevenfold. Rural communities would greatly benefit from having access to a network of practitioners providing guidance on economic repairing alternatives, like open-source communities supporting each other in software maintenance through the Internet.

Sustainability-Embedded Design

Design-embedded sustainability refers to robust, modular, reusable and repairable artefacts. Sustainability-embedded design refers to encoding into crypto an algorithm that could evaluate the degree of sustainability in a design. The areas of interest in what may also be called "token-embedded sustainability" would relate to the likes of distributed ledger technologies, smart contracts, traceability and licensing.

Different novel approaches to sustainability in manufacturing are pointing out that the material production should be local, and the knowledge and know-how should be global and open. Access to the digital means of production through the Internet is an essential component for sustainability in distributed design. By using digital information, communities can find the best-fit solutions to be implemented in specific local contexts. But communities do not produce locally aiming to profit maximization; their goal is perpetuating and improving the local community. The real value lies in the subsistence of a group of people in a determined territory, resisting the pulls of a globalized economy that has been tearing the communities apart.

Let's stop for a moment and imagine that we embed crypto with values connected to sustainability. A block may contain an OSH design, including the documentation and authorship credentials. Blocks containing designs that rank high in a chosen sustainability ranking would produce more tokens than blocks containing designs ranking low in sustainability.

Likewise, designs that are good for rural communities can be defined and encoded in crypto. And what rural communities may consider as good and sustainable design would certainly differ from what other crypto communities, like the one around Bitcoin, would deem of worth.

Sustainability related to communities — especially to rural communities — involves persistence, endurance, resilience. It also entails finding a path that allows the community to find a long-term fit within their ecosystem and other interconnected communities. Distributed design and OSH are powerful tools to help communities realise a long-term sustainable fit in the digital era. Cryptos would play a role between distributed design and OSH by securing sustainable forms of design sharing -a global commons of design.

First, cryptos share many of the principles that make distributed design and OSH so full of potential and promising for the digital age: open-source, peer-to-peer, decentralization, a global scope, flexibility, interoperability, scalability.

Second, cryptos can encode different sets of values. Designs that rank higher according to the encoded values would receive higher compensation than designs ranking lower.

Third, cryptos allow the traceability of design. A crypto block can include any digital information inside its security seal. An OSH design encoded inside a crypto block could be traceable all along with the network, providing accountability (reputation tokens) and directing resources (currency tokens) to the original owner of the design.

Fourth, cryptos can transparently encode information. An open protocol may evaluate each design and assign an adequate number of tokens to distribute between the design owner, the design upgraders, and the end-users.

In short, we propose encoding in crypto the incentives to recompense sustainable design better than unsustainable design. An algorithm would automatically assign resources through an open and transparent process in which sustainability regulates compensation and distribution.

If markets are guided by profit-maximization, moving resources whenever money can make more money, we propose a market model driven by sustainability-maximization. The more sustainable a design is, the more resources would receive. For that, we need OSH.

In the current monetary system, money has a short memory. That's how money can flow undisturbed while helping destroy our planetary ecosystem: no banknote or digital money transfer presents any stains from the bleeding of the planet. To shift from unsustainability to sustainability, we need to bring transparency and accountability into the markets.

OSH should play a part here, providing a mechanism to create sustainable products and artefacts that everyone can "study, modify, distribute, make, and sell". In this scenario, we may define distributed design as "peer-design". It would unlock mass collaboration in self-organized communities of designers, following the same principles that made Wikipedia possible.

Looking Forward into Sustainable and Distributed Design

This review highlights the sustainability dynamics of communities that promote cosmolocal modes of production utilizing distributed design practices. We hence analyze the cases of rural communities and cryptocurrencies. We present two approaches to utilise distributed design for enhancing sustainability in a cosmolocal setting, i.e. design-embedded sustainability and sustainability-embedded design, indicating thumb rules that could benefit communities. The design-embedded sustainability includes robust, modular, reusable and repairable products, while the sustainability-embedded design refers to the encoding of sustainable design traits into algorithms operating over crypto to enable a global digital commons of sustainable design.

In this context, it is obvious that distributed design could enable a sustainable alternative to industries of scale and global supply chains that exacerbates inequality and environmental collapse. Through a systemic and holistic approach, human creativity combined with sharing practices could connect different localities, harvesting the benefits of distributed design for sustainability. For this to happen, a political economy is required to provide the structural foundation needed for this alternative to build on. Otherwise, discussing distributed design within the current socio-economic framework will create more contradictions than it will solve.

Fab City OS

Giving designers the infrastructure needed to flip the power relations of our current productive model.

Contributions from Benedikt Seidel, Fab City Hamburg & Denis 'Jaromil' Roio, Dyne.Org, edited by Kate Armstrong, from Fab Lab Barcelona at IAAC

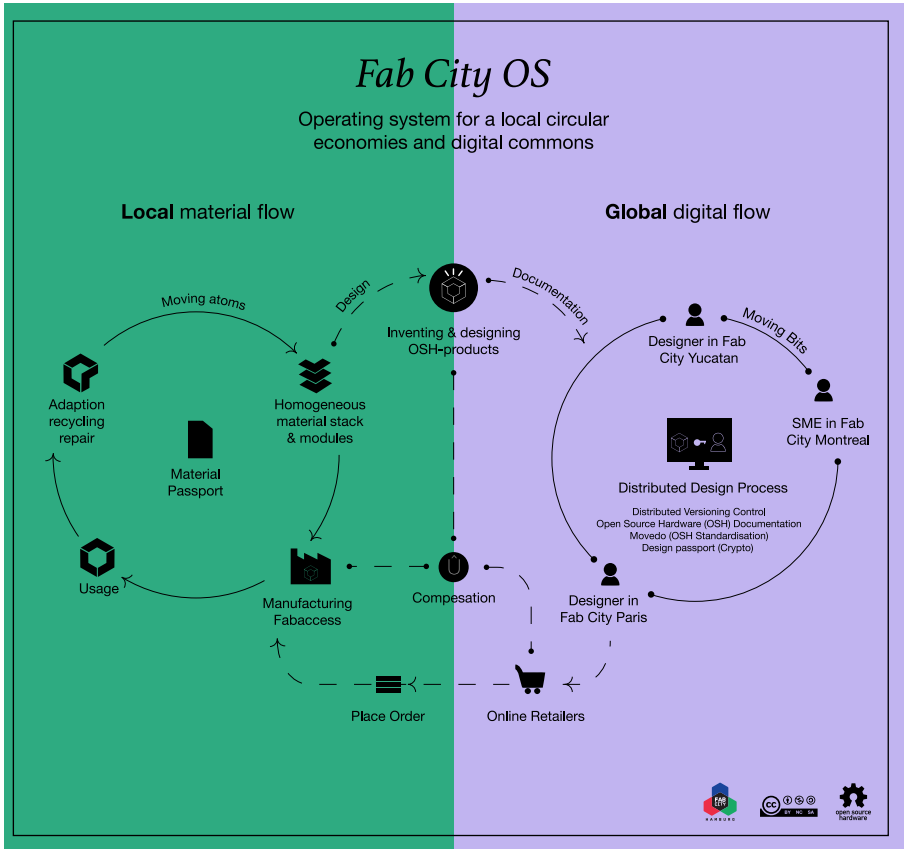
Fab City's mission is to scale up the potential of digital fabrication to reconfigure our current model of production and consumption, in order to reduce its impact in the biosphere and in society. For Fab City to be able to increase the impact of the open hardware and maker communities, it needs a platform to enable creators to engage with the reality around them. Distributed design gives makers and designers a framework to practice design for the real, digital world. Shared values guide design decisions to favour open, decentralized processes; local and situated solutions and material regeneration. A prefigurative design approach is emerging that is more ecologically sound, democratic and accessible. To actualise such alternatives, infrastructure is vital. The global spread of fab labs, makerspaces and distributed small-to-medium production facilities provides the basis for globally situated hardware infrastructure. And Fab City OS is aiming to develop the necessary operating system for it.

An operating system, or OS, is the software interface between the user and hardware. It facilitates basic operations of a computer from managing internal hardware like memory and processing; to establishing a user interface; to managing peripheral devices such as printers. An operating system designed for Fab City would also support the basic logic of Distributed Design. That is, it facilitates design and collaboration at a global scale in a distributed manner, while enabling local production.

A globally distributed infrastructure

Fab City is aiming to bring production back to cities by 2054, following a forty-year roadmap which was launched by the City of Barcelona in 2014. The global movement envisions a paradigm shift from the industrial model of Product-In, Trash-Out (PITO) to Data-In, Data-Out (DIDO) where "atoms" stay local and "data" moves globally. Fab City OS is being developed as the digital infrastructure to facilitate this transition. The roadmap for its Alpha and Beta release until March 2023 is being led by Fab City Hamburg Association, supported by the project INTERFACER, funded by the European Commission REACT-EU (Recovery Assistance for Cohesion and the Territories of Europe) recovery plan following the COVID-19 pandemic.

At the core of the Fab City OS software is an adaption of Reflow OS, a cryptographic design and material passport based on "smart contracting" technology. This core technology is combined with open-source software such as Fab Access, Git or FreeCAD to managae the movement of "data" including digital designs and respective finances, licences and documentation. Powered by a secure central signature-scheme and a plug-and-play software stack, Fab City OS aims to make distributed production secure, efficient and competitive.



21.07.2021, Hamburg, CCBYSA 4.0, Fab City Hamburg e.V.

The idea-to-product pipeline

´The design system favours products that allow for repair, reuse, adaptability or design for disassembly.´

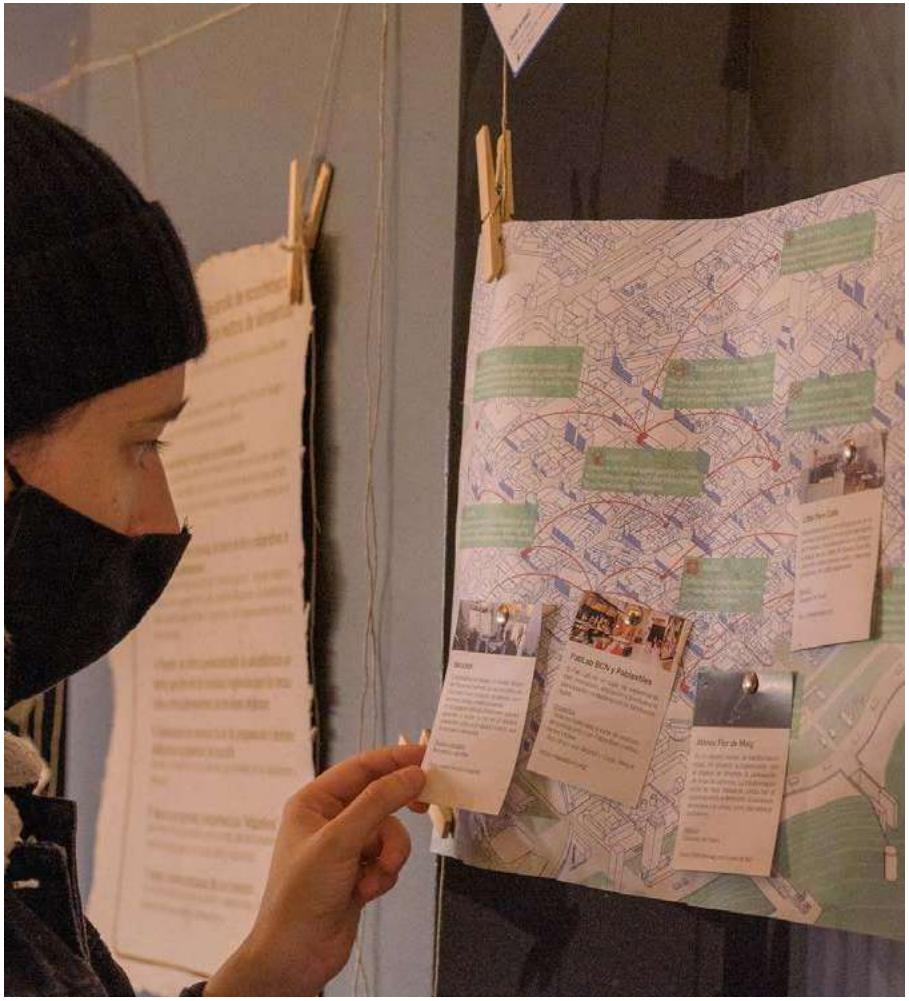
A design is developed by a maker or designer in a makerspace, SME or Fab Lab. The 3D-model is uploaded in FreeCAD to a public repository. Using MoVeDo the design can be standardised including all manufacturing specifications like build instructions or bill of materials. Anyone, anywhere, can suggest improvements to this design. If the original author accepts the changes, each successful contribution is stored in the design passport. The design is then offered, with all necessary instructions on an E-Commerce store that is local or familiar to the designer or their target audience.

Fab City OS gives financial incentives to product designers and manufacturers - in the distributed mode of production. Each time a customer buys a product in the online store, all designers involved receive a share of the price according to their individual contribution stored in the design passport. When a purchase is made, manufacturing information is sent to local manufacturers located near the customer. On completion, the product is delivered to the customer and a physical extension of the design passport is included with the purchase. It can communicate manufacturing, material, repair and reuse details via a unique identifier on the physical product such as an RFID-chip or a QR-code. The design system favours products that allow for repair, reuse, adaptability or design for disassembly. The passport facilitates maker and user feedback to control the level to which these values are reflected when the product is in manufacture or use. Designers can receive financial reward for successful integration of such distributed design principles, or be reviewed, and in some cases sanctioned, if their design does not reflect these principles. So designers have a financial incentive to design according to values of distributed design.

Operationalisation of values

Operationalising the values of Distributed Design in an OS aims to in-turn support designers and makers with a digital infrastructure that can help them to operationalise their values and importantly, ensure everyone along the value chain benefits.

In addition to designers and makers, Fab City OS has different kinds of users along the value chain of distributed production, such as small and medium enterprises, corporations, makerspaces, public administration, hobbyists and tinkerers, innovators, fab labs, even public waste departments, or e-commerce stores. The end-customer's user experience does not differ from any existing product purchase on an e-commerce store. And, they can be assured that their purchase was manufactured locally, supporting their local economy and lessening their global impact.



Remix El Barri Exhibition, Mapping the city.

It is clear that our mainstream economic model has created wealth but has also caused huge ecological and social consequences that are haunting us. The solution for these problems must be as radical as these consequences are. Fab City OS will provide an effective solution by flipping the power relations of the current economic mode of production upside down. Fab City OS will enable designers to sell and distribute their designs globally without relying on intermediaries of physical supply chains and their business model logic.

A Distributed Bauhaus Society

Collaboration Networks and Design to Fabricate the Commons.

Tomas Diez and Kate Armstrong from Fab Lab Barcelona at IAAC

The Bauhaus is one of the most recognised movements in the history of design. Known for clean lines, functionality and a reimagination of utilitarian materials, it merged previously siloed creative disciplines under one pragmatic approach to design and making. It originated in post-WW1 Germany as a revolutionary art school that introduced economics to the production of artifacts. Born in Europe and fueled by the Industrial Revolution, it propelled the 1920's art world towards the burgeoning mass market. Gathering various disciplines under the desire to "conceive, and create the new structure of the future"(Gropius, 1919), it was a design frontier that redrew the creative field around principles, and endorsed hands-on making for the masses.

Today, Distributed Design is treading a similar path. Enabled by three digital revolutions: communications (Internet), computation (smartphones and PCs), and fabrication (3D-printing, CNC manufacturing), which created the conditions for our own moment of transition towards a new industrial paradigm. Distributed Design is igniting a revolution towards new decentralized modes of production and manufacturing, driven by regenerative principles, and gathering multifarious actors connected by the Internet under new and disruptive ideas. Emerging in a post-industrial landscape, it is fueled by a need to reduce planetary impact and inequalities between populations and cultures. Distributed Design may be the Bauhaus of our time. Taking shape a century later, Distributed Design's embrace of technology enables distributed, democratic and accessible realisations of many of the Bauhaus' principles. A Bauhaus in the 21st Century will not be seen from a centralised European perspective, but from the interconnected web of relations built by Europe over the past five centuries.

This provocation is particularly interesting in light of the European Commission's New European Bauhaus initiative (NEB). The initiative will develop "a collaborative design and creative space, where architects, artists, students, scientists, engineers and designers work together (…) to combine sustainability with good design (Von der Leyen, 2020).' Through open co-design processes, the Initiative engages and leverages existing efforts by the creative sector towards European Green Deal, that aims to make Europe climate neutral in 2050[24].

Morgan Shaban shows Silent Playscape Game, a tool for children to engage with new design fields. Picture by Fab Lab Barcelona,

Distributed Design Platform became an official partner of the New European Bauhaus initiative in April 2021. With this recognition, the Platform joined the ranks of European cultural and creative institutions promoting the wide-spread implementation of the initiative's objectives: beautiful, sustainable, together.

The New European Bauhaus is a bold and necessary move that recognises the social and environmental innovation potential of a multidisciplinary approach that encompasses art, design, technology and science. It bridges innovation with the cultural ephemerality of the Bauhaus in an effort to embolden and empower today's creative practitioners to contribute to a greener, more inclusive Europe. But many have questioned the decision to name it after the Bauhaus School, pointing to the original movement's Eurocentricity, non-inclusiveness and its links to Industrialization. None of which are complementary a "net-zero emission economy" in which "no one or no place is left behind[25]." Whilst the Bauhaus has great narrative potential in the collective consciousness of Europe, the complexities it presents cannot be ignored. These complexities were the topic of two high-level events delivered in reflection of the New European Bauhaus with the support of the Distributed Design Platform.

The first, a keynote conversation at the Fab City Distributed Summit 2020, between Tomas Diez, Executive Director of the Fab City Foundation, and Indy Johar, co-founder of Dark Matter Labs. The keynote discussion was titled "From Emergency to Resilience". Diez and Johar unpacked the Eurocentricity and socio-environmental externalities imposed by the Bauhaus School. They called for the need for a Bauhaus Society, not another Bauhaus School but "New". The second, a roundtable event within the framework of the New European Bauhaus in April 2021 titled "Makers and a Distributed Network Approach Towards a Green and Inclusive Europe." The event proceedings formed part of a set of recommendations delivered by the Platform's members to the Commission's New European Bauhaus co-design process.

Eurocentricity and Socio-environmental Externalities. Towards a Bauhaus Society.

In 1923, the Bauhaus School reinforced a focus to design for the mass-market, feeding standardisation. Embracing technology and the post-materialist potential that industrial production provided, this period was coined "Art into Industry." It resulted in some of the most recognisable Bauhaus designs, birthing the legacy of Kandinsky, Moholy-Nagy, or Bauersome; or the infamy of the Barcelona Chair designed by Ludwig Mies van der Rohe. Designed in 1929 it is still in production, and popular today. Industrial growth follows an economics-driven mindset, to which the Bauhaus' teachings contributed, and from which we are reeling from today. The wide-spread impact of Industrialisation - the extractive, imperial models of production and consumption - are being felt the world over in crisis' including the climate crisis and extreme social injustice derived from competitiveness. In the Fab City Distributed Summit conversation, Johar explained: "externalities are now systematically creating feedback, whether it's climate change, plastic pollution, biodiversity loss, the feedback we receive is beginning to undermine us (Johar, 2020)."

In pursuit of the European Green Deal, many opportunities exist for the conception and implementation of a "New Bauhaus" to not only update, but work toward rectifying these impacts. Diez and Johar propose a "Bauhaus Society" to go beyond Technocratic or human-centered solutions and to lead to the real democratisation of design and production through distributed education environments. Designed to bring new skills, opportunities and empowerment to large swathes of the population, learning environments can contextualise progress instead of manifesting standardised practices dictated from a centralised model; transform our dependence on material resources which is compromising communities and ecosystems; and allow new regenerative economies and organisational structures that encourage a reduction in inequality, while fuel redistribution of wealth, skills and access to opportunities to create diverse happiness. This would mean true distributed agency: means and knowledge for people to directly participate in the production systems that they consume from. Such impact would go beyond the borders of the political and economic union that is Europe, to contribute to rebuilding the global relations built by its colonial past. It would present an opportunity for Europe to shepherd an international design awakening, instead of dictating how design should be.

The Distributed Design Platform has the necessary infrastructure to influence such wide-spread cultural change in Europe and globally. The implementation of a radical idea like the Bauhaus Society proposed by Diez and Johar requires bottom-up learning processes that are open and accessible to different cultures and contexts. Indy Johar: "We need systemic reform of learning as a societal act. We're returning to a new advanced distributed learning and craft age, which is open and additive in a radical sense. That's the only way we're going to unlock the full capacity of the collective intelligence of our whole society" (Johar, 2020). The findings from the high-level roundtable event of April 2020, recognised the distributed and open potential of the Distributed Design Platform and associated networks such as the Fab Lab Network and Fab City initiative. This distributed infrastructure holds the key to the potential implementation of the distributed learning environments needed to realise a Bauhaus Society.

Like the Bauhaus' "Art into Industry", our current educational system continues to fuel the depletion of natural resources and the standardisation of culture. Some of the most recognized and prestigious design schools in the world keep promising to their students that they will become the next Van Der Rohe, Phillippe Starck or Bjarke Ingels, and be able to develop themselves as their own renowned brand or even industry. New designers learn about creating unique and complex products that need to be produced in centralised factories under cheap labour, using raw materials that compromise ecosystems, and rely on fossil fuel powered logistics to arrive for consumption. Design schools today indoctrinate students to use patenting and IP, which are both fundamental tools to exploit a product, and control its production and distribution cycle to benefit the profit-generating machine that the design industry has become. Using Distributed Design principles and global networks of collaboration allows for the creation of ubiquitous learning environments, embedded in the real world: in towns, neighbourhoods, cities, bioregions, and online communities. We are sitting on top of the backbone of a true Bauhaus Society.

The Fab Lab Barcelona learning enviroment. Picture by Fab Lab Barcelona

Distributed Workshops or Labs, to Global Learning Environments.

In 1923, the Bauhaus School reinforced a focus to design for the mass-market, feeding standardisation. Embracing technology and the post-materialist potential that industrial production provided, this period was coined "Art into Industry." It resulted in some of the most recognisable Bauhaus designs, birthing the legacy of Kandinsky, Moholy-Nagy, or Bauersome; or the infamy of the Barcelona Chair designed by Ludwig Collaborative networks of Fab Labs and makerspaces form a Europe-wide (and globally) distributed infrastructure for design, creativity and bottom-up innovation. Over 2000 Fab Labs[26] - digital fabrication laboratories - existing across the globe, touching every continent. These are collaboration and community production spaces that not only host machines, but also domestic-scale innovation, research and design, and house communities of practice in a given context. The Bauhaus gave importance to the spaces in which collaborative work and prototyping was undertaken. The original Bauhaus manifesto, written by Walter Gropius, proclaimed the importance of the workshop as a site of exploration, prototyping and learning by doing. His manifesto impressed that "training in the crafts, acquired in workshops and in experimental and practical sites, is required of all students as the indispensable basis for all artistic production." Gropius' workshop was the nucleus of the school connecting students to industry and into society. Today, the Fab Labs and makerspaces of the Distributed Design network function similarly to Gropius' utopian vision, connecting makers to emerging digital markets and providing spaces for innovation, research and development of products. But in today's climate, they are also central to the implementation of social and environmental efforts, as well as places to test and organise, they respond to the needs of the communities in which they are established. The example of Precious Plastic[27] open-sources the machines to recycle plastic in order to create globally distributed, community recycling centres and community wealth building.

The opportunity presented by today's lab is more utopian than Gropius could have imagined a workshop being. Moving towards new post-industrial industries that focus on local community wealth building and wealth distribution, a multitude of situated design solutions are arising from these spaces to reflect the social, cultural and natural beauty of a place. Embracing regenerative principles, labs generate positive local feedback loops between creation and value, embracing local cultures and indigenous knowledge to enable dialogue between communities to "unlock the full capacity of the collective intelligence of our whole society" (Johar, 2020).

Societal connection is occuring in a distributed, bottom-up, decentralised manner from the innumerable locations globally in which these labs are established. Distributed networks provide key knowledge platforms for exchange and replication of best practices and solutions, increasing access and agency in the field of design through open data, co-design and user (or nature) centred solutions. This scenario serves as the foundation from which we can begin to imagine and build global learning environments, in which local impact in communities and global sharing of knowledge are critical principles. We can learn from programs like the Fab Academy, and it's efforts to make MIT[28] obsolete, by offering access to tools and knowledge around digital fabrication to thousands around the world. Much like Gropius imagined, and the Bauhaus Schools' turn to "Art into Industry," when supported through Initiatives like the New European Bauhaus, the impact of such learning environments can be augmented and expand significantly to build the critical mass needed to mobilise institutions, companies, governments and society towards a new society that tackles social and environmental regeneration through design.

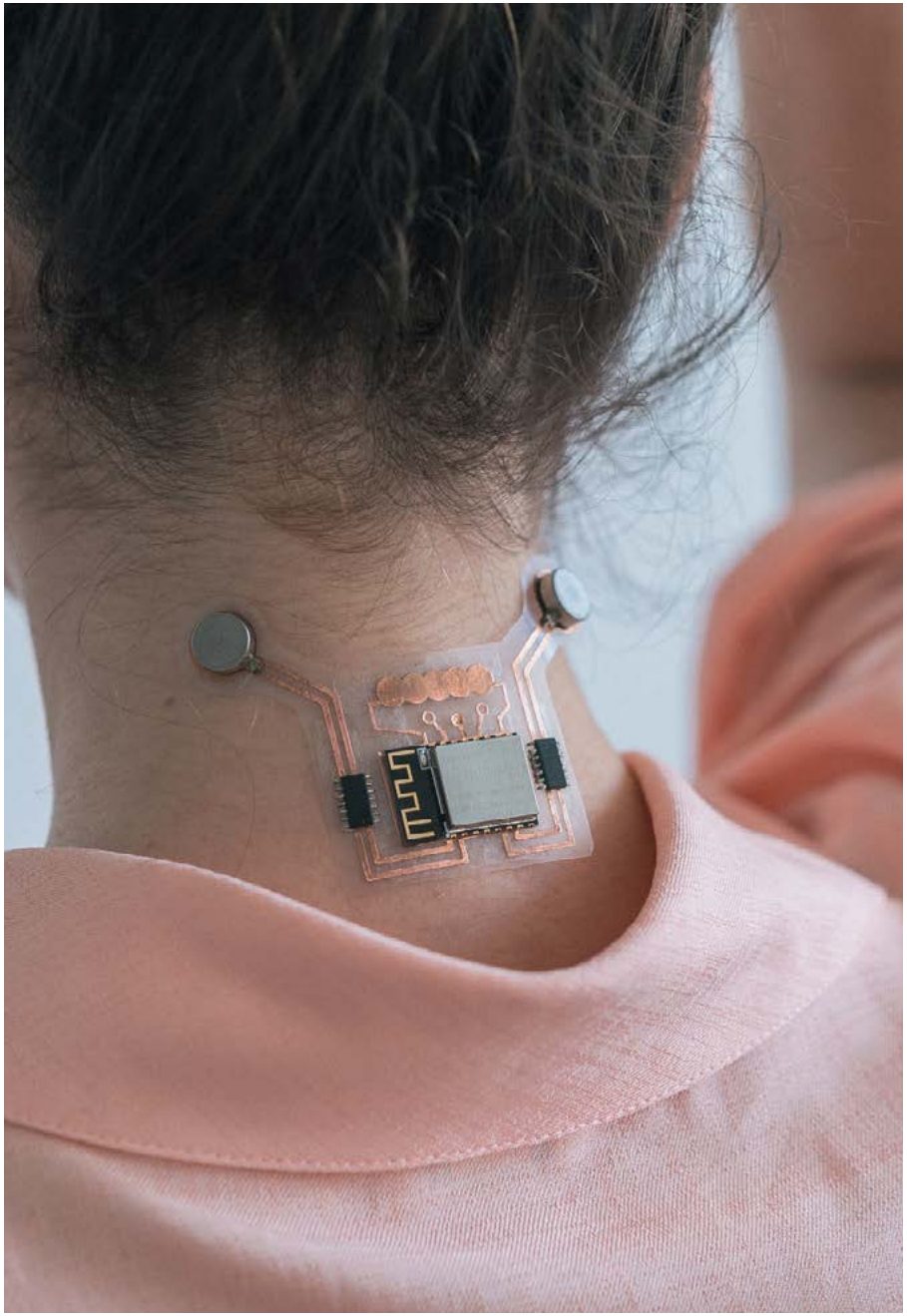
Mies van der Rohe. Designed in 1929 it is still in production, and popular today. Industrial growth follows an economics-driven mindset, to which the Bauhaus' teachings contributed, and from which we are reeling from today. The wide-spread impact of Industrialisation - the extractive, imperial models of production and consumption - are being felt the world over in crisis' including the climate crisis and extreme social injustice derived from competitiveness. In the Fab City Distributed Summit conversation, Johar explained: "externalities

are now systematically creating feedback, whether it's climate change, plastic pollution, biodiversity loss, the feedback we receive is beginning to undermine us (Johar, 2020)."

Fabricating the Global Commons for a Bauhaus Society

Do we want to make the Bauhaus obsolete? Not the core principles of the Bauhaus and its manifesto, but its implementation model. We live in a completely different global context than the beginning of the twentieth century. Aesthetics, nor beauty take priority as several crises are converging, and the industrialisation of everything including our design to education systems means we need radical reform to respond to the real challenges of our time. A Bauhaus in our current climate emergency cannot only be European, it needs to be planetary. The interdependence of global systems of production, and the current model of consumption, are putting pressure in ecosystems and communities around the globe. For centuries, European expansion has relied on the extraction of resources in the Americas, Africa, and Asia. Nowadays, we see how extractive relations produce negative effects over time, from forcing migration of citizens, to reducing biodiversity where resources are extracted, to distorting the planetary climate cycles that end up hitting back in the centre of Europe. A Bauhaus of this century needs to be distributed, and anchored in those countries that have fed the consumption needs of Europeans for centuries. It should rebuild the utopia of a productive society from the very corners of the world that have been supplying aggressive Industrial growth with cheap labour and resources.

A global Bauhaus Society, powered by the European capacity to generate wealth and stability, can generate abundance of knowledge and resources in a commons approach. The approach of commoning resources and knowledge is logical when collaboration happens at a small scale. When scaled to a global context, the commons become more complex. While digital technologies can connect us globally, we have repeatedly seen how the internet can also divide us specifically through the application of extractive models that have been imposed since the early days of globalisation. In spite of today's globalised world, not every local context is the same. As such, the tools and systems needed to fabricate just global commons need to be adaptable, open and flexible. They need to respond to cultural diversity and to local needs, while supporting the wider community and the interconnected life-support systems. Distributed Design gives us the opportunity to learn from designers, makers, and activists that are building such tools and systems for large-scale collaboration. We hope Distributed Design opens a discussion about the fundamental principles that need to be embedded by design into the future platforms that can enable a just common approach at the global scale, while providing the means for collaboration to not only design, but transform the real world while learning how to do it.



Master in Design for Emergent Futures, final project by Cesar Rodriguez show the potential of design. Picture by Fab Lab Barcelona.

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[12]CENTRINNO will deploy pilots in the following areas: Amsterdam (Buiksloterham and the NDSM-warf area), Barcelona (Poblenou in Sant Martí District), Blönduós (Town and municipality in the Northwestern Region of Iceland), Copenhagen Rentemestervej in the Northwest Neighbourhood), Geneva (Zone industrielle de Charnille - ZIC), Milan (Ex-Ansaldo area), Tallin Kopli Peninsula, Paris (Mouzaia and Jardin des Traverses in the 18e and 19e arrodissements, Zagreb (Sljeme former factory in the Sesvete district)

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[15]HUB-IN will deploy local pilots in Historic Urban Areas in Angouleme, Belfast, Brasov, Genova, Lisbon, Nicosia, Slovenska Bristica and Utrech.

[16]T-FACTOR will study as advanced cases the following areas: Barcelona (22@ Poblenou), Dortmund (Dortmunder U), Florence (Manifattura Tabacchi), Lodz (EC1), London (King's Cross), Marseille (La Friche La Belle de Mai), New York (Industry City) and Shanghai (Red Town)

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CHAPTER 5
The Importance of People

What Kind of Openness is Consistent with Distributed Design?
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[20]www.openknowhow.org

[21]www.openknowwhere.org

[22]www.internetofproduction.org

CHAPTER 7

Where To? – What’s Next in the Field of Distributed Design

Attempting to Fab in Rural Areas of Japan

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A Distributed Bauhaus Society

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[25]https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[26]The most recently updated figures about the global network of Fab Labs can be seen at www.Fab Labs.io

[27]Precious Plastic is an initiative of One Army. www.preciousplastic.com

[28]Fab Academy is a distributed program founded by the Center for Bits and Atoms, MIT (Massachusetts Institute of Technology) https://fabacademy.org/

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This is Distributed Design is the fourth in a series of four publications developed within the Distributed Design Platform, co-funded by the Creative Europe program of the European Union.

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Written, edited and advised in a collaborative process led from Fab Lab Barcelona, Institute of Advanced Architecture of Catalonia, Barcelona, 2021.

Information, comments and discussion: www.DistributedDesign.eu

ISBN: 978-84-617-2454-3

Co-funded by the
Creative Europe Programme
of the European Union

This book was co-funded by the Creative Europe Programme of the European Union.

Emerging at the intersection of the Maker Movement and design sensibility, Distributed Design provides a framework for designers, makers and creatives to innovate the field of design towards more sustainable, inclusive and collaborative practices. As global challenges intensify, shifting the global paradigm to support global connectivity and local productivity where “bits travel globally, while atoms stay local” becomes urgent. Distributed Design is a proactive response for makers and designs to prefigure viable design alternatives to the current paradigm which is designed for mass consumption.

As the final of four publications developed by the Distributed Design Platform, ‘This is Distributed Design’ presents a state-of-the-art, in an effort to inspire makers, designers and scholars alike. Within these pages you will hear from a non-exhaustive list of experts, hobbyists and educators whose work is advancing Distributed Design, clarifying through practice, its standing as the framework for collaborative, open, inclusive, sustainable design.

Distributed Design

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