VIRAL DESIGN

The COVID-19 Crisis as a Global Test Bed for Distributed Design

Edited by **Distributed Design Platform**

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CONTENT

Chapter 05
Supply Chains and Materials

Chapter 06
Organising, Deployment and Distribution

Chapter 07
Life and Times of COVID-19

Chapter 08
Closing

Chapter 01

CONTEXT

This is the third in a series of four books developed within the Distributed Design Platform, co-funded by the Creative Europe program of the European Union. Distributed Design allows creatives, designers, makers and innovators to participate in the creation of a new model of production and consumption, in which “bits travel globally, while atoms stay locally”.

The title of the book ‘Viral Design’ is based on Enrico Bassi’s article (FabLab Opendot) which can be found in the final chapter (pp 194-199). The name was inspired by the rapid mobilisation of designers and makers during the crisis. As the virus spread, designs of personal protective equipment (PPE) were globally distributed, designed and produced. Hence, the title ‘Viral Design’.

Preface

How Distributed Design Matters Now More than Ever

Kate Armstrong, Emily Whyman and Paula Sánchez
from Fab Lab Barcelona at IAAC

What a strange world we are living in, but what an opportunity for Distributed Design. Through the Coronavirus Disease 2019 (COVID-19) pandemic 2020 we have seen the rapid decentralisation and diversification of design and production as well as the uptake of maker skills across Europe and the world to meet failing global supply chains and central production systems overwhelmed by unprecedented demand.

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. We call this process and the subsequent market which is emerging from these trends, distributed design.

Over six months, we watched the world change around us, as design went viral. Prototyping and digital fabrication spaces filled broken supply chains and local production systems emerged organically with Fab Labs at their centre. Designs for Personal Protective Equipment (PPE) were being shared globally and digitally manufactured at small to medium scale the world over.

The effect of this was personal. The pandemic launched us all into a living laboratory in which our distributed design practices were lived, worked and tested under emergency conditions. Makers and designers turned their homes into live, work and education spaces, taking time to manufacture personal protection equipment from their kitchen tables whilst also schooling children. Others took their design lectures online and our bio-friends were busy sharing recipes for bioplastics over instagram to help make use of increased food waste (and spare time) at home. It seems many of us also discovered our inner budding chefs, experimenting (and sometimes failing) at breadmaking, fermentation and hosting digital dinners with family and friends. These activities helped to get many of us globally to remain strong throughout a hugely intense and unprecedented time. This will remain symbolic for us in many ways for the rest of our lives.

This book collects observations and reflections from the Distributed Design Platform and extended community. It aims to give shape to the experiences of designers and makers across Europe and throughout the globe during the COVID-19 pandemic. As a platform that works through a series of articles, profiles and case studies that explore the role of design and the wider “design world”.

This book compiles 35 contributions from 18 countries across the world. Some articles are a personal reflection, written by multiple authors whereas other articles are more academic. This book was written distributedly during the pandemic, embodying the concepts and discussing the societal and sociological practice of Distributed Design. We hope this book questions, inspires, and emboldens you. You can dip in and out of the different articles, it is not intended to be followed cohesively. Below you will find the question we asked each contributor to answer in their response.

We asked contributors to consider: *the crisis has accelerated distributed design practices. What is the experience of those working in distributed design during this time and how can we learn from this experience for the future?*

Introduction

The DIY and Open Hardware Response to the COVID-19 Crisis

Tomas Diez from Fab Lab Barcelona at IAAC
and Peter Baeck from Nesta

The COVID-19 crisis has brought the world's do-it-yourself (DIY), maker, and open hardware movements into the spotlight. As global supply chains felt short and countries introduced lockdowns, localised community-based production offered alternative routes to design, produce and distribute anything, from ventilators to protective personal equipment and essentials needed for people on the frontline of the fight against the virus.

While the crisis has illustrated the many opportunities in collective intelligence by using new combinations of people and technology and data to tap into our shared capacity to develop solutions to the crisis, it has also highlighted the challenges in getting the design of collective intelligence right. Better collaboration, avoiding duplication of efforts between individual projects and connecting the response of distributed networks with institutions are but a few of these. Below we discuss some of the opportunities in turning to the maker movement when developing different responses to crises such as COVID-19 and the limitations and challenges the recent attention has also brought to the fore.

The Maker Movement Opportunity

The "maker movement" is an incredibly broad term used to describe, in its simplest form, a technology-based DIY culture where people and teams use everything from milling stations and 3D-printers to open-source electronics to tinker, hack and make new tools and products (CCCB Lab, 2013). These range from small hobby projects to developing a large international distributed network of air pollution sensors (Smart Citizen, n.d.). While often based in local makerspaces, it is the use of open-source hardware tools such as Arduino and Rep Raps printers and the ability to share the code behind projects on Github or similar platforms that have enabled the community to grow rapidly in the last decade (Arduino, n.d.), (RepRap, n.d.).

The use of open-source tools and the distributed nature of the movement enables makers to continuously iterate, adapt and learn from shared repositories of tools. This in turn can help reduce the cost and increase the speed of developing new products and solutions to emerging needs or challenges— a feature which has been heralded as an integral part of the future of manufacturing and the fourth industrial revolution.

While no one organisation or network defines the movement, it has to some extent been loosely organised by the global networks of more than 2000 Fab Labs— a type of makerspace that originated from the MIT Center for Bits and Atoms, and since become an international community. This has subsequently evolved to a number of more coordinated initiatives, including cities such as Barcelona setting up public networks of Fab Labs: the international Fab Academy program and the Fab City Global Initiative (Ateneus de Fabricació, n.d.), (Fab Academy, n.d.), (Fab City Global Initiative, n.d.). While there are many commercial opportunities, perhaps the most interesting opportunity lies in how it is changing our ability to solve social challenges in new ways— a field we have studied and supported at Nesta through our work on Digital Social Innovation (Nesta, n.d.).

Globally-connected makers have historically mobilised as a collective movement to develop novel responses to crises. This is facilitated by relatively low cost of hardware; sharing and collaborating on open designs with an international community and spaces for making in local communities. One of the most prominent examples of this is the Safecast project where an international community of makers and developers came together to build open-source geiger counters that local volunteers could use to capture and share data on local radiation levels following the Fukushima nuclear power plant disaster in 2011 (Safecast, n.d.). The mobilisation of the maker community during the COVID-19 was no different— makers designed, adapted, printed and distributed in an unique situation like no other.

Open Hardware Responses to COVID-19

Since the outbreak of COVID-19, there has been a rapid mobilisation of different individual makers and maker communities to respond to the many new challenges posed by the COVID-19 crisis. We can see a sheer volume and diversity of projects— projects such as www.Opensource.com pulled together a helpful shortlist of the different ways people are contributing their skills to support open-source COVID-19 health projects (www.opensource.com, 2020). Other projects used crowdsourcing for Corona maker projects— for example, www.careables.org developed a "Coronavirus Tech Handbook" (Hardware | Coronavirus Tech Handbook | JoeDocs'. n.d).

The many different health-related initiatives can broadly be grouped into those focusing on more complex medical equipment and, simpler yet, much needed personal protective equipment and other tools required for staying safe during the pandemic. As with everything else happening in the world at the moment, this field is changing day by day, so today's list might be outdated tomorrow.

Complex Medical Equipment

The World Health organisation has warned all countries about "optimising the availability of lung ventilation equipment" (CNN, n.d). Alongside governments enlisting the help of major manufacturers like Dyson, Fiat and General Motors, makerspaces are exploring different ways they can support the development of ventilators and other forms of complex medical equipment such as DIY testing kits needed by hospitals (Bloomberg, 2020).

Examples of projects include the open-source Ventilator, a Dublin-based open-source project which was launched to tackle a shortage of ventilators in Ireland and internationally (opensourceVentilator, n.d.). In Milan, at the Institute of Studies for the Integration of Systems, Massimo Temporelli and Fab Lab Milano have developed two projects for local hospitals (Massimo Temporelli, n.d.),(Make in Milano, n.d.). Their first project 3D-printed 100 valves for a local hospital that had run out of supply. The second modified and combined snorkelling equipment with 3D-printed components to create a DIY respirator (dgil.uz, 2020). While the respirator doesn't have health authority certification, it was found to work on patients and has reportedly been used to ensure nearly 500 patients in northern Italian hospitals have access to life-saving respirators. Similarly, MIT's CBA alumni Manu Prakash and his lab at Stanford are developing open-source cotton-candy-type machines to make N95 filters for masks (Prakash Lab, n.d.).

Personal Protective Equipment and Other Tools for Keeping Safe

There has been even greater activity in the development of personal PPE and other tools for keeping people safe during the pandemic. This is most likely because the demand for PPE has been even greater and the making of many of these tools are simpler and less risky than some of the more complex medical equipment. One example of this is in the UK. A partnership between Makerversity and Shield enabled the set up of a PPE micro-manufacturing hub for NHS workers to develop sustainable masks, visors and equally critical PPE using 3D-printers and other tools at the maker space (Makerversity, 2020).

> 'While the crisis has shown the potential in maker solutions, it has also illustrated some of the challenges involved in the sustainability of this opportunity— mainly around collaboration, avoiding duplication of efforts, finding ways of creating collaboration between traditional, institutional responses and those of distributed networks such as the maker movement.'

Similar initiatives to make face masks, shields, gloves, gowns and hand sanitisers are happening all over the world. While some require machines such as 3D-printers, it is important to note that not all making of PPE requires high tech tools. This is best illustrated in how people from all over the world are sewing facemasks for themselves, and for others. We have not only developed PPE. We have designed a number of creative solutions to challenges caused by the pandemic and the need to reduce the risk of transmission. You can now easily find guides for making DIY hands-free door openers, currency disinfection boxes and hands-free sanitiser dispensers (3dprintingmedia, n.d.),(hackster.io,n.d.),(ibid).

Collaboration, Quality Assurance and Ways to Work with Institutions Remains a Challenge

While the crisis has shown the potential in maker solutions, it has also illustrated some of the challenges involved in the sustainability of this opportunity— mainly around collaboration, avoiding duplication of efforts, finding ways of creating collaboration between traditional, institutional responses and those of distributed networks such as the maker movement.

Open-Source Doesn't Necessarily Lead to Better Collaboration

There are at least 98 different open-source ventilator projects currently happening around the world, each with their own strengths and weaknesses. While open-source means that all projects can be copied, hacked and moderated, the reality is that the field as a whole often lacks structured collaboration between projects. As a result, there is a significant amount of duplication and "reinventing the wheel" taking place which, ultimately, risks slowing down the speed at which products can be developed and put to use. The distributed and global nature of the maker movement and lack of awareness or interest in collaboration with other initiatives is probably the most significant barrier to collaboration. However, there is also risk of a more traditional technology startup competition and a “winner-takes-all” mindset, thus influencing projects and reducing their interest in collaboration. The last challenge for open-source collaboration is related to the exploitation of commercialised resorts, as well as attribution. While open collaboration is at the heart of the communities developing projects collectively that can save lives, there is always the risk for external actors to extract value and commercialise community-led efforts without injecting any value back.

A number of initiatives have been set up specifically to coordinate efforts and resources from makers towards COVID-19 challenges, such as GetusPPE in the US and the HelpfulEngineers open-source group setup by Project Open Air which has more than 3,000+ members looking for different COVID-19 solutions (www.getusppe.org, 2020),(www.app.jogl.io, 2020),(www.projectopenair.org, 2020). Other examples of trying to coordinate international and local efforts include CoronaMakers, Reesistencia in Spain, the French COVID-19 Initiatives network and the Fab Lab Network Open Corona Repository (www.coronavirusmakers.org, 2020), (www.gitlab.com/reesistencia, 2020), (www.covid-initiatives.org, 2020), (www.gitlab.fabcloud.org/pub/project/coronavirus/, 2020). It is a joint effort between the worldwide network of Labs and MIT’s Center for Bits and Atoms, and a tracker for maker resources in cities by the Latin American Network of Fab Labs to enable better coordinated COVID-19 responses.

Quality Assurance and Validation of Designs

The maker movement grew out of a desire for people to hack and modify everyday tools and products at home. Developing medical equipment that could be the difference between life or death is risky and requires a different kind of quality assurance and validation of designs. Most existing projects were still too early-stage to get a sense of the quality and that “a large amount of future work needed to move open-source ventilators up to the level considered scientific-grade equipment” (f1000research, 2020). One example of trying to manage this challenge is the Facebook group, open-source COVID-19 Medical Supplies which has been set up to support the development and quality assurance of open-source emergency medical supplies with contributions from engineers, designers and medical professionals to generate and validate ideas. This has, amongst others, led to the validation of an open-source ventilator developed by collaborators on the group by Ireland’s Health Service Executive (Tech Crunch, 2020). However, much more work is needed to ensure growth / development in quality assurance in the collaboration between crowds of makers and the institution, carers and health professionals they are trying to support.

Scale in Production

Some commentators have described open hardware projects as the “Plan C” for how countries can respond to crisis and the urgent need for medical equipment (Make Zine, 2020). Plan A is governmental takeover of factories through policies such as the “Defense Production Act” in the US and Plan B a commitment by the private sector shifting their manufacturing capacity to producing medical equipment as has been the case with companies such as Fiat and General Motors.

While the maker response strength is fast, agile, distributed and often low cost, one of its biggest challenges is large-scale production. Fab Labs and makerspaces have laser cutters and 3D-printers, however, they are not micro-factories designed for sustained production. Instead of seeing the maker movement solutions as separate to the work done by large-scale manufacturers, these need to be considered as part of a larger, integrated process.

Fab Labs can play a role in making this connection. In Barcelona, for example, an open-source design of face masks improved the production time through moving from 3D-printing to laser cutting. This was shared with a local manufacturer, who could then increase their production capacity from a few dozen to 5,000 masks per day (www.libreguard.care, 2020).

Additionally, maker spaces and on-demand manufacturing can not only pursue production efficiencies solely for profit but can also serve the local needs of people. An inventory of local materials and manufacturing capacity could, for example, serve as a tool for designers, manufacturers and others that play an important role to revitalize local economies, especially after the pandemic.

Copyrights and Patents

At the heart of open hardware and the maker movement is the open-sourcing of designs, meaning everyone is free to copy, hack or moderate existing products. Making the most of the opportunity in making and open hardware within a billion pound market built for medical devices built on patents will continue to cause issues. While the risk of bad PR is likely to be holding back many manufacturers from taking legal action, there have already been reports of some threatening lawsuits against organisations who 3D-print new valves for their ventilators (Tech Dirt, 2020).

Some manufacturers such as Medtronic have taken a more positive approach and made the specifications for their ventilator freely available so that it can be replicated and built by others with the production capacity. Similarly, there have been calls for companies to sign the Open Covid Pledge and for governments to loosen patent law for any products related to COVID-19 and further, ensure the right to repair (www.opencovidpledge.org, 2020), (Bloomberg, 2020). However, in spite of these and other initiatives, a better and more flexible approach to patents and copyright is needed if the maker community is to be more deeply involved in developing and fixing medical equipment.

Supply Chains

Finally, it is important to note that whether made in a factory or makerspace, the making of medical equipment requires materials. While the maker movement has globally spread, supply chains and material-flows of these new production spaces are still tied to industrial principles. Most of the machines are made by existing industries, shipped from overseas. The waste flows are rarely repurposed or reinjected in the local material supplies. Recent projects such as Precious Plastics have opened opportunities to rethink how materials flow in local maker communities, and how by designing interventions in the supply chains and waste streams, we could think about new ways to source materials for local prototypes and production in makerspaces (Precious Plastics, 2020). In a context of limitation of supply chains, as we have seen happen during a pandemic, material sources can be explored at a bioregional level. The current crisis has pushed more creative solutions in the reuse of existing materials, not only at the maker, but also at the industrial level. One example is in the oxygen ventilator in Barcelona, which incorporated windshield cleaner motors in the production line of a car assembler, and then rapidly adjusted their assembly line to respond to the crisis (www.oxygen.protofy.xyz, 2020).

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What Next?

As with everything else happening in relation to COVID-19 and it's disruptive effects, it is hard to predict the long-term impact of the recent surge of activity and interest in the maker movement. Will this lead to long-term change in our response to crises, bringing more attention to the idea of creating more resilient and sustainable communities through distributed manufacturing? Or, will it lead to multiple one-off projects that will disappear once the pandemic is (hopefully) over?

To build on the opportunities that have been created by the responses to COVID-19 we need to understand how to enable better collaboration within the community itself and how to create the right connections between distributed maker communities and large-scale institutional responses. The many funders and policy makers who will hopefully turn their attention to the maker movement over the coming months can play their part in this by not just focusing on backing individual projects, but the wider capacity of the community to respond to this and the next crises. Maybe the increase of climate events in the years to come will require even faster and more articulated responses— we are just warming up.

Chapter 02

COLLABORATION AND WAYS TO WORK WITH INSTITUTIONS

How have makers, businesses and policymakers collectively collaborated during the crisis? This chapter contains accounts which are academically-framed responses to the crisis, personal accounts of makers from Denmark and France, and humane, inspiring activities developed to engage children in the darkest moments of the lockdown. Whilst exploring the novelty of social constructs and rapid innovation, the chapter poses questions on the longevity of newly-formed partnerships.

"Collaboration And Ways To Work With Institutions" contains contributions from Massimo Bianchini, Patrizia Bolzan, Stefano Maffei, Michaël Araujo, Soumaya Nader, Quentin Perchais, Asger Nørregård Rasmussen, Stina Sabally, Malte Hertz Jansen and Xavier Domínguez.

Designing in the Post-COVID Era

Transition Artifacts for Distributed Futures

Massimo Bianchini, Patrizia Bolzan and Stefano Maffei
from Polifactory, Department of Design & Politecnico di Milano

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About Innovating between Cycles and Waves

"Cycles" and "waves". These two different words are used to describe a wide variety of phenomena and processes affecting the environment, society, economy, technology, and innovation. Today more than ever, it is important to understand how these mechanisms work, how they are connected to each other and what impact they generate, but also to think about the kind of relationship they have— or may have— with design and production.

A cycle is a series of natural and non-natural events, which repeat in a similar manner, following the same order, during a given period of time. Throughout their evolution, humans have learned to know, reproduce, modify, design and build in an artificial way, both natural and biological cycles. Perhaps this is why we tend to attribute a productive and proactive connotation to cycles, such as agriculture or industrial production.

In contrast, a wave is often the sudden or underestimated flow of one or more climatic, social and economic phenomena with an adverse nature which spills over into a social or territorial context, with a potentially catastrophic impact. In relation to climate change, we hear about heat waves more and more often. The term "wave" is also commonly used to refer to uncontrolled migration flows and the spread of epidemics. Waves stress communities because they modify their economic and productive cycles, making them vulnerable, but also because they require costly investments in preparation to defend or protect themselves, or else they catch them unprepared. Finally, the waves both have a global dimension and a territorial distribution, with local effects and specificities.

Starting from a simple definition, the first step is trying to understand if waves are "objects of change" that influence the birth, the development, and the distribution of innovation cycles. Rising parts of the international scientific community are increasingly reminding us that in the Anthropocene, natural cycles, cycles of human activity, and "wave phenomena" are now definitively interpolated, generating cause-effect dynamics which scale and acceleration can get out of human control and intervention. Researchers such as Timothy Morton define these phenomena as "hyper-objects", i.e. objects whose main characteristic is to exist on space-time dimensions that are too large to be seen or perceived in a direct way (Morton, 2013; 2016). If we assume that it is possible to act on these "hyper-objects" as a starting point, it is also possible to tackle the most interesting elements compatible with the current potential of distributed design and production processes.

'The society we live and operate in is already striving to innovate and produce through virtuous cycles that facilitate the transition to a circular economy model.'

In the field of economic development theories, innovations— especially technological ones— spread in society by cycles and waves. Since the 1920s, scholars like Kondratiev, Schumpeter and Carlota Perez have progressively elaborated and consolidated theories on the existence of long waves (or "super-cycles") of socio-technical revolutions that generate constellations of innovations in several sectors. These long-lasting phenomena follow each other and are characterised both by increasing frequency, speed of development and by a growing impact of socio-economic transformation (Perez, 1983). Carlota Perez has recently highlighted how the COVID-19 crisis fits in the middle of two revolutions, the industrial one and the information technology one. In the same way that some of the businesses that have become more important in our daily lives were born during the Great Recession of 2008-2010, the most emblematic businesses of the next decade could be born from the sudden change in lifestyles due to the pandemic. Given that the neoliberal economy has shown its limits and the pandemic has triggered a rethink about the need and the rules of production management and distribution systems of goods and services in a more global and shared direction, it is important for Perez to understand how the birth of new innovations, or rather the transition to a system based on distributed innovation cycles will happen (Lakhani and Panetta, 2007).

The second step concerns the change of approach and design agency related to distributed innovation. In fact, the society we live and operate in is already striving to innovate and produce through virtuous cycles that facilitate the transition to a circular economy model. This model of circular innovation is developing in a global context that is increasingly facing phenomena with exponential trends that can deflect or favor development trajectories. Bruno Latour (2017) spoke about a continuous mutation of our relationship with the world and a permanent instability in the relationship between nature and culture (scientific, material, design, and production). This means thinking primarily about the evolution of the culture of responsibility and risk in innovation cycles.

In the last few months, the COVID-19 emergency has completely rewritten the agendas of innovators, designers, manufacturers and policymakers by introducing priorities and project themes. Innovating within scenarios in continuous and rapid transformation, transition and mutation requires developing both a design culture of prevention (to limit objective and proven risks) and precaution (to limit potential and uncertain risks).

(Re)Thinking about the Relationship between Distancing and Distribution

The health emergency scenario that has emerged globally since the beginning of 2020 has called into question many of the established socio-economic assets as well as daily practices, habits and lifestyles. From a globalised world— in which the distances between people, cultures, and commodities were cancelled thanks to the logistics networks of people and goods, fed by exchange agreements between nations— the COVID-19 emergency has in fact forced to physically distance itself from people and things. The proxemics of physical and collective relations has been completely overturned, generating a new experience of the concept of spatial and social distance. This type of relationship is rapidly creating a new routine, characterised by the presence of a repertoire of products-services that act on the new and different degrees of separation between individuals and their community or social practices.

This situation has a strong impact on the organisation of different systems:

- It has generated a strong pressure on logistic and goods distribution systems, also contributing to reintroducing the centrality of human subjects and professionals operating in a sector characterised by a massive and extensive technological infrastructure.
- In terms of innovative response, it has accelerated the debate on the potential of distributed production models and of micro and/or self-production in all its possible organisational and executive structure— from professional and entrepreneurial forms to domestic self-production (DIY).
- It has restored centrality to the organisational models of territorial healthcare in terms of geographical distribution, capillary coverage and medicine of proximity, as well as, social recognition to its operators.

(Re)Thinking the Role of Open Innovation in Contemporary Society

In a short period, we have learned that the new innovative scenario related to COVID-19 requires resilience and speed of design's reconfiguration, production, distribution, and consumption systems to adapt to the evolved and still evolving social needs and habits. But at the same time, it also leads to a shift in the regulation and standardisation system that must verify and authorise it. Hence, on a global scale, there is the emergence of a series of phenomena like the explosion of the need for mass protection products such as masks, protective gloves, visors, and other sanitary materials (before the emergency they were considered commodities), which have shown an unbalanced territorial distribution of entire sectors and production chains. In the past, few countries have concentrated on the production of these products, creating a small monopoly from which speculative phenomena and consequent political-economic tensions have derived.

In response to scarcity in supply chains, some manufacturing companies belonging to different sectors (especially in the textile-fashion sector) have made themselves available to partially and/or temporarily reconvert their production. These companies have then encountered technical difficulties which has slowed down their production capacity. Also regarding the production of life-saving medical equipment, the spread of the pandemic and the consequent lockdown have caused a widespread shortage of materials and components for the production of masks and visors, but also respirators and their maintenance, leading to critical situations in the health care system of the various countries involved. The producers of these goods and their global subcontracting systems have been under great pressure, generating interruptions and intermittence in manufacturing flows.

At the same time, the COVID-19 emergency has revealed on the global scene some real potential of the Maker Movement and of the technologies, places and services for distributed production. For their natural configuration, Fab Labs and Makerspaces are in fact places where you can experiment and produce on-site and on-demand through the tools of digital fabrication. In countries like Italy, France and Spain, characterised by the presence of dozens of geographically distributed and digitally connected laboratories, Makerspaces and Fab Labs have been able to respond promptly to the challenge, activating networks for the design and production of masks, visors, valves and connections for intensive care respirators. It is an interesting fact that more than 30 different models of masks and visors are downloadable from the web and potentially self-producible through 3D-printer, from the beginning of the pandemic until now. Of equal relevance, is the case of the solidarity struggle that engaged the entire community of local makers in northern Italy between March and April to produce large quantities of Charlotte valves in the shortest possible time to convert a simple Easybreath Decathlon snorkeling mask into a potential life-saving garrison to multiply beds in intensive care (Guzzini, 2020).

In the face of this extraordinary global design and production mobilisation, however, not everything worked and there were executive and organisational limits as well as some problems of comparison, regulatory verification and certification. From the executive point of view, the main problem is the impossibility to guarantee quality homogeneous parts production. Moreover, it has not been possible to start an effective control of the output made through 3D-printing which, starting from the same file, can generate parts with very different tolerances, sometimes made by materials not suitable for medical use. As far as the organisational aspect is concerned, the focus shifts to the management of the flow of information, which is crucial in all emergency situations. For several reasons, during the pandemic, it was not possible to structure an official communication channel between maker/Makerspace and local health systems, despite their natural propensity to organise themselves in a network. The difficulty of collecting and managing feedback on the efficiency and necessity of parts and components made it difficult to coordinate and control the distributed production system, which was spontaneously organised. As soon as the industry was able to reorganise itself to face the needs, the whole virtuous network of makers and self-producers was cancelled, as it clearly could not compete in terms of numbers and quality of the products made.

These phenomena, if observed as a whole, outline the partial emergence of a potential ecosystem with an innovative model that we could define as open innovation, based on a more integrated relationship between industrial production, design, and distributed production and policymaking system. An integration between these worlds is possible on the side of experimental research and advanced prototyping, through open design and open manufacturing processes, which can facilitate the definition of common standards for processes and products (and the use of data that supports them). In parallel, there can be a greater union between these worlds with the certification and authorisation system, which is now a substantial part of the innovative development process: in terms of regulations, it is possible to imagine higher transparency and openness of certification processes, while at

the design level it is supported the possibility to access and use open data to configure application scenarios (critical futures), in which to prefigure and test solutions that then have an impact on society (critical making). The result of these scenarios is the creation of a potential field of development of open-source experimental solutions, prepared and validated according to the scenarios considered and the processes tested, ready to be adapted, and materialised according to needs.

(Re)Thinking Nature, Types and Role of Contemporary Artifacts

Latest economic studies report how the first phase of the pandemic generated new and different behaviors in the relationship between individuals, things and environments (Chao, 2020; Karin et al.,2020). The COVID-19 emergency and the consequent lockdown have led people to build new familiarity in the use of devices for personal protection, sanitation, and the measurement of body parameters. The temporary lockdown and reorganisation of food distribution and delivery has meant that domestic food consumption has passed through the rediscovery of individual and family practices of self-production, socially supported and shared through the network. Finally, distance learning and smart working practices have accelerated intergenerational processes of personal and environmental digital capacitation.

At the same time, the shift in the ways of access to services, has accelerated the process of changing the culture of control through systems and devices that operate to scan, track and monitor people's actions and behaviors. All these transformations have already had a direct economic impact in different sectors, triggering reflections on transitions of contemporary society's consumption patterns towards the circular economy. Recent evidence demonstrates the elasticity of bottom-up initiatives by both private companies (e.g. breweries producing disinfection alcohol for medical applications from residue products) and individual citizens (e.g. maker's movements producing mouth masks from textile leftovers and supplying hospitals and care facilities) to recycle locally available resources and thus reduce import dependency.

In response to the need to build local resilience, supply and production systems (as well as associated consumption systems) will likely in the future need to become more localized (Wuyts et al, 2020). Also such legal guidelines would mean that users would not suffer adverse legal consequences when trying to repair products by, for example, fashioning replacement parts using 3D-printing technologies. This shift would help to alleviate durability problems caused by the tendency of manufacturers to design products for premature obsolesce while encouraging greater reuse, recycling, and reclamation of products and components (Hernandez et al., 2020). For distributed design, this means practicing the design of artifacts that are configured as new basics: artifacts designed on new needs and with new standards; artifacts that incorporate new essential functions; tools that help us recover basic skills or develop new ones.

The second theme of reflection concerns the nature of objects developed through distributed design and production processes. The pandemic requires the adaptation of many existing product-service systems, but also the rapid conception of new artifact systems designed in anticipation, preparation or facilitation for the transition from one situation to another and to adapt to the continuous change and adaptation of existing rules, regulations and laws.

Experimenting an Educational Design Experience: Conceiving Solutions for Everyday Life in the Post-COVID Era

Polifactory, the Politecnico di Milano's Fab Lab, during the most difficult days of the lockdown, has chosen to interpret the challenge of the third year of activity of the Distributed Design project focusing on the development of design solutions in response to the habits change and new needs that emerged, both during the sanitary emergency phase and in the following period, making them synergic with the distributed and circular innovation models. The idea of Polifactory is to populate with new solutions the scenario of a "new present", the beginning of a "post-COVID era" in which the watchword is "transition". The epicenter of this transformation starts from the understanding that we live in a world bound by a radical interdependence (Escobar, 2018). All kinds of connections (relational, functional, energetic, emotional) have always characterised the society in which we were born and grew up, and also all the creative imagery and the resulting systems of knowledge, infrastructure, services and artifacts. It is these systems that can and must be redesigned, starting from the things that surround us and that must look at these new times. We are therefore talking about innovative objects for everyday life that not only concern health, but also new needs and activities related to the condition of social distancing and isolation.

Designing Everyday Life in the COVID-19 Era (DELiCE) is the initiative that Polifactory has put in place in 2020 to give shape to new scenarios of everyday life post-COVID, exploring the potential of open and distributed design in the development of ideas. The objective is to prefigure solutions that go beyond the health emergency and remain valid even in the subsequent phase. Polifactory has chosen to launch the DEliCE challenge to 50 young designers of the Concept Design Lab of the School of Design of the Politecnico di Milano (MSc Integrated Product Design). The start-up phase of the Concept Design Lab coincided with that of maximum diffusion

of the COVID-19 in Italy. This situation forced designers to experience firsthand the sudden change in their habits, providing them with a unique opportunity to translate, almost in real time, the daily difficulties and limitations into new design opportunities.

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The emerging scenario of post-COVID era has been put in relation with the field of micro and distributed self-production, areas in which the democratisation of digital fabrication allows more subjects to give shape to more artifacts even autonomously, while the simplification and miniaturisation of technologies facilitate the introduction into objects of new ways of interaction, connection and control. Young designers were asked to develop two different solutions by experimenting with two design strategies: on the one hand to create new projects by adopting a maker approach, on the other hand to work on hacking existing objects by modifying their function or field of application.

Through DELiCE, in just two months, 22 concepts were generated: while lingering on some design ingenuity due to the impossibility of prototyping the objects in the conception phase because of the lockdown that has afflicted even the university laboratories, eleven solutions conceived from scratch and eleven hacking projects that constitute a first example of post-COVID era's design biodiversity. The set of these concepts tries to tell some new categories of artifacts representing a first plausible idea of distributed future:

- Artifacts that support a transition to new or different working conditions within domestic and shared spaces. They are add-ons and objects designed to distance without creating social barriers, portable micro-habitats, mobile devices that recreate indoor outdoor environmental conditions, for the comfort of people in isolation (e.g. portable lighting windows that recreate natural light).
- Artifacts that support the reconfiguration of public and (semi-public) submitted spaces to constant changes in terms of rules and behaviour. We are talking about solutions designed for the need of a new way of living social aggregation in safety "colonizing" new empty urban spaces, creating alternative ways for urban mobility, redesigning the distribution of flows of goods and people.

- Artifacts that help people reconfigure and differentiate the same space with different functions. When it is impossible to access spaces other than the domestic one, rethinking leisure time is a theme of design interest. To address this need, it is possible to explore the design of new analog tools and equipment that can be coupled with digital home devices for sports, recreational and cultural activities accessible in a distributed form for individual use.

Of the 22 concepts, four were selected as particularly significant to illustrate the small and large changes in habit caused by COVID-19 and then implemented to become 100% open and distributed. KLAW-4040, Maskering, Must, and Duo are not only innovative solutions that can be easily implemented with the skills and technologies present in makerspaces, but they share an attention to environmental and economic sustainability, the latter aspect not negligible in a moment of global rediscovery of a "digitisable self-sufficiency".

Soon everyone will be able to self-build KLAW-4040, a modular system for the transport of objects designed for private users and professionals that responds to the new needs of social distancing. Masks have become a personal item of daily use for millions of people.

Thanks to Maskering, a silicone support to be worn around the ear together with the mask, it is possible to prevent skin irritation due to prolonged use of PPE, but also to meet the needs of users who have particular ear anatomies or hearing aids.

Finally, when the desire for change also attacks existing objects, solutions such as Must and Duo can take hold through the combination of hacking and digital fabrication techniques. Must is a new low-cost tool for the rapid welding of polymeric materials and fabrics that uses an electric hair straightener thanks to a series of functional add-ons designed ad hoc to allow different techniques and types of joining. In this way, it is possible to create airtight suits or containers for sterilisation.

On the other hand, Duo is a digital device designed to help people with visual impairments to respect the rules of social distancing on the street and in public environments, by intervening both on the white orientation stick and on the harness for guide dogs.

These projects have been designed with the aim of manufacturing with the typical Fab Labs technologies and therefore they can be easily replicated in any of the hubs of this network. Due to that reason, they can be considered as first demonstrators to consolidate the potential of *open and distributed production within the cities*, which is particularly important in the present-day, facing rapidly particular and changing needs.

Acceleration, Transition and Systemic Change. These three words can be the coordinates to define a trajectory of socio-technical innovation in which open and distributed design can play an enabling role. One of the places to trigger this transformation can be precisely the field of design education. Recently, European Commission President Ursula von der Leyen announced her intention to create a new European Bauhaus on the model of the influential design school. The aim of this action is to create a cultural and sustainable movement in the European Union, "a co-creation space where architects, artists, students, engineers and designers work together". This seems the right space to learn how to co-design a new lifestyle in the post-Covid Era, because a transition from a post-emergency system to an *emergence of systemic opportunities* is already underway!

KLAW, DELiCE Project, 2020

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pp. 14 - 21

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Designing in the Post-COVID era

pp. 24 - 33

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pp. 34 - 39

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pp. 40 - 41

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Jugando con la Luz

pp. 42 - 47

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Personal Protective Equipment and other Tools for Keeping Safe

Personal Patient Pack, a Winning Design

pp. 50 - 55

N/A

The Story behind the SIMPLE Face Shield

pp. 56 - 63

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UNA Laboratories

pp. 64 - 65

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pp. 66 - 79

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Quality Assurance, Validation of Design, Copyrights and Patents

The Validation of Design

pp. 82 - 89

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The year of 2020 will be unforgettable in many ways. It in some ways symbolises a year of contradictions - we have experienced mass mobilisation to generate collective intelligence, yet we have never been so geographically and physically restricted. The Coronavirus (COVID-19) pandemic has affected all areas of society, from supply chains to education. One of the key things we have experienced during this unprecedented period, is the rapid uptake of distributed design. The collaboration of makers and designers to collectively prototype, produce and distribute has mitigated negative impacts of halted supply chains, opened up intellectual property rights (IP), formed new partnerships between businesses, designers, key workers and most importantly, set the foundation to question the resilience of newly forged networks for the future.

This book collects observations and reflections from the Distributed Design Platform and extended community. It offers a selection of different articles, profiles and case studies of designers and makers across Europe and the rest of the world during the COVID-19 pandemic. Most importantly, it highlights and explores the socio-technological role and cultural impact of distributed design in the response to crisis.

Distributed Design

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