

Material culture(s). Research paths in an evolving material design culture, and the connected future designer's attitudes

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# DESIGN CULTURE(S)

Cumulus Conference Proceedings Roma 2021

Volume #2

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Cumulus Conference  
Proceedings Roma 2021**

Volume #2

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DESIGN CULTURE(S) | CUMULUS ROMA 2021  
JUNE 08.09.10.11, SAPIENZA UNIVERSITY OF ROME

## About the conference

**Loredana Di Lucchio, Lorenzo Imbesi**

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### The theme

More than three years ago (it was 2018), when we presented our candidacy to host the Cumulus Conference in Sapienza, our first effort was to set up a Conference Theme. The duty was not simple since we wanted to avoid any naïve, fashionable or captivating topic. We were in search of a theme which is appropriate to the times, the context and moreover, to the Cumulus's community.

Our starting point was to consider what Cumulus meant and still means, not only for us, but within the worldwide design community. Looking back in the history of Cumulus, we found an interesting picture in its name: in fact, "cumulus" is the English name of a specific kind of clouds and comes from a Latin word that means "heap, pile, mass". Therefore, the word Cumulus is refereed, at the same time, to those big clouds that appear in the sky every time in different forms and always in constant change, as well as it is referred to a set of singular elements that make up a unit together. As a consequence, Cumulus efficiently describes the idea of a set of many singularities that meet, settle and become each time a new and different entity.

This picture helped us to set our goal: offering to such variegated, mutant, but nevertheless aggregated "cumulus", a conference theme where to recognize itself. This idea of big entity made of a huge number of singularities is connected to the idea of community, and then we had no doubt that this was the exact purpose of the founders of Cumulus when they decided its name.

Today the concept of community is increasingly complex, since it is crossing new social, technological, political and economic challenges and at the same time it is more global and multicultural than ever, more and more enriched by new hybrid languages and habits, due to the increasing flows of goods and people around the world. As a consequence, also a

Design Community, as Cumulus, is evolving as a wide-open field with many new practices and sometimes new principles.

In this regard, in order to figure out such complexity, we found a suitable answer in another word with Latin roots: the word "culture". Culture comes from the Latin word "colĕre" which means "cultivating the land to make grow" and, figuratively, also "taking care" of something, including knowledge, and therefore, "cultivation through education, improvement and refinement of the mind". This second meaning of "culture" is based on an insightful concept by the ancient Roman orator Cicero in his *Tusculanae Disputationes*: "cultura animi", which is the cultivation of the soul.

The resulting parallel between the culture of the land and the culture of the soul was fascinating and highly significant to us, since it is showing the challenge of growing something new, starting from the roots, from the soil, from the context and - as we know - depending on available soil, context and roots, we are growing different plants, obtaining different fruits and seeds, to plant again in a virtuous life-cycle. Thanks to this metaphor, we understood that diversity is a prime condition for the birth and the growth of culture, while it doesn't mean opposition but combination, arrangement and hybridization. Thanks to this metaphor, we got back to the initial concept of accumulation, and to the concept of Cumulus.

On another note, the Cambridge English Dictionary states that culture is also "the way of life, the customs and beliefs, of a particular group of people at a particular time". This could be an interesting stimulus but, when associating "Culture" with "Design", it was immediately clear that we cannot refer to one unique Culture, but we need to open to the concept of bio-diversity, where Design cannot be considered as the result of a single dominant, globalized, levelling thinking.

Finally, looking into design as an expression of Culture(s) and Culture(s) as the outcome of Design means to take into consideration not only what we are doing now, but what we are inheriting from the past and which should be granted for the benefit of future generations, so intertwining past and future, tangible and intangible, innovation and tradition.

Here is our conference theme: Design Culture(S)

Here, the suffix (S) is not only indicating the plural, the diversities, but it is also connected with the "saxon genitive", which is taking Design as subject, while connecting it to other different objects/meanings.

Following this concept, we found the ten keywords which we used to describe the tracks:

Artificial, Languages, Life, Making, Multiplicity, Proximity, Resilience, Revolution, Thinking and New Normal.

Each keyword was enriched with three additional keywords, to better explain the different directions and connotations, which are:

- Artificial is connected with Digital, Technology, Robotics
- Languages is connected with Aesthetics, Expression, Visual
- Life is connected with Nature, Biology, Human
- Making is connected with Process, Production, Post-Industry
- Multiplicity is connected with Gender, Pluralism, Diversity
- New Normal is connected with Health, Education, Work&Play
- Proximity is connected with Places, People, Economy
- Resilience is connected with Social Innovation, Circular Economy, Sustainability
- Revolution is connected with Critical Thinking, Interruption, Change
- Thinking is connected with Theory, History, Criticism

We obtained 40 wonderful words, full of possible meanings, ready to be interpreted and declined by the worldwide community of cumulus to figure out Design not as a singular specific voice but as a plural ecosystem of meanings.

After three years, during which our world is extremely changed, we can say that these words and this topic seems even more current and significant.

In the next pages of the Conference Proceedings, we are very enthusiast to offer a big picture of the biodiversity of Design Cultures and the multiverse of our Cumulus.

## The experience

Cumulus Roma 2021 'Design Culture(S)' covered four days full of parallel sessions, working groups, poster sessions, exhibitions, social events, and more, but above all attending was a new form of experience than a conference.

While feeling the responsibility of filling a long void caused by the pandemic, we tried to re-design the whole experience to deliver a new form of conference which is keeping the in-presence through the online opportunities, so to bring you all to Rome and get the colors, the smell and the taste of the city, the architecture, the arts, the food, and the wine, always giving a cultural and a scientific perspective.

When facing the challenges, we wanted to deliver a new format to the whole Cumulus community, with the aim of innovating with technology, enhancing networking and the sociability of the experience, and keeping everyone on board to ensure the participation and democracy to our association from anywhere in the world, no matter of the time zone.

After four full days, we trust this conference at Sapienza University of Rome to be one of the longest Cumulus initiatives, counting with approximately 680 attendees, more than 350 papers and posters, 10 exhibitions, 10 tracks and 80 parallel sessions, 20 track keynotes and

four plenary keynotes, more than 50 schools exhibiting in the New Members Fair from everywhere in the world, and 18 schools participating in the Italian Members Fair.

Our aim was to develop a new form of hospitality to welcome and to make all of you feel at home in Rome but in a new virtual environment, while sharing design research and knowledge, along with the true spirit of Cumulus.

It is not enough to have a good project to gain good results, but it is necessary to get good responses. Your reaction was extraordinary, not only for the massive amount of registered participants, but for the involvement, the enthusiasm and not lastly the patience you have shown during the days of the conference. You joined in perfect Cumulus style from all over the world: from Oceania to the Americas, from Africa to Europe, to Asia, and you have actively followed the four days continuously, participating in a chat that often could not make your voices heard, but made us feel your presence very close.

Thank you for trusting us since the very beginning to the very end, while making this event possible. We will remember it for a long time for its extraordinary nature. We wish we will meet all together soon again without mask, and we will keep the memory of these days together among the best memories of this difficult period.

TUE08JUNE	WED09JUNE	THU10JUNE	FRI11JUNE
9:30 CET   DAILY PROGRAMME STARTS			
6 X ITALIAN MEMBERS FAIR	10 X TRACK SESSIONS	10 X TRACK SESSIONS	5 X WORKING GROUPS
6 X ITALIAN MEMBERS FAIR	1 X WORKING GROUP	1 X WORKING GROUP	POS TER SESSION
6 X ITALIAN MEMBERS FAIR	6X NEW MEMBERS FAIR	6X NEW MEMBERS FAIR	EX TRAS
	10 X TRACK SESSIONS + ROUND TABLE	10 X TRACK SESSIONS + ROUND TABLE	5 X WORKING GROUPS
	1 X WORKING GROUP	1 X WORKING GROUP	POS TER SESSION
	6X NEW MEMBERS FAIR	6X NEW MEMBERS FAIR	DESIS EVENT
12:50-14:30 CET   LUNCH BREAK   DESIGN CULTURE(S) OF ROME: FOOD EXPERIENCE			
OPENING PLENARY	10 X TRACK SESSIONS	10 X TRACK SESSIONS	CLOSING KEYNOTE SPEECHES
	1 X WORKING GROUP	POS TER SESSION	
	6X NEW MEMBERS FAIR	EX HIBITION SESSION	
KEYNOTE SPEECHES	10 X TRACK SESSIONS	10 X TRACK SESSIONS	FREE BREAKOUT SESSIONS & 1:1 SPEED NETWORKING
	1 X WORKING GROUP	POS TER SESSION	
	6X NEW MEMBERS FAIR	GENERAL ASSEMBLY	
17:30 CET   DAILY SESSIONS ENDING   18:30 EVENING EVENTS START			
EXHIBITION OPENING	DC(S) OF ROME: WINE DESIGN & TASTING	DC(S) OF ROME: MODERN ART EXPERIENCE	CLOSING REMARKS, CUMULUS GREEN



## The Roman team

### Conference chairs

Loredana Di Lucchio | Full Professor in Design, Sapienza University of Rome

Lorenzo Imbesi | Full Professor in Design, Sapienza University of Rome

### Conference managers

Angela Giambattista | PhD, Research Fellow, Sapienza University of Rome

Viktor Malakuczi | PhD, Research Fellow, Sapienza University of Rome

### Conference design team

Gianni Denaro | PhD, Research Fellow, Sapienza University of Rome

Luca D'Elia | PhD candidate, Sapienza University of Rome

Paolo Cenciarelli | Photo and Video director

### Conference staff

Hoda Aman, Safouane Azouzi, Carlotta Belluzzi Mus, Alessio Caccamo, Gabriele Cito, Silvia Cosentino, Chiara del Gesso, Mariel Dominguez, Paride Duello, Raissa D'Uffizi, Ebrahim Imani, Miriam Mariani, Afshin Nazarieh, Susanna Parlato, Carmen Rotondi, Elettra Scotucci, Andrea Vendetti

| PhD candidates at Sapienza University of Rome, PDTA Department

### Student ambassadors

Camilla Gironi

Dimitri Russo

### Track ambassadors

Joy Abi Rizk, Michel Abou Noujeim Saada, Eya Chammakhi, Sun Chaoyan, Francesco Gregori, Tutku Hezgul, Elisa L'Angiocola, Nadine Mahfoud, Sara Muscolo, Behnoosh Nejat, Andreina Nunez, Miriam Saviano, Fjolla Voca, Mingzhu Zhang, Akerke Zhantiles, Li Zhou

| Students of the MSc in Product and Service Design at Sapienza University of Rome

## Track chairs

### ARTIFICIAL

D I G I T A L  
T E C H N O L O G Y  
R O B O T I C

João de Sá Bonelli, PUC-Rio Department of Arts & Design, Brasile  
Mathias Funk, Eindhoven University of Technology, Netherlands  
Patrizia Marti, University of Siena, Italy  
Giuseppe Mincoelli, University of Ferrara, Italy

### LANGUAGES

A E S T H E T I C S  
E X P R E S S I O N  
V I S U A L

Nicolò Ceccarelli, University of Sassari, Italy  
Chele Esteve Sendra, Polytechnic University of Valencia, Spain  
Spartaco Paris, Sapienza University of Rome, Italy  
Merav Perez, Shenkar College of Engineering and Design, Israel

### L I F E

N A T U R E  
B I O L O G Y  
H U M A N

Anna Bernagozzi, Ecole Nationale Supérieure des Arts Décoratifs  
Pepetto Di Bucchianico, D'Annunzio University of Chieti–Pescara  
Emilia Duarte, IADE, Universidade Europeia, Portugal  
Sabrina Lucibello, Sapienza University of Rome, Italy

### M A K I N G

P R O C E S S  
M A N U F A C T U R I N G  
P O S T - I N D U S T R Y

Mario Buono, University of Campania “Luigi Vanvitelli”, Italy  
Eujin Pei, Brunel University London, United Kingdom  
Andreas Sicklinger, University of Bologna, Italy  
Oscar Tomico, ELISAVA Barcelona School of Design and Engineering

### MULTIPLICITY

G E N D E R  
P L U R A L I S M  
D I V E R S I T Y

Özlem Er, Istanbul Bilgi University, Turkey  
Raffaella Fagnoni, Università Iuav di Venezia, Italy  
Gianni Sinni, Università Iuav di Venezia, Italy  
Pradyumna Vyas, National Institute of Design, India

## NEW NORMAL

HEALTHCARE  
EDUCATION  
WORK/PLAY

José Allard, Pontificia Universidad Católica de Chile, Chile  
Adam de Eyto, University of Limerick, Ireland  
Philipp Heidkamp, Köln International School of Design, Germany  
Michael Krohn, Zurich University of the Arts, Switzerland

## PROXIMITY

PLACES  
PEOPLE  
ECONOMY

Sam Bucolo, Swinburne University of Technology, Australia  
Frédéric Degouzon, L'École de design Nantes Atlantique, France  
Claudia De Giorgi, Polytechnic University of Turin, Italy  
Giuseppe Lotti, University of Firenze, Italy

## RESILIENCE

SOCIAL INNOVATION  
CIRCULAR ECONOMY  
SUSTAINABILITY

Davide Fassi, Polytechnic University of Milan, Italy  
Miaosen Gong, Jiangnan University, China  
Nicola Morelli, Aalborg University, Denmark  
Regina Aparecida Sanches, University of São Paulo  
Maria Antonietta Sbordone, University of Campania "Luigi Vanvitelli"

## REVOLUTION

CRITICAL THINKING  
DISRUPTION  
CHANGE

Hélène Day-Fraser, Emily Carr University of Art + Design, Canada  
Alastair Fuad-Luke, Free University of Bozen-Bolzano, Italy  
Stefano Maffei, Polytechnic University of Milan, Italy  
Betti Marenko, Central Saint Martins, University of the Arts London

## THINKING

THEORY  
HISTORY  
CRITICS

Paola Bertola, Polytechnic University of Milan, Italy  
Pier Paolo Peruccio, Polytechnic University of Turin, Italy  
Márton Szentpéteri, Moholy-Nagy University  
of Art and Design, Hungary

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Claudio Germak | President of Italian Scientific Society of Design  
Christian Guellerin | Past President of Cumulus Association  
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Rodrigo Rodriguez | President of Material Connexion Italia srl  
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## Keynote speakers

### Roberto Marchesini

Roberto Marchesini is Director of the Center for the Study of Posthumanist Philosophy, as well as the School of Human-Animal Interactions, both based in Bologna, Italy. His studies focus on philosophical ethology, bioethics, zooanthropology, and posthumanism in an effort to better comprehend human-animal interactions. The cornerstone of his philosophical proposal is the unmasking of a perspective error that places humans at the center and at the measure of his predicates. One of his last books reinterprets the union between human beings and technology as a partnership that emerged from the phylogenetic set of the Sapiens species, highlighting the hybridizing and shaping potential of technology. From this perspective, every invention, every discovery, has an epiphanic effect; that is, it opens up a new dimension of the unexpected and of opportunities that change the boundaries and the perception of what we define human.



### Salvatore Iaconesi and Oriana Persico

Salvatore Iaconesi is a robotic engineer, designer and artist; Oriana Persico is a cyber-ecologist, autobiographer and expert in digital inclusion. Living and working together since 2006 under the brand [ AOS – Art is Open Source ], they created artworks and performances of global interest united by the exploration and observation of contemporary technological human beings and societies – and their continuous mutation. Promoting a possibilistic vision of the world in which art is the glue between science, politics, anthropology and economics, they are the founders of Nuovo Abitare and HER, the two research centers they use to study the psychological and social implications of data and computation in human societies. Together they wrote *Digital Urban Acupuncture* (Springer, 2016), *La Cura* (Codice Editore, 2016), *Read/Write Reality* (FakePress Publishing, 2011), *Romaeuropa FakeFactory* (DeriveApprodi, 2010) e *Angel\_F: diario di vita di un'intelligenza artificiale* (Castelvecchi, 2009).



## Pier Luigi Capucci

Pier Luigi Capucci has been concerned since the '80s with the studies on communication, the new media and the new art forms, and with the relationships among arts, sciences and technologies. His theoretical activity is concerned with technologies of representation and communication, with technoscience-based art forms and with the media archaeology studies. He published more than 350 texts in books, magazines and conference papers in Italy and abroad. Founder of the first online magazine in Italy NetMagazine / MagNet; president of Noema, journal on the relationships between forms of expression, technologies, sciences and society; member of the International Advisory Board in many editions of Ars Electronica. Recently he founded art\*science, a three-year research project on art and climate change and he serves as a consultant to the European Commission on the relationships between scientific disciplines and technologies (in particular Artificial Intelligence and Big Data) and humanities.



## Chiara Luzzana

Chiara Luzzana is an Award-winning Sound Designer. She pairs a broad range of leadership in Sound Design, Music Composition, Sound Branding, Soundtrack and Audio Installation collaborating with companies and agencies all over the world. Noted among others for her project “The sound of city”, she explores and listens in awe to the artifacts of the urban environment, the products of the industrial cultures all around the world. Eclectic Artist, she wanted to break the rules imposed by notation, working only with noise. Former student at Berklee College, she investigated how the brain reacts to sounds, experimenting with everything from the neurobiology of musical cognition, to the construction of microphones and sound sculptures. Her projects and talks take us to a journey starting from listening to our life, up to listening to ourselves turning life into a “soundtrack”.





DESIGN CULTURE(S) | CUMULUS ROMA 2021  
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# Material culture(s). Research paths in an evolving material design culture, and the connected future designer's attitudes

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**Abstract** | This contribution will investigate how material design culture is evolving: in fact, as designers, we can choose materials taking into account their variety during the design process, as well as design them. The article, through the analysis of a first exploration of just some of the most active and innovative academic case-study laboratories, in which tests and experiments on innovative materials for design are performed, will highlight the most recent research directions covered by designers in the new materials world: growing and living materials, DIY materials, active materials, materials in the circular economy, manufacturing processes applied to innovative fields and innovative ancient materials, rediscovered from the past and re-launched in the next future will be discussed. Those trends will be investigated to outline the directions of designer's and research group's activities and their new attitudes on the topic.

**DESIGN BOUNDARIES; MATERIALS EXPERIENCE; MANUFACTURING PROCESSES; MATERIAL DRIVEN DESIGN; MATERIAL ACTIVISM**



## 1. Expanding the horizon of the materials for design

Materials, as underlined by many authors (Ashby, Johnson 2009; Karana, Pedgley, Rognoli 2014; Karana et al. 2015; Miodownik 2014), are the essence of what matters just as the choices made by the designer when contriving conscious products. Expanding the horizon of research and experimentation activities that designers constantly perform, some emerging phenomena can be highlighted within the wide world of materials for contemporary design dictated by the hybridization between different disciplines, from the birth of a "scenario founded on the collaboration between design and science" (Ito 2016; Langella 2019) and also from the changes that the production processes have undergone, thanks to the evolution of some specific technologies: the researches on materials for design are as wide as ever and offer a broad spectrum of opportunities for achieving new material experiences in design (Karana et al. 2019). This contribution will investigate how material design culture is evolving: in fact, as designers, we can choose and feel materials taking into account their variety during the design process, as well as design themselves.

In recent years, the value of craftsmanship has grown significantly: this revaluation and re-flourishing of craftsmanship (Bardzell et al. 2012), or of those who have a deep connection with the material world and can "dominate a dialogue between knowledge abstract and practical", is parallel to the spread of the maker (and Fab Labs) phenomenon who, according to Richard Sennet (2013) responds to the need (of many designers) to regain possession of the surrounding world through an active experience, a material comparison with it (Miceli 2012).

Hard experimentations, biological methods and systems found in nature are applied to the study and design of engineering systems and modern technology: these are examples of how designers and other experts in different disciplines can collaborate to transform the matter and modify it at will: Synthetic Biology and Living Technologies are some of the disciplines in which man tries to produce "natural" materials and to face some of the key sustainable challenges of the 21<sup>st</sup> century.

On the other hand, the experiments in the families of DIY (Do It Yourself), cooked materials and open materials are characterized by subtle and labile boundaries: according to the principles of molecular gastronomy and alchemy (but also of botany and biology), today's designers are able to produce new materials for the project through new or renewed processes starting from industrial production waste, materials from plant sources (plants and fungi), animal sources and bacteria, traditional materials, such as wood or stone, and many others.

3D printing latest interesting frontiers go beyond the traditional 3D printing process: experiments have been carried out with food, ceramic and stone materials, but also for architectural fabrication. Sugar, waste polymers, flexible elastomers, organic mixtures, stone or glass can all be 3D-printed, thanks to a consolidated and renewed technology, by the use of new materials for the production process. And thanks to this technology and other

production and design processes, defined and cared for by interventions and design, they give a new shape to traditional materials and ancient arts.

Materials from the past, from local and ancient traditions are becoming more and more new future materials: an archaic material library that is still not set, should instead be conceived in the next future in Politecnico di Torino, investigating the ancient natural resources, artefacts and everyday practices of a specific area. Materials and cultural heritage, the core essence of typical territories that are disappearing or that have been forgotten by time, could be oriented to innovative and speculative further design developments.

## 2. Today's places of experimentation: the laboratories

In a new, more blurred vision of disciplinary boundaries, known as “The Age of Entanglement” (Oxman, 2016), the point of view changes: the focus of the materials designers – including that of manufacturers – is no longer primarily oriented towards the final application, but is increasingly curiosity-driven, i.e. guided by the pure and simple curiosity of researching, experimenting and observing the material.

The gym in which designers increasingly test the crossroads of knowledge in the matter of materials for design is represented by experiences gained during graduation theses and PhDs or – in the case of in-house designers – during their continuing education outside the company, working in interdisciplinary laboratories within universities or experimenting during workshops and summer/winter schools in close contact with artists, scientists and professionals in various fields. The research tools change too: books and scientific journals are abandoned and ecomuseums, pots and pans and microscopes are rediscovered, along with waste deposits and blogs. The following overview represents a first exploration of just some of the most active and innovative academic case-study laboratories, in which tests and experiments on innovative materials for design are performed. A selection of the most up-to-date laboratories is presented with a brief description that leaves room for the original presentation words of the team, accompanying it with the university or research body that hosts it, the country of origin, the name of the laboratory coordinator and the website, for further investigations, and a short overview on the originality of each approach.

### 2.1 Hybrid Design Lab

Università degli Studi della Campania “Luigi Vanvitelli”, Naples (Italy) [Prof. Carla Langella]

“Hybrid Design Lab is a research, design, and teaching laboratory geared towards testing the relationship between design and science. The lab is oriented to experience the opportunity to integrate advanced research, teaching and production through science-inspired design. One of the main objectives is to transfer the theoretical and experimental research in the areas of biological sciences, new materials and new technologies, to the design dimension of the sustainable

innovation of products and services. The ability to spread through common products, and preferably daily, new knowledge and sensitivity on the environment, human health and on social equity, offers new prospects for real and tangible improvement of quality of life and growth of awareness, precisely because based on large numbers and, therefore, a large impact. The HDL is based on the integrated processes that underlie the life of biological systems and the balance of their ecosystems. Birth, life, death and re-integration in the natural cycles become references to proposal design production, process and strategies for the recovery of resources, innovative, yet environmentally and socially sustainable.”

(<http://www.hybriddesignlab.org/>, accessed on February 13<sup>th</sup> 2020)

In Hybrid Design Lab, the original approach arises from the new and unprecedented prospects of *intersection between scientific knowledge and design culture*.

## 2.2 MakeGrowLab

Puławy (Poland) [Dr. Roza Janusz and Dr. Josh Brito]

“The project began with one question: What if we could grow materials instead of making them and at the end of their cycle, use it as fertilizer which would then be used to continue the cycle of a biological production system? The MakeGrowLab now consults, designs and produces bio-materials for mission-driven companies. The goal is to mimic the symbiotic processes of nature, to not pollute the environment but enrich it instead. They aim for The Biorevolution Movement - to fuse science with design, to create a fully circular production of local, sustainable materials and spread it around the world. The inspiration derives from the symbiotic processes of nature, specifically the life-cycle of plants, where there is no waste and everything is recycled. Since 2019 the team is growing with Future Farmers from different backgrounds but with the same goal: to spread The Biorevolution.”

(<https://www.makegrowlab.com/>, accessed on February 13<sup>th</sup> 2020)

The MakeGrowLab key-element of innovation is *thinking the material as a living element*, able to born, grow, live and die, exactly like any other living beings.

## 2.3 Design and Living Systems Lab

Central Saint Martins, University of the Arts London, London (United Kingdom) [Prof. Carole Collet]

“The Design and Living Systems Lab is a pioneering research laboratory that explores the interface of biological sciences and design to challenge established paradigms and envision new sustainable materials and forms of production for the future. The Lab explores a new hierarchy of relationships with the ‘living’ where designers operate within a sliding scale of a ‘natural nature’ and a new ‘programmable nature’ in the quest for innovative ecological design and fabrication models. The main objective is to explore biological sciences through design to grow new design

propositions that could facilitate the transition to the 'one planet living' horizon 2050. Not only we are beginning to explore the advantage of biological systems in terms of zero waste, minimum use of energy and materials, but with synthetic biology, scientists have developed means to bio fabricate like 'Nature' does. We can program and engineer living organisms to grow tailored materials. Such extraordinary tools can trigger a paradigm shift in terms of design and manufacture for the future."

(<http://www.designandlivingsystems.com>, accessed on February 13<sup>th</sup> 2020)

In the Design and Living Systems Lab design is seen as a *proposer of innovative fabrication models*, able to set potential speculative scenarios.

## 2.4 Mediated Matter

MIT Media Lab, Boston (U.S.A.) [Prof. Neri Oxman]

"The Mediated Matter group focuses on Nature-inspired Design and Design-inspired Nature. It conducts research at the intersection of computational design, digital fabrication, materials science and synthetic biology and apply that knowledge to design across scales from the micro scale to the building scale. They create biologically inspired and engineered design fabrication tools and technologies and structures aiming to enhance the relation between natural and man-made environments. The research area, entitled Material Ecology, integrates computational form-finding strategies with biologically inspired fabrication. This design approach enables the mediation between objects and environment; between humans and objects; and between humans and environment. The goal is to enhance the relation between natural and man-made environments by achieving high degrees of design customization and versatility, environmental performance integration and material efficiency. The group seeks to establish new forms of design and novel processes of material practice at the intersection of computer science, material engineering, design and ecology, with broad applications across multiple scales."

(<https://mediatedmattergroup.com/>, accessed on February 13<sup>th</sup> 2020)

In the Mediated Matter group, a step back to *natural processes intertwined with current production processes* informs the new Material Ecology culture.

## 2.5 [MI] - Material Incubator

Centre of Applied Research for Art, Design and Technology (CARADT), 's-Hertogenbosch (The Netherlands) [Prof. Elvin Karana]

"Material Incubator is a creative research lab that explores the potentials of materials from living organisms for an alternative notion of the everyday.

Bringing together researchers and practitioners from different schools, Material Incubator [MI] encourages tangible interactions with the living organisms, such as

algae, fungi, plants and bacteria, to explore and understand their unique qualities and constraints through diverse technical and creative methods taking artists, designers and scientists as equal and active partners in the material creation. The core research team of the MI includes artists and product designers specialised in bio-design, (digital) storytellers and micro-biologists.

In exploring and designing for an alternative notion of the everyday from materials from living organisms, the [MI] researchers ground on the theory of Materials Experience, which suggests that whilst our experience with an artefact may originate from - or be moderated by - a wide variety of sources, one of the prominent sources is its physical reality, i.e., its material(s)."

(<https://www.materialincubator.com/about>, accessed on February 13<sup>th</sup> 2020)

Material Incubator [MI] sets its original approach on a *co-creation process between different expertise*, within whom the design is a participant of the co-creation, and the new matter is the possible output.

## 2.6 Self-Assembly Lab

MIT's International Design Center, Boston (U.S.A.) [Prof. Skylar Tibbits]

"The Self-Assembly Lab is a research lab at MIT inventing self-assembly and programmable material technologies. Self-Assembly is a process by which disordered parts build an ordered structure through only local interaction. In self-assembling systems, individual parts move towards a final state, whereas in self-organizing systems, components move between multiple states, oscillate and may never come to rest in a final configuration. The Self-Assembly Lab is located in MIT's International Design Center, a cross-disciplinary design research centre. The Singapore University of Technology and Design was established in collaboration with MIT to advance knowledge and nurture technically grounded leaders and innovators to serve societal needs. This will be accomplished, with a focus on Design, through an integrated multi-disciplinary curriculum and multi-disciplinary research."

(<https://selfassemblylab.mit.edu/about>, accessed on February 13<sup>th</sup> 2020)

In the Self-Assembly Lab the *design process is informed by mathematics, physics, robotics and digital technologies*, following a "techno-creative" approach.

## 2.7 Material Experience Lab

Technische Universiteit Delft (TU Delft), Delft (The Netherlands) and Politecnico di Milano, Milan (Italy) [Prof. Elvin Karana and Prof. Valentina Rognoli]

"Materials Experience Lab is a cross country research group bringing together researchers/practitioners who introduces unique ways of understanding and designing (with) materials to radically change and enhance the relationship people have with materials and artefacts. The lab introduces unique ways of understanding and designing (with) materials by combining research methods, techniques, and

tools from product design, social sciences, materials science, and engineering. The term ‘materials experience’ describes the holistic view of materials in design, emphasising the role of materials as simultaneously technical and experiential. In most of the research activities, the Materials Experience Lab combines interpretive and empirical research techniques in a unique iterative manner, actively promoting a Do-It-Yourself (DIY) approach to materials that pushes the boundaries of material (driven) design. The DIY approach to materials brings people and materials closer in the making, promoting further consideration of contexts and time in designing, making, and use, greater awareness of the resources required, greater agency for working with materials, all of which leads to novel design outcomes.”

(<http://materialexperiencelab.com>, accessed on February 13<sup>th</sup> 2020)

In the Materials Experience Lab, the *direct experience of the matter* is the key point of the new materials development, with a “creating-by-doing” approach.

## 2.8 Institute of Making

University College London (UCL), London (United Kingdom) [Prof. Zoe Laughlin and Prof. Mark Miodownik]

“The Institute of Making is a multidisciplinary research club for those interested in the made world. The mission is to provide all makers with a creative home in which to innovate, contemplate and understand all aspects of materials and an inspiring place to explore their relationship to making. At the heart of the Institute of Making is the Materials Library – a growing repository of some of the most extraordinary materials on earth, gathered together for their ability to fire the imagination and advance conceptualisation. A place in which makers from all disciplines at UCL can see, touch, research and discuss, so that they can apply this knowledge and experience to their own practice. Alongside the collection is the Makespace – a workshop where members and guests can make, break, design and combine both advanced and traditional tools, techniques and materials. The facility brings together equipment, expertise and perspectives of making from a wide range of disciplines, encouraging users to engage in the craft, design, technology, history, philosophy, art and engineering of making.”

(<https://www.instituteofmaking.org.uk/>, accessed on February 13<sup>th</sup> 2020)

The original approach at the Institute of Making lies on a *makers community*, in which the exchange of knowledge between peers is fundamental for generating new know-hows.

## 2.9 Material Design Lab

KEA - Copenhagen School of Design and Technology, Copenhagen (Denmark)

“Material Design Lab consists of The Box, The Lab and The Library. The Box is a walk-in expandable box that contains an exhibition of raw materials. It is the starting point to a basic understanding of the ‘raw ingredients’ before they are processed and

mixed. The Lab itself is the heart of Material Design Lab and resembles a hybrid between a design prototyping workshop, a scientific laboratory and an industrial kitchen. It is a space designed for materials to be tested, manipulated, refined and potentially, for new ones to be created. The library is the Material Connexion Copenhagen collection containing 1500 material samples, as well as access to the online database providing detailed information on over 7500 materials. The library also holds a wide range of books on materials relating to design and architecture.”

(<http://materialdesignlab.dk/>, accessed on February 13<sup>th</sup> 2020)

*Understanding and knowing the raw materials* that are at the basis of the materials that we experience every day is the original approach at the Material Design Lab.

## 2.10 LAMA - Ancient Materials Analysis Laboratory

IUAV University, Venice (Italy) [Prof. Fabrizio Antonelli]

“The Ancient Materials Analysis Laboratory was created in 1993, with the aim of carrying out didactic, research and service activities for third parties in the field of stone and lithic materials used in ancient times. The extraordinary technological development of the last few years has made science previously unthinkable progress, and therefore also the acquisition of a large mass of data on the historical-artistic materials of cultural heritage in general, data that are of significant interest for the characterization, dating and conservation of the cultural heritage itself. The institutionalization of the above teachings, as well as archeometry, geoarchaeology, and various other disciplines such as chemistry or physics applied to conservation science, as well as the creation of associations and specialized journals, among other things with specific tasks promotional, has finally positively changed the national panorama in this sector of applied sciences.”

(<http://www.iuav.it/SISTEMA-DE/Laboratori3/>, accessed on February 13<sup>th</sup> 2020)

A reference to the *materials of the past to understand the materials of today* is the key point to the approach of the Ancient Materials Analysis Laboratory.

## 2.11 Wearable Technology Lab

University of Minnesota, St. Paul, MN (USA) [Prof. Lucy Dunne]

“The Wearable Technology Lab (WTL) is an interdisciplinary research laboratory founded in 2009. WTL research focuses on the intersection between apparel and new technology: for instance, in expanding garment functionality through dynamic geometry and new sensing functions; in improving the way we use, manage, and consume clothing; and in streamlining the design and manufacturing processes of smart clothing and e-textile products. New technology opens new frontiers in understanding the human body, mind, and capability through pervasive sensing, actuation, and interaction. Many projects deal with translating technological potential into the real, everyday world: understanding human physical and

emotional comfort and balancing these variables with trade-offs of performance variables in a smart system design.”

(<https://wtl.design.umn.edu/>, accessed on February 14<sup>th</sup> 2020)

The *intersection between new materials, new technologies and the world of wearables* is the meeting point of the Wearable Technology Lab, where new intelligent and active “skins” are conceived.

## 2.12 Smart Textile Design Lab

Swedish School of Textiles, University of Borås, Borås (Sweden)

“At the Swedish School of Textiles creativity and theory are combined with practical work in several machine parks and laboratories. The unique with the educational programmes is that students and researchers have the opportunity to work with the entire process, from hand knitting machines to advanced 3D techniques, from hand weaving to effective weaving machines. Students and researchers also have the opportunity to elaborate with colours and different types of coatings in the colour lab, to use pattern construction the traditional way or use the latest computer programmes. The well-equipped sewing room gives almost unlimited possibilities. The Smart Textile Design Lab turns textile traditions and materiality upside down; the researchers develop, explore, and experiment with new expressions for textiles through the use of various technologies and textile techniques.”

(<https://stdl.se>, accessed on February 14<sup>th</sup> 2020)

The process, from dyeing to knitting to sewing, is the main core of the Smart Textile Design Lab, where *innovation is the reinterpretation of traditional and well-established techniques and processes*.

As already introduced, this overview doesn’t want to be exhaustive, it rather outlines how the matter of material design is evolving in new material design cultures, thanks to the collaboration with different disciplines and know-hows, and new approaches, producing heterogeneous materials belonging to some possible clustered trends.

## 3. The consequent new material design cultures

The article, through the analysis of substantial case studies of the most recent and academic laboratories, in which innovative materials for design are tested and developed, highlights the most recent occurrences and research directions covered by designers in the new materials world: materials in the circular economy (i.e. from circular materials to urban mining); growing and living materials; DIY (i.e. Do-It-Yourself) materials and material tinkering approach; manufacturing processes such as 3D printing applied to innovative fields



(e.g. food, stone, architecture, etc.); innovative ancient materials, rediscovered from the past and re-launched in the next future.

It should be pointed out how designers feel the need to "compose, modify, transform, and self-produce their own materials" (Rognoli, Ayala 2018), by using ancient materials and new technologies, by modifying traditional materials, waste materials, bacteria, vegetables (see Figure 1)(Karana et al. 2019; Ayala-García, Rognoli, Karana 2017).



*Figure 1. Biolace, Carole Collet.*

For example, Blood Related (Figure 2) is a material that uses waste materials, a zero kilometre, for the production of new raw materials. Awarded at the Dutch Design Week in 2018, it is a compound material, printable like plastic, selected by dried and pressed cow blood: waste from the meat and livestock industry, they become raw materials and we are asked about the limits of what can be transformed and be matter. Moreover, as underlined in the introduction, designers, alchemists and cooks experiment the production of self-produced materials from vegetable sources: the principles of molecular gastronomy and methods, the techniques of self-production, individual or collective, are the tools for the creation of new democratic materials, accessible and with a low technological impact (Rognoli, Ayala 2018; Rognoli et al. 2015; Rognoli, Ayala, Parisi 2016a; 2016b; Parisi, Rognoli, Sonneveld 2017). On the other hand, the materials grow and transform themselves within laboratories (Figure 3): "we can grow all kinds of structures using living organisms, from foams that can replace plastics in footwear, to leather-like materials without animals. Furniture, flooring all are currently being prototyped. Fungi are able to grow materials that are naturally fire retardant, without any chemicals" (Lee 2019).



*Figure 2. Blood Related, Basse Stittgen.*



*Figure 3. Packaging film from bacteria, MakeGrowLab.*

While many of these activities are currently conducted on an experimental and extemporary basis, this does not mean that the approaches to research are not based on a solid scientific framework. Exploring the way that other professionals work and trying to "tune in" with their skills, sometimes borrowing their methods, helps not only material designers but also manufacturers to break free from prefabricated schemes, pursuing new currents and new avenues of research. The new figure of the materials designer is therefore more and more

outlined by ephemeral and blurred “boundaries”, coherently with the contemporary Design condition: in those laboratories, the designer turns himself into new professionals characterised by a hybrid knowledge, driven from different know-hows. We can therefore discover a “designer-maker”, a “designer-archaeologist”, a “designer-biologist”, a “designer-detective” and a “designer-alchemist”, following the latest materials culture trends (De Giorgi, Lerma, Dal Palù 2020). These and other emerging issues coming from the materials design culture are currently investigated by the authors of the present contribution.

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