

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

Original

Material culture(s). Research paths in an evolving material design culture, and the connected future designer's attitudes / Dal Palù, Doriana; Lerma, Beatrice; De Giorgi, Claudia. - ELETTRONICO. - Volume #2:(2021), pp. 1711-1723. (Design Culture(s) Roma (Italia) 8-11 giugno 2021).

Availability:

This version is available at: 11583/2913710 since: 2021-09-30T10:31:50Z

Publisher:

Cumulus the Global Association of Art and Design Education and Research. Aalto University, School of

Published

DOI:

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(Article begins on next page)

DESIGN CULTURE(S)

Cumulus Conference Proceedings Roma 2021

Volume #2

ARTIFICIAL ARTIFICIAL
LANGUAGES
LIFE LIFE
MAKING MAKING
NEW NORMAL
MULTIPLICITY
PROXIMITY
RESILIENCE
REVOLUTION
THINKING THINKING

**Design Culture(s)
Cumulus Conference
Proceedings Roma 2021**

Volume #2

Editors

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Layout and Graphic Design

Viktor Malakucz
Concept for Cumulus
Conference Proceedings
Series was developed in
2018 by Jani Pulkka

Cumulus conference

Design Culture(s)

hosted by

Sapienza University of Rome, Italy
on June 8-11, 2021.

Conference website:

www.cumulusroma2020.org

Published by Cumulus

Cumulus the Global Association of
Art and Design Education and
Research. Aalto University, School
of Arts, Design and Architecture
PO BOX 31000, FI-00076 Aalto
www.cumulusassociation.org

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ISBN 978-952-64-9004-5 (PDF)

ISSN 2490-046X

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Series, N°7

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Cumulus Conference Proceedings Roma 2021

Volume #2

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Rome 2021

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SIGN
CULT
URE (S)

ROMA **2021**

JUNE 08.09.10.11
CUMULUS CONFERENCE

OVERVIEW

36 **ABOUT THE
CONFERENCE**

49 **EXHIBITIONS**
all tracks

81 DESIGN
CULTURE (OF)
ARTIFICIAL
track

629 DESIGN
CULTURE (OF)
LANGUAGES
track

1175 DESIGN
CULTURE (OF)
LIFE
track

1425 DESIGN
CULTURE (OF)
MAKING
track

1891 DESIGN
CULTURE (OF)
MULTIPLICITY
track

2095 DESIGN
CULTURE (OF)
NEW NORMAL
track

2604 DESIGN
CULTURE (OF)
PROXIMITY
track

3153 DESIGN
CULTURE (OF)
RESILIENCE
track

3929 DESIGN
CULTURE (OF)
REVOLUTION
track

4383 DESIGN
CULTURE (OF)
THINKING
track

4768 **POSTERS**
all tracks

CONTENTS

36 About the conference
Loredana Di Lucchio, Lorenzo
Imbesi

49 EXHIBITIONS

51 ARTIFICIAL | City of Experiences
George Brown College, Canada

54 LANGUAGES | Post collaboration
as a form of counter-culture: The
birth of new languages
University of Johannesburg,
South Africa

57 LIFE | Design for social problems
in Mexico: living with disabilities
Autonomous Metropolitan
University, Azcapotzalco, Mexico

60 MAKING | New Textile
Topologies: Experiments at the
intersection of surface, textile
and form
The Swedish School of Textiles,
Sweden

63 MULTIPLICITY | Self-Acceptance
to Self-Indulgence
Pearl Academy, India

66 NEW NORMAL | Expedition 2
Degrees
Zurich University of the Arts

69 PROXIMITY | Newcomers: Design
for Immigrants
Pratt Institute's School of Design,
USA

72 RESILIENCE | Designing for
Resilience: Creating new
possibilities for industrial cities
University of Monterrey, Mexico

75 REVOLUTION | UFØ Drift: In
Search of Practice
ArtEZ University of the Arts
Arnhem, Netherlands

78 THINKING | Design and
awareness: user meeting
ESDAP Catalunya, Spain

81 DESIGN CULTURE (OF) ARTIFICIAL

83 A participated parametric design
experience on humanoid robotics
Francesco Burlando, Xavier
Ferrari Tumay, Annapaola Vacanti

99 A systemic vision for the common
good : |C|A|S|E| Goods Mobility
in the fourth industrial revolution
Veneranda Carrino, Federica
Spera

CONTENTS

-
- 117 **Activist Activated: Efficacies of AR Political Poster Design**
Sarah Edmands Martin
-
- 130 **Art, Design, and Mathematics: Software programming as artifice in the creative process**
Carlos de Oliveira Junior, Eduardo Ariel de Souza Teixeira
-
- 142 **Artificial Creativity – Hybridizing the Artificial and the Human.**
Yael Eylat Van Essen
-
- 156 **Artificial Intelligence is a Character? Exploring design scenarios to build interface behaviours**
Andrea Di Salvo, Andrea Arcoraci
-
- 168 **Becoming Janus: The Subversive Potential of Face Recognition Technologies**
Romi Mikulinsky
-
- 181 **Between digital and physical. Envisioning and prototyping smart material systems and artifacts from data-informed scenarios.**
Stefano Parisi, Patrizia Bolzan, Mila Stepanovic, Laura Varisco, Ilaria Mariani
-
- 199 **Consensual (Design) Fictions: co-creating iterative use cases to define technology conceptualization**
David Hernández Falagán, Andreu Belsunces Gonçalves, Kevin Koidl
-
- 215 **Design of robotic for superhuman tasks**
Fabrizio Formati
-
- 227 **Design, space management and work tools: enhancing human work in transition to Industry 4.0**
Luca Casarotto, Pietro Costa, Enrica Cunico
-
- 237 **Designers' skills for Social Robotics**
Maximiliano Romero, Giovanni Borga, Rohan Sashindran Vangal, Francesco Baldassarra
-
- 251 **Designing for the future by understanding evolving culture based on advancing technology and the changing behaviours that accompany it.**
Nayna Yadav
-
- 264 **Designing Somatic Play for Digital Natives through a Body-centric Design Process**
Seçil Uğur Yavuz, Kristi Kuusk, Michaela Honauer
-

CONTENTS

-
- 279 Designing unpredictable futures. An anthropological perspective on the algorithmical prediction of human behaviour
Giovanna Santanera, Roberta Raffaetà
-
- 290 Digital Creativity Tools Framework
Marita Canina, Carmen Bruno
-
- 304 Digital tools that support students to reflect on their design competency growth paths
John Fass, Job Rutgers
-
- 316 Domestic AI and Emotional Involvement. Design Perspectives
Mauro Ceconello, Martina Sciannamé, Davide Spallazzo
-
- 328 Empowered by Code, to act in real word
Alfredo Calosci
-
- 339 Exploring Digital Inequalities: How Welfare States are disappearing behind an AI
Paola Pierri
-
- 349 From Decoration to Functionality — Research on smart accessories design in the Internet era
Qingman Wu
-
- 360 From the evaluation of acceptability to design of an assistive robot for elderly
Francesca Tosi, Mattia Pistolesi, Claudia Becchimanzi
-
- 376 Future heritage and heritage futures. A design perspective on the activation of Digital cultural heritage stored in archives
Margherita Tufarelli
-
- 386 Going beyond the problem of privacy: individual and social impacts of the use of personal information in connected services
Laura Varisco
-
- 400 Human and Artificial Intelligence for the Cultural Reform of Design
Elena Laudante, Mario Buono
-
- 412 Human Sensibility, Robotic Craft: Toward Autonomous Stonework
Tom Shaked, Karen Lee Bar-Sinai, Aaron Sprecher
-
- 423 Interface takes command. Educational environments, tools and practices to face the new normal.
Alessio Caccamo
-
- 437 Intelligent Voice Assistants: A Review of User Experience Issues and Design Challenges
Lucia Rampino, Sara Colombo
-

CONTENTS

-
- 449 Research on Gender Differences of Adult Head Shape in China
Renke He, Wenxiu Yang,
Wanshan Li, Haining Wang
-
- 461 Speculative Physical Models Created Through a Robotic Process
Sara Codarin, Karl Daubmann
-
- 476 Teaching Design in the Age of Platforms: A Framework for Platform Education
Xinyi Li
-
- 488 The body as an artefact: a case of hand prosthesis
Venere Ferraro, Silvia Ferraris,
Lucia Rampino
-
- 502 The design of human machine interfaces: from data to risk prevention.
Annalisa Di Roma, Alessandra Scarcelli
-
- 516 The Designer in the AI/Machine Learning Creation Process
Frederique Krupa
-
- 526 The encounter between Design and Artificial Intelligence: how do we frame new approaches?
Marzia Mortati
-
- 537 The Perceptual and Dialogical Form of Design between Time, Space and Technologies
Camelia Chivăran, Sonia Capece
-
- 552 The role of Design in telepresence robotics experience
Claudio Germak, Lorenza Abbate
-
- 565 The Venice Backup: Case studies on the use of Virtual Preservation Techniques on Architectural Heritage sites in Venice, Italy
Kai Reaver
-
- 587 Towards a visual-based survey on explainable machine learning
Beatrice Gobbo
-
- 604 Toys and Play, Weapons and Warfare: Militarizing the Xbox Controller
Rachel Berger
-
- 619 Wearing the smart city: Supporting older adults to exercise by combining age-friendly environments and tailored digital public data
Nicole Aimers, Alen Keirnan, Ann Borda, Sonja Pedell
-

CONTENTS

629 DESIGN CULTURE (OF) LANGUAGES

631 A Sidewalk museum. Exhibiting the collective dimension of the moving image
Nicolo Giacomo Ceccarelli, Marco Sironi, Sabrina Melis

645 Abstract to figurative, and everything in between: visual design approaches and linguistic codes of a traditional form of animated product.
Vincenzo Maselli, Eleni Mouri

659 Al-Kafiye: A Symbol of Change
Hala Abdel Malak

688 Beyondstories. People Narrative makes a Territory
Aureliano Capri, Valeria Michetti, Veneranda Carrino, Mauro Palatucci

707 Brand in Product. The language of the brand to govern complexity
Mario Rullo, Massimiliano Datti

726 Creating Visual Identity as Constellation: Methodological Project for a Design Workshop
Ximena Izquierdo, Magdalena Ballacey

754 Data visualization as a qualitative driver in knowledge communication: an interpretative framework
Giulia Ciliberto

771 Design and Cultural Sites: New signage methods and languages for fruition, accessibility and storytelling
Monica Oddone, Irene Caputo, Marco Bozzola

786 Design and the 'Magical magic'. Disney and history, perceived heritage and shared memory
Luisa Chimenz

800 DEsign DEcide The sign
Tsvetomira Girginova

811 Designing the Gross. In search for social inclusion
Adrien Rigobello, Nadja Gaudillière-Jami

828 Finding New Representations of Old Knowledge: a design study of visualizing I-Ching
Yvette Shen

843 Form is function. Ethics and aesthetics of digital technologies in inclusive interface design.
Letizia Bollini

CONTENTS

-
- 852 'Graphicmance'. New Visual Languages between Design and Performance
Giulia Scalera
-
- 865 Inner Geographies as poetic-aesthetic knowing: the inspiration and manifestation of creative doings through an emotively-orientated sensory methodology
Mizan Rambhoros
-
- 883 Italian Pavillion at XXII Triennale di Milano
Ilaria Bollati, Luisa Collina, Laura Daglio, Laura Galluzzo
-
- 895 Language and identity in new Italian design
Stefano Follesa, Peian Yao
-
- 906 Metaphors as Knowledge Activators in Data Visualizations: the case of the Archipelago of Calvino's literary works
Tommaso Elli, Maria de los Angeles Briones Rojas, Beatrice Gobbo, Margherita Parigini, Virginia Giustetto, Valeria Cavalloro, Michele Mauri
-
- 925 Patient Autonomy Indicators: a knowledge visualization tool for patient autonomy support
Wen Zhang, Yuan Liu, Li Hou
-
- 938 Performativity as a language of sense-making for cultural service in local museum
Shu Hongming, Eleonora Lupo
-
- 950 Solid perspectives and optical corrections of spaces in graphic & architectural design
Tommaso Empler
-
- 962 Spatial construction for ideational meaning: An analysis of interior design students' multimodal projects.
Andrew Gill, Giovanna Di Monte-Milner
-
- 976 Tales of Surprise: Exploring Sense Making Processes Through User Narratives
Miray Hamarat, Ozge Merzali Celikoglu
-
- 992 The Design of Politics: Understanding the Arrest of Cesare Battisti Through the New Media Factor
Noemi Biasetton
-
- 1007 The Enlightenment of the Contemporary Transformation of Chinese Traditional Visual Space Perception on Cultural Sustainability design for all
Jixiang Jiang, Dong Tao
-

CONTENTS

1021 The Interplay between Ethics and Aesthetics in Intelligent Systems-Users Interaction
Gabriele Barzilai

1034 The pluralistic aesthetics of nowadays design
Francesca La Rocca

1049 The role of vernacular typography in the linguistic landscape of multicultural Singapore: A multimodal analysis case study of a gentrified street
Min-Yee Angeline Yam

1063 The Threshold of Language: Design and Soma
Daniela Monasterios-Tan, Susan Sentler, Ginette Chittick

1082 Towards a new design culture of scientific production – Innovating the formats of scientific publication of design
Eleonora Lupo, Beatrice Gobbo, Emilio Lonardo

1098 Translation Design for medicine leaflets. Research and innovation.
Elena Caratti, Antonella Penati, Valeria Bucchetti

1115 Visual dialects. Exploring early design sketching in various design disciplines
John Daniel Öhrling, Åsa Wikberg-Nilsson

1127 Visualizing Offshore Foreign Direct Investments: The Atlas of Offshore
Michele Mauri, María De Los Angeles Briones Rojas, Jonathan Gray, Daniel Haberly, Chris Anderson

1144 What does this symbol mean? Icons as a Language for Emergency
Rodrigo Ramirez

1159 Where methods meet form
Meret Ernst, Maya Ober

1175 DESIGN CULTURE (OF) LIFE

1177 Adopt a costumer - to design new processes and packagings
Maria Benedetta Spadolini, Chiara Olivastri

1190 Autonomy as a Design Principle: Service Design for the Technology Literacy of Older Adults
Houjiang Liu, Miso Kim, Canqun He, Tia Thomson

1208 Bio-revolutions: radical change, design cultures and non-humans
Carolina Ramirez-Figueroa, Luis Hernan

CONTENTS

-
- 1222 Cognitive Ergonomics
Components for Analysis of User
Interface in Healthcare Industry
Mariia Zolotova, Angela
Giambattista
-
- 1238 Connect art and science for a
functional biomimicry in design
Andrea Forges Davanzati
-
- 1244 Development of a test setup for
validating a cognitive assessment
platform within ICU's
Muriel De Boeck, Philippe Jorens,
Guido De Bruyne, Kristof Vaes
-
- 1256 Food design as a tool for social
development: experimental study
in the evaluation of child smell
Lígia Afreixo, Francisco
Providência, Sílvia Rocha
-
- 1272 FUTUR.DRESS. The Superskin for
the Human Body in nearspace
Maria Antonietta Sbordone, Ilaria
Giampetraglia, Alessandra De
Luca
-
- 1286 Hybrid systems of human |
technological | biological
products: a road to a greater
sustainability?
Marco Marseglia, Francesco
Cantini, Alessio Tanzini
-
- 1301 No more whining – natural smart
textile
Nuutinen Ana, Pietarine Heidi,
Kunnas Susan , Korpinen Risto,
Sipola Reeta
-
- 1308 Paving the way to post-digital
smart materials. Experiments on
human perceptions of a bio-
inspired cellulosebased
responsive interface
Stefano Parisi, Markus Holzbach,
Valentina Rognoli
-
- 1325 The flow of emotions in co-
creation
Mariluz Soto, Caoimhe Isha
Beaulé, Satu Anneli Miettinen
-
- 1337 The Food Futures Teaching
Cluster. Food Culture, Visual
Communication Design, and
Collaboration
Peter K. Chan, Ben McCorkle, Rick
Livingston
-
- 1351 The river and the revered: Tracing
the impermanence of the land,
the people and the embroidered
Indrajit De, Saumya Pande
-
- 1364 The Shape of Drugs: a matter of
Human-Centred Design
Antonella Valeria Penati, Silvia
Luisa Pizzocaro, Carlo Emilio
Standoli, Valeria Maria Iannilli
-

CONTENTS

-
- 1377 The Wicked Home: Living Space as Ecological Holobiont
Rachel Armstrong, Rolf Hughes, Nel Janssens
-
- 1392 Three Dimensional technologies: Digitising Nature
Gregor MacGregor
-
- 1405 Towards Neurodesign. The Mental Effort in packaging design
Alessio Paoletti, Lorenzo Imbesi, Angela Giambattista
-
- 1413 “WIT” as a Sustainable Engine Overcoming Mind Fixation in Ideation
Alon Weiss
-
- 1425 **DESIGN CULTURE (OF) MAKING**
-
- 1427 A designed generation: Maker's maturity and social responsibility
Luca D'Elia
-
- 1438 Accumulation of empirical investigation into joint structures in wooden furniture design
Yi Shiang Lin, Ming Huang Lin, Jen Kuan Yau
-
- 1453 Amorphous Stacks: A Low-Tech Construction Method for Jointless Cast Structures
Liqiong Huo, Jongwan Kwon
-
- 1468 An Exploratory Study about Communicating 4D Printing between Product Designers and Manufacturing Engineers
Faten Ezrin Azhar, Eujin Pei
-
- 1482 Biotextiles applied to everyday objects
Viviana Quiña, José Francisco Alvarez Barreto, Cristina Muñoz Hidalgo
-
- 1504 Claudio Alcorso and Post-war Textile Culture
Tracey Sernack-Chee Quee
-
- 1521 Collaborative Capabilities: aural encounters in digital/analogue co-creative making
George S. Jaramillo, Lynne J. Hocking-Mennie
-
- 1535 Collaborative ontology design for Open Hardware and Open Design
Massimo Menichinelli, Emilio Velis, Andre Rocha, Alessandra Schmidt
-
- 1551 Contemporary Spaces of Apparel Design: Embracing both Digital and Physical Environments
Krissi Riewe
-

CONTENTS

-
- 1562 Design Cultures of Making:
Fashion thinking as creative
process and pedagogy
Susan Postlethwaite
-
- 1573 Design culture of playing. The
musical instrument industry: an
important culture of made in
Italy.
Marco Mancini
-
- 1588 Digital encounters in the culture
of textile making: developing a
hybrid craftsmanship for textile
design by fusing additive methods
of surface fabrication with
knitting technology
Delia Dumitrescu
-
- 1600 Distributed design and
production for distributed care.
Investigation on materializing
bottom-up open and indie
innovation in the field of
healthcare
Patrizia Bolzan, Massimo
Bianchini, Laura Cipriani, Stefano
Maffei
-
- 1614 Heterotopia of Space: How
capitalism is alienating and
controlling societies
Sarah Khayat
-
- 1625 I - D (I – Design _ Idiosyncratic
Meta Design) Idiosyncratic
Proceedings on Reading and
Production Meta-Objects in
Contemporary Industrial Design
Mantikou Angeliki-Sofia, Farangas
Athanasios, Zafeiropoulos
Theodoros, Psychoulis Alexandros
-
- 1640 If we can't make it together, we
won't make it alone. The
challenge and potential of
collective making
Lena Håkansson, Stephanie
Carleklev, Stephan Hruza, Anna-
Karin Arvidsson
-
- 1652 Inter-Weaving Culture and Crafts
in Design Education
Puja Anand, Alok Bhasin, Priyanka
Khattar
-
- 1668 Learning through codesign
toolkits. A case study on
codesigning the cinema of the
future
Simone Taffe, Sonja Pedell
-
- 1681 Letterpress: A Survey of Print
Culture or an Immersive Learning
Experience
Alexander Cooper, Rose Gridneff,
Andrew Haslam
-
- 1695 Made by (Material) Frustration
Arielle Blonder, Shira Shoval, Eran
Sharon
-

CONTENTS

1711 Material culture(s). Research paths in an evolving material design culture, and the connected future designer's attitudes
Doriana Dal Palù, Beatrice Lerma, Claudia De Giorgi

1724 Mind-mapping in design culture: A tool for ideation in graphic design education?
Philip Jones, Marion Morrison

1738 New scenarios for developing cooperative platforms for local manufacturing
Alberto Calleo, Giorgio Dall'Osso, Laura Succini, Michele Zannoni

1752 Playing for change: designing a board game for the circular economy
Thomas David Cockeram, Jessica Clare Robins, Emmanuel Tseklevs, Leon Cruickshank

1769 Progetto Glume: from milling waste to resource for new materials
Danilo Perozzi, Laura Dominici, Elena Comino

1785 Re-distributed manufacturing in makerspaces. Towards a model of sustainable production
Louis Rose

1799 Research on the Application of Lacquer Craft in Modern Accessories
Tianxiao Xie

1811 The Emerging Fashion-Tech Paradigm in the Contemporary European Landscape
Chiara Di Lodovico, Chiara Colombi

1825 The evolving role of prototypes in design research: a discussion on terms and meanings
Silvia D. Ferraris, Gabriele Barzilai

1840 The Making of a Dress: Explicating the Implicit Processes
Adrian Huang

1857 The shape of wellbeing: investigating an approach for the development of a design requirements framework for design for wellbeing projects
Sandra Dittenberger

1873 Weaving sequential changes – designing textiles with multiple embedded stages
Riikka Talman

CONTENTS

1891 **DESIGN CULTURE (OF) MULTIPLICITY**

1893 Architectural Design Education as an Agent of Change: The Case of the Ultra-Orthodox Branch, Jerusalem
Elissa Rosenberg

1904 “But I’m a lecturer not a therapist”: Educational Coaching – a proposed alternative approach to supporting students through their creative education
Gary Pritchard

1918 Decoding the birth of transcultural fashion
Shipra Kukreja

1934 Design as a medium for an informal learning. INDICOLearning from the interface to the activity
Marina Puyuelo, Mónica Val, Hugo Barros da Rochas

1946 De-stereotype UX Design – Discussing and managing issues related to the clustering of users in the design of innovative solutions
Margherita Pillan, Alessandra Mazzola

1958 Framing diversity: designing hearing aids from a deaf culture perspective
Patrizia Marti

1979 Gazes and Gatekeeping: Reconceptualising the entrance portfolio in the post-colony
Diane Steyn

1994 Hybridity as a culture of making
Maya Ober, Nicole Schneider

2011 Hyper-Contextual Futures in Mexico City
Paolo Cardini, Karla Paniagua

2025 Learning and Differences reciprocally shared and validated: A decade long Participatory Design collaboration between KG Elementary School and AD University
Raymond Patrick Zachary Camozzi, Helene Day Fraser, Caylee Raber

2040 On (un)becoming in Design Academia: A Coloured female’s autoethnography
Cheri Hugo

2058 The Ethics of Knowing a Shared Language and Intention in Design
Lisa Elzey Mercer, Terresa Moses

CONTENTS

-
- 2066 The Neighbourhood Home. System of environments for plural inclusion
Ilaria Longo, Sonia Massari, Alessandro Spalletta
-
- 2081 Universal Visual Languages in a Male-oriented Society
Valeria Bucchetti, Francesca Casnati
-
- 2095 **DESIGN CULTURE (OF) NEW NORMAL**
-
- 2097 A Comparative Study of Online Teaching Modes of Sino-Italian School of Design: A Politecnico di Milano, Tsinghua University, and Tongji University perspective
Fan Chen, Lin Li
-
- 2107 A COVID-19 Horizon Scan Looking for Post-Pandemic Implications for Design
Marcus Foth, Glenda Amayo Caldwell, Joel Fredericks
-
- 2126 A new way of perceiving the locality: economic growth, social inclusion, environmental protection
Fabio Mongelli
-
- 2141 A Sustainable Jewellery Design Practice for Psychological Health after Covid-19
Huiyi Qu
-
- 2153 Autopoietic design; seven components for a sustainable future design model
Gonzalo Raineri Bernain
-
- 2165 Community-led design capabilities during the COVID-19 pandemic and beyond
Mariana Fonseca Braga, Eduardo Romeiro Filho, Haddon G. Guimarães Pereira, Emmanuel Tsekleves, Rosângela Míriam L. O. Mendonça
-
- 2182 Cross-Team Brainstorming and a Comparison of Online to Physical Version
Heng-Yi Mie, Hsi-Jen Chen
-
- 2198 Design Education in a Pandemic Context
Harald Skulberg
-
- 2210 Design for Sustainable Healthcare. Cutting the impact of medical products through disposable packaging
Gabriele Maria Cito, Angela Giambattista
-

CONTENTS

-
- 2227 Designing new learning experiences in pandemic time: how digital can support a new didactic in Service Design
Andrea Taverna
-
- 2239 Ecosystem Framework for Community Life Circles based on Life Projects in the Post-COVID-19 Era
Tao Chen, Yong-Ki Lee, Juyoung Chang
-
- 2253 Expansive Video Capture – Up close, personal & specific tutoring “performances”
Brendon Clark
-
- 2265 Gamified e-Learning approached through Emotional Design in the Post-Covid-19 era
Na Wei, Yong-Ki Lee, Juyoung Chang
-
- 2275 Healthcare innovation during the pandemic time: digital technologies to enhance clinic 4.0
Stefania Palmieri, Mario Bisson, Alessandro Ianniello
-
- 2289 Hospitals’ decision-making regarding infrastructural adaptations in response to Covid-19
Pleuntje Jellema, Margo Annemans, Ann Heylighen
-
- 2302 Identifying Factors for Designing a Successful Telemedical Training System for Remote Pediatric Physical Exams
Elham Morshedzadeh, Ph.D., Andre Muelenaer, MD, Jr, MD, MS,, Michelle Morris, Dana Werlich, Margaret Nelson, MD.
-
- 2316 Inter-University Design Workshop: plurality in design education
Inés Alvarez-Icaza Longoria, Diego Alatorre Guzmán, René Harari Masri, Lucero Donaji De la Huerta Santaella, Ana Elena Hernández Palomino
-
- 2332 Kids-centered Pocket Park design. Well-being for children in the urban post-covid context.
Benedetta Terenzi, Anna Laura Pisello
-
- 2347 Nanomedicine and Tourism in the post-pandemic era: smart “mobility & health” through wearable design for lab-on-chips
Claudio Gambardella, Pietro Ferraro, Assia D'Alesio
-
- 2358 Post-pandemic medicines: towards a new normality
Antonella Valeria Penati, Carlo Emilio Standoli, Patrizia Bolzan
-
- 2372 Reaching Audiences in 2020
Sharon Hooper
-

CONTENTS

-
- 2387 (Re)envisioning the contribution of design to the sustainable transition of healthcare systems
Amina Pereno
-
- 2404 Reinforcing Networks of Place-Based Care and Resilience
Julie Van Oyen, Jacquie Shaw, Laura Kozak, Jean Chisholm
-
- 2419 Research on rapid mass production of emergency products based on FDM 3d printing
Xueyan Wang, Dongmei Peng
-
- 2433 Semi-immersive Virtual Habitat to Enhance Relaxation in People with Dementia during COVID-19 Emergency
Silvia Maria Gramegna
-
- 2446 Shifting paradigms in Sustainable Fashion Design education: Studying implications & effectiveness of pedagogical methods adopted in a pandemic setting
Pragya Sharma
-
- 2471 Strengthening city resilience through the re-orientation of a social innovation incubation programme in Covid-19 time. The case of 'The School of the Neighbourhoods'
Marta Corubolo, Anna Meroni, Daniela Selloni
-
- 2487 Telemedicine, today more than ever. The ABBRACCI design concept for COVID-19 patient monitoring
Alessia Buffagni, Martina Frausin
-
- 2500 The Challenges and Benefits of online Education and the possible impacts of the entry of IT firms in the education ecosystem
Nayna Yadav
-
- 2512 The design culture and the challenges of the new normal
Nicola Morelli
-
- 2524 The effects of eye expression on emotion perception
Yi-Hsun Liu, Hsi-Jen Chen
-
- 2537 The value of design in the emergency-driven scenarios. Crafting Ecosystems with data
Francesco Dell'Aglio, Enza Migliore, Chiara Scarpitti
-
- 2551 Thinking With Card: Curriculum-Led Making Activities Integrated with Distance Learning
Benjamin Hughes
-

CONTENTS

2569 Understanding public health communication design globally during the Covid-19 pandemic: The Good, the Bad and the Ugly
Emmanuel Tsekleves, Mariana Fonseca Braga, Alejandro Moreno-Rangel, Linli Zhang, Mafe Salazar, Hannah Field, Hayley Alter

2594 "United in isolation. An online letterpress festival". A community response to the Covid-19 pandemic
Andrea Vendetti, Elettra Scotucci

2604 **DESIGN CULTURE (OF) PROXIMITY**

2606 A Design Experience for Interactive Narrative Based on The User Behavior
Yuan Yao, Haipeng Mi

2619 An answer to the complex representation of territory. The fertile ground of mnemotopes and design of communication.
Clorinda Sissi Galasso, Giovanni Baule

2630 Attractive Factors in the Experience of an Online User-supported Learning Platform
Min-Yuan Ma, Hsin-Yi Huang, Eric Chen-F Hsieh

2650 City Branding and Fictional Layers: Reading Istanbul through Filming Locations
Zeynep Arda, Onur Mengi, Deniz Deniz

2667 Co-Design processes for the inclusiveness of Rome's temporary communities
Gianni Denaro, Luca D'Elia, Safouan Azouzi

2679 Co-designing the future of a public space and its related services. The case of the Reggio Emilia Ducal Palace and its park
Marta Corubolo, Anna Meroni, Daniela Selloni

2694 Collaborative Futures: a pedagogical model for delivering future-focused and citizen-centred design education
Marianne McAra, Kirsty Ross

2710 Communicating social values to children using design solutions
Laura Girdali, Marta Maini, Francesca Morelli

CONTENTS

-
- 2720 Creating an inclusive learning environment to support transformative learning and encourage upward educational mobility opportunities for economically or academically under-resourced design students
Michal Rotberg
-
- 2736 Cultural Differences as Challenges and Design Drivers in the Development of Smart Assistive Technology for an Ageing Society
Danying Yang, Louise Moody
-
- 2752 Data visualization and knowledge sharing in participatory design to improve people liveability in urban places
Giovanni Borga, Massimiliano Condotta, Chiara Scanagatta
-
- 2768 Democratizing design: lessons from a case study in the Alpine area
Daniele Busciantella Ricci, Ilaria Argenziano, Marta Gandolfi, Michela Ventin
-
- 2786 Design for Promoting Pro-environmental Behaviours of the Georgian Domestic Workers in Ankara
Ayşe Kaplan, Lilyana Yazirlioğlu
-
- 2800 Design projects as drivers for organisational change in the public sector
Felicitas Smittinger Schmittinger, Alessandro Deserti, Francesca Rizzo
-
- 2813 Design when you are the other 90%, a student's perspective
Kyle Graham Brand
-
- 2826 Design with Social Justice in Mind. The Case Study of Furniture Design in Elementary Schools
Caroline Gagnon, Claudie Rousseau, Thomas Coulombe-Morency, Sonia Cadoret, Colin Côté
-
- 2846 Evolving future city-based retailing via design thinking: A Chinese hybrid model approach
Yujia Huang, David Hands, Rachel Cooper, Nick Dunn
-
- 2862 Feeling Endem. How travel enhances applied-autonomy in spatial design
Hans Venhuizen
-
- 2878 Global Proximity: case studies of international and interdisciplinary collaboration between the USA, Italy, Guyana and Japan
Valeria Albani, Paolo Cardini
-

CONTENTS

-
- 2887 Heritage and cultural accessibility: the role of design in the creation of an intercultural dialogue
Marco Bozzola, Irene Caputo, Claudia De Giorgi
-
- 2903 Immigrant Cultural Acculturation - A study of Tibetan Clothing in India
Anahita Suri
-
- 2920 Making in Proximity: Design Policies for collaborative making cultures
Lina Monaco, Luca D'Elia, Viktor Malakuczi
-
- 2931 Making practice as narrator of changing social worlds-Textiles and the Scottish Borders, in the 21st century, but based firmly on the past?
Britta Kalkreuter
-
- 2942 Multiple narratives for multiple visions: engaging citizens in building future scenarios for their city through participatory design and storytelling.
Davide Fassi, Annalinda De Rosa, Francesco Vergani
-
- 2955 New Technological Space for Tourists. Design as a Trigger of Experience, Osmotic-Membrane Interface, Know-How Provider and Social Engager
Luisa Collina, Ilaria Bollati, Claudia Mastrantoni, Umberto Tolino
-
- 2968 Placemaking through Creative Practice: Enabling Change and Empowering Future Change-makers
Cheryl Giraudy, Saskia van Kampen
-
- 2984 Proximity as space of opportunity: connecting people, productions and territories
Valentina Gianfrate, Elena Formia, Flaviano Celaschi, Elena Vai
-
- 2998 Radius 100 model – Working multidisciplinary theories, methodologies and design practice: An approach to social design beyond academia
Dr. Yona Weitz, Arch. Sharon Koniak
-
- 3014 Rethinking User Experience of Parking Garage. Exploring Innovative Suicide Prevention Strategies Through Motivational Design
Sébastien Proulx, Adam Fromme, Leila Akberdin, Maria Basile, Olivia Forsyth, Maya Jenkins, Abby Nelson, Claire Spicer
-

CONTENTS

3031 Signs of the Artisan City
Eleonora Trivellin, Susanna Cerri

3046 Social networks as enablers of
design cultures: An analysis of
multiplex relationships among
members of a creative hub
Sine Celik, Tua A. Björklund

3059 Subversive Design. Designer
Agency Through Acts of
Insurgence
Seth Parker

3072 The City of Care
Anna Anzani, Elena Elgani, Maria
Renata Guarneri, Francesco
Scullica

3084 The power of designing choices
Raffaella Fagnoni

3101 The systemic approach and the
use of new technologies to
communicate cultural heritage
and develop a culture of
proximity
Marco Faccini, Alessandro
Spalletta

3121 Towards a Design Observatory:
crafting a distributed approach
Nina Costa, Vasco Branco, Rui
Costa, Afonso Borges, Raul Cunha,
Ana Catarina Silva, António
Modesto

3137 When a designer encounters an
artisan: a parameter analysis
investigation
Carla Paoliello

3153 **DESIGN CULTURE (OF) RESILIENCE**

3155 0 Textile. A Design Research
applying Circular Economy in
textile field
Maria Antonietta Sbordone,
Viviana Vollono, Carmela Ilenia
Amato, Barbara Pizzicato

3173 A Research on the Sustainability
in Traditional Cave-Dwelling
Construction Skills in Northern
Shanxi Province (Jinbei Area)
Runze Liu, Haoming Zhou

3182 A Study of Zero Waste Fashion
Design and its Possibilities within
a Design for Circularity Process.
Debbie Moorhouse, Tracy
Cassidy, Parikshit Goswami,
Andrew Hewitt

3198 Awareness, compatibility and
equality as drivers to resilience in
sustainable design research
Giuseppe Mincoelli, Gian Andrea
Giacobone, Silvia Imbesi, Michele
Marchi, Filippo Petrocchi

CONTENTS

-
- 3212 Circle Sector: exploring the role of designers in a circular economy
Ben Hagenaars, Niels Hendriks
-
- 3222 Cooperatives enterprise, incubators for the co-design of a new organizational and management model for sustainable development.
Caterina Rosini, Silvia Barbero
-
- 3235 Craft Your Future: Building a circular space through the European digital craft
Chele Esteve Sendra, Manuel Martínez Torán, Eileen Blackmore, Hendrik Jan Hoekstra
-
- 3249 Creativity as a Driver in Social Innovation Processes
Debora Giorgi, Irene Fiesoli
-
- 3264 Design culture (of) resilience. Space & Service design taxonomy, overcoming undefined space & service design contexts
Nansi Van Geetsom, Andrea Wilkinson
-
- 3282 Design education and forest environments – learning from and with living systems
Caroline McCaw
-
- 3297 Design educators in the 21st century: Applying The Compass methodology to prepare future designers as changemakers in a culture of resilience
Catalina Cortés, Alejandra Amenábar
-
- 3311 Design for Social Impact and Crafts Communities in Turkey
Hazal Gumus Ciftci, Stuart Walker
-
- 3324 Design Plugin: Using Design Thinking Approach in Smart Sustainable Cities Education
Tarmo Jaakko Karhu, Martijn Gerhard Rietbergen
-
- 3337 Design projects as drivers for organisational change in the public sector
Felicitas Schmittinger, Alessandro Deserti, Francesca Rizzo
-
- 3350 Designing community: creating resilience through collaboration
Jessica Clare Robins, Emmanuel Tseklevs, Leon Cruickshank
-
- 3365 Designing resilience. Design dealing with communities
Carlo Branzaglia
-
- 3371 Designing Resilience. Mapping Singapore's Sustainable Fashion Movements
Harah Chon, Lim Jiayi Natasha, Elisa Lim
-

CONTENTS

-
- 3382 Designing Sustainable Product-Service Systems applied to Distributed Economies in Water-Energy-Food Nexus approach
Renke He, Meng Gao, Carlo Vezzoli, Ke Ma
-
- 3401 Discovering Design Values in the Chinese Pre-Qin Classics
Miaosen Gong
-
- 3412 Eco-lab-orating. Insights from an ongoing intervention with design school faculty
Rakefet Kenaan
-
- 3424 Educating Designers for the Circular Economy: Innovative Digital Resources, Collaborative Learning and Synergic Actions
Lucinda Morrissey, Roberta Barban Franceschi, Ana Margarida Ferreira
-
- 3436 Evolving the conventional curriculum: innovative learning interventions in a classroom to enhance design students' learning competencies
Joselyn Sim, Harah Chon
-
- 3448 Fashion Futuring. Rethinking sustainable fashion design
Alessandra Vaccari, Ilaria Vanni
-
- 3458 FASHIONABLE FAÇADE: textile waste innovations for the built environment
Hilde Heim
-
- 3476 Food Cycles. Redesigning processes and products
Silvia Pericu
-
- 3487 From Objects and Products to Things and Stuff
Clare Green
-
- 3501 Green infrastructures and satellite images: the case study of Munich
Giovanni Borga, Filippo Iodice, Federica D'Acunto
-
- 3516 I Don't Want to Feel Outdated. The dissonance between product attachment and contemporary relevance
Malene Pilgaard Harsaae
-
- 3527 Innovation through circular economy: Tool development for multidisciplinary approach to product-service-system Design
João Sampaio, Ana Afonso
-
- 3544 Lost in transition; Methodologies and tools of Product-Service Systems Design for major life transition
Maria Paola Trapani, Nadejda Cervinscaia, Nadejda Cervinscaia
-
- 3560 Materials Designers. Boosting Talent towards Circular Economies
Laura Clèries, Valentina Rognoli, Pere Llorach-Massana
-

CONTENTS

-
- 3572 Preparedness and infrastructure design for disaster and emergency situations; the key to a resilient community
Noemi Bitterman, Medardo Chiapponi, Alessia Buffagni, Andrea Cotti
-
- 3585 Replicating the Unpredictable: Board Games as Prototypes for Wildfire Evacuations
Thomas Maiorana
-
- 3597 Revised Function Analysis of Sustainability - understanding the complexity of sustainability
Paul Topf Aguiar de Medeiros, Charlotte Sjödel
-
- 3616 Role of Social Ecologies within Social Design and Social Innovation
Neeta Verma
-
- 3626 Slow Engagement & Widening the Frame – Emerging Models of Social Innovation and Design Culture
Diana Nicholas
-
- 3641 Smart, Safe and Green System. A Resilient-Based Strategy for Sustainable Buildings and DIY Design
Cecilia Cecchini, Miriam Mariani, Paolo Mondini
-
- 3655 Strengthen Ties of Social Bonding Through Design from and Emotional Perspective
Deyanira Bedolla Pereda
-
- 3672 Study on the Sustainable Design of the Young Elderly Oriented Smart Wearable Products
Chen Han, Shen Lei
-
- 3686 Surviving in the wild: Sustaining design and social innovation initiatives in Asia-Pacific
Cyril Tjahja
-
- 3699 Sustainable Deliberation; an Empathetic ‘Mantra’
Amita Deshpande, Ranjana Dani
-
- 3715 Teaching and Practicing Service Design and Social Innovation: Experiences with Communities at the Margins in São Paulo, Brazil
Rosana Vasques, Mari Suoheimo, Maria Cecilia Loschiavo dos Santos
-
- 3727 The cot, the pot and other stories
Lena Gupta
-
- 3755 The Materiality of Resilience
Emile De Visscher, Lorenzo Guiducci, Iva Rešetar
-

CONTENTS

3774 The poetics of waste in contexts of satisfactory use and social action

Desamparados Pardo Cuenca,
Patrik Baldan

3795 The potential of Theory of Change to visually model the underlying logic behind service design projects

Luca Simeone, David Drabble,
Kerstin Junge, Nicola Morelli

3810 The SDGs framework as strategic lever for design education.

Simona Maccagnani, Marco Ricchetti

3823 The Tree and The Room: Co-Designing DIY WiFi Networks with Emergent Local Metaphors

Michael Smyth, Ingi Helgason,
Lauren Lapidge, Katalin Hausel

3838 Towards 'regenerative interior design': exploring a student project

Giovanna Di Monte-Milner

3853 Trace: design and responsibility in the Prato textile district

Elisabetta Cianfanelli, Renato Stasi, Matilde De Gennaro, Maria Grazia Soreca, Margherita Tufarelli

3863 Walk the talk: Towards an ecological futures framework for our designed cultures

Håkan Edeholt, Jomy Joseph, Nan Xia

3878 Water infrastructure as leverage for resilient cities: a multi-scalar design perspective on urban flooding

Sophie Leemans, Erik Van Daele

3894 Weaving the New Way of Making from the Andes

Rodrigo Muñoz-Valencia

3912 Working with the United Nations Sustainable Development Goals in Design Education

Silje Alberthe Kamille Friis

3929 DESIGN CULTURE (OF) REVOLUTION

3931 Alternative narratives data visualization archive

María de los Ángeles Briones Rojas, Michele Mauri

3945 Becoming Lost and Found in Translation

Mark Ingham

CONTENTS

-
- 3963 Critical Thinking in fashion design education - New learning approaches for a systemic change in the fashion industry
Carolin Ermer, Julia Schwarzkopf
-
- 3980 Design as a methodological stance in interdisciplinary research
Valérie Côté, Caroline Gagnon, Lynda Bélanger, Daphney St-Germain
-
- 3996 Design for Fast Track Democracy
Jennifer Schubert, Bastian Koch
-
- 4009 Disrupting governance by Systemic Design and co-creating the public value
Carolina Giraldo Nohra, Eliana Ferrulli, Silvia Barbero
-
- 4025 Disruptive technologies and behavioural change: Design fiction as trigger for critical thinking
Mila Stepanovic, Venere Ferraro
-
- 4043 Does design thinking matter? Empirical study and survey on the effectiveness of design thinking
Hannah Park
-
- 4057 Education formats to integrate Design with Humanities, Politics, Social Sciences & Education
Anna Lottersberger
-
- 4071 Experiments on complex systems mapping around materials.
Flavia Papile, Romina Santi, Beatrice Gobbo, Tommaso Elli, Barbara Del Curto
-
- 4088 Exploring visualizations of design processes from a design activist perspective – a scoping study
Karina Goransson, Anna-Sara Fagerholm
-
- 4105 Fashion-Tech Revolution: Future Frontiers from Products to Processes
Alba Cappellieri, Chiara Colombi, Livia Tenuta, Susanna Testa
-
- 4123 From the product to the object. The speculative design practice as instance.
Chiara Scarpitti
-
- 4135 From trustful empowerment to overwhelming guilt: pedagogy in current activism practices
Alexia Autissier
-
- 4147 Guilty Materiality: why we play down material relations
Stéphane Treilhou, Clare Green
-
- 4160 MANIFESTO! Now: Game Design for Revolutionary Thinking
Julian Hanna, Simone Ashby, Sónia Matos, Alexis Faria, Callum Nash
-

CONTENTS

-
- 4174 Ph.D. Admission System Based Comparative Study in Design Discipline under Chinese Context
Fan Chen, Jing-Yi Yang
-
- 4187 Politics by design
Elisabetta Cianfanelli, Maria Claudia Coppola, Margherita Tufarelli
-
- 4200 Projecting Change: Redefining Preservation in the Era of Sea Level Rise
Liliane Wong
-
- 4218 Realising Discourse: A Strategic Design Solution to the Problem of Addiction
Jason Hobbs
-
- 4239 Reframing development: A proposal on the role of design research in Latin America based on situated views of the world
Juan Alfonso de la Rosa
-
- 4250 Speculative Design for the Public Sector. Design Fiction as a Tool for Better Understanding Public Services
Gianni Sinni
-
- 4263 Speculative Design in Education: Mapping the Landscape
Ingi Helgason, Ivica Mitrović, Julian Hanna, James Auger, Enrique Encinas, Michael Smyth
-
- 4275 Targeting Design Intervention across Levels of Complexity
Tanner Slade, Nicola Morelli
-
- 4288 The Agency of Discursive Design Exists in the Industrial
Karma Dabaghi
-
- 4303 The Patient Revolution. New design perspectives in healthcare innovative processes.
Carla Sedini, Laura Cipriani, Massimo Bianchini, Barbara Parini, Stefano Maffei
-
- 4319 The transformation will not be televised
Peter Friedrich Stephan, Raz Godelnik
-
- 4333 Time and Design. Time as a key parameter for a survey on contemporary design
Enza Migliore
-
- 4351 Walking the Line: Creative Research as Critical Activity for Design
Brooke Chornyak, Tania Allen
-
- 4370 Why we need more somatic culture in design
Silvia Sflijiotti
-

CONTENTS

4383 **DESIGN
CULTURE (OF)
THINKING**

4385 Always ordinary, never straightforward: Considering the work of Lorraine Wild
David Cabianca

4403 Anticipatory Design and Futures Literacies: A Need and a Hope
Andrew Morrison, Manuela Celi, Laura Clèries, Palak Dudani

4420 Authorship and automation in the digital design culture
Giuliano Galluccio

4434 Banham's 'Unhouse' as Anti-Interiority: Towards Twenty-First-Century Theories of Design and Domesticity
Helen McCormack

4444 Bodies of Evidence: making in/visible histories in South African Design Education
Nike Romano

4459 Culture and Relationality. Moving towards 'post-rational' modes of design
Tom Ainsworth, Sally Sutherland

4472 Design History and the Decline of Historical Thinking
César Peña

4482 Designers-Thinkers and the Critical Conscience of Design
Sanna Simola

4500 De-signing Ambiguity
James Dyer, Christian S. Petersen

4514 Disruptive Thinking in Design Education
Riccardo Balbo, Elda Scaramella, Serena Selva

4524 Diversified Orientation and Design Value in Safeguarding of Intangible Cultural Heritage
Tie Ji, Yinman Guo, Xiaolei Min

4542 Domesticity and digital eugenics: design cultures of Silicon Valley
Luis Hernan, Carolina Ramirez-Figueroa

4551 Exploring Asian Philosophies and Service Culture: the Notion of Dignity
Miso Kim

4562 Fantasia and analogical thinking: a specific reflection on teaching the essence of the Creative Leap
Valentina Auricchio

CONTENTS

-
- 4573 How to teach design thinking to non-design students: enablers and barriers to transfer design research practices.
Gianluca Carella, Michele Melazzini, Xue Pei, Cabirio Cautela, Marzia Mortati
-
- 4595 Not just Thinkers, Makers
Hein Dubery, Kyle Brand
-
- 4605 Radical Interdependence: learning/doing with things
Jaron Rowan
-
- 4615 Rethinking & Appropriating Design Education for a VUCA World
Jan Eckert, Sabine Junginger, Guillermina Noël
-
- 4636 Rethinking Design through Literature
Susan Yelavich
-
- 4649 The chain reaction. How to design a process for transforming museums by rethinking the role of personnel
Alessandra Bosco, Silvia Gasparotto
-
- 4664 The concept of Interaction Design under review: literature review and interviews with qualified informants
Eduardo Ariel de Souza Teixeira
-
- 4674 The Emergence of Modern Design Discourse in the Eastern Mediterranean Region (EMR)
Qassim Saad
-
- 4689 The engagement of visitors in faber's houses and studios. Empirical design research and experimental actions in Lombardy
Raffaella Trocchianesi, Anna Mazzanti, Alessandra Spagnoli, Davide Spallazzo
-
- 4703 Theory under suspicion: criticality and material meaning in practice based research
Marta Camps, Jaron Rowan
-
- 4720 Tokyo 2020: globalization and self-orientalism in the communication of the next Asian Olympic Games.
Claudia Tranti
-
- 4736 Towards borderless futures: How transcultural approaches changed the practice of graphic design
Juliana F. Duque
-
- 4753 Which way to go? Some complicated crossroads facing design culture in Aspen.
Elena Dellapiana, Ramon Rispoli
-

CONTENTS

4768 POSTERS

4769 A visual-analytical approach to phases of transition in people's life paths

Laura Heym, Jennifer Schubert, Irene Visentini, Sofia Sanchez, Alvise Mattozzi

4770 Aeon, in his original meaning of "life", "vital force" or "being", "generation".

Ana Maria Fessmann, Elene Bakhdatze, Vaishnavi Bala, Varshini Janakiram, Janina Hietl, Gianfranco Olivotto

4771 Co-creating prosthetics as fashion accessories for assisting people with disability. The case of hearing impairment

Andree-Anne Blacutt, Stéphane Roche

4772 Collaborative methods: design bridging academia and industry

Teresa Franqueira, Pereira Catia

4773 Craft in Makerspaces: The Potential for Social Change for Sustainability

Alessandra Fasoli

4774 Creative design process for envisioning the future of emergency medical services in smart cities

Vipul Vinzuda, Niall Deloughry, Leonard O'Sullivan

4775 Design and Neuroscience for the UX. Possible tool for Designers

Alessio Paoletti

4776 Design as a tool for participatory transformation of urban space

Jacobo Muñoz Duato, Damià Jordà Bou

4777 Digital visual tool for design project development in a multidisciplinary team

Michela Carlomagno

4778 Education in social design by means of artistic photography

Cecilia Casas-Romero

4779 Enabling Collaborative Turns: A Conversation-Based Approach for Design Workgroups

Sze-Yunn Seah

4780 Experimenting new joints for more sustainable and easier to assemble furniture

Patrizio Cipollone, Viktor Malakuczi, Felice Ragazzo, Michele Russo

CONTENTS

-
- 4781 Exploring the potential uses of ocean plastic and public engagement activities for raising awareness
Xingyu Tao
-
- 4782 Feed: design for Eating Disorders prevention in pre-adolescent age.
Carlotta Belluzzi Mus
-
- 4783 Festival Living Labs: Involving the Festival Community in Sustainable Experimentation.
Marije Boonstra, Aranka Dijkstra, Peter Joore
-
- 4784 Grey matter - Matière grise. When the 'thé dansant' is no longer an option. Imagining an inclusive and intergenerational urban future, placing seniors as productive actors of the civic life.
Jerome Picard, Elida Mosquera, Benoist Desfonds, Matthieu Boustany, Peeraya Suphasidh
-
- 4785 Guided by Voices from the Fields: A case study on earth, plants and fashion design
Piret Pupart, Julia Valle-Noronha
-
- 4786 Heirloom a device for the survival of the fittest memories
Valeria Volanti
-
- 4787 Hybrid Town, Stories in Maps: from China to Milan
Guido Tattoni, Hagit Pincovici, Germana De Michelis
-
- 4788 Identities and sustainable futures
David Serra Navarro, Carme Ortiz Valeri
-
- 4789 Interaction studies applied to Robotic Surgery
Giovanna Giugliano, Sonia Capece, Víctor Fernando Muñoz Martínez
-
- 4790 Intervention of Indian Textile Craft in Design Pedagogy for Social innovation and Economic Growth
Sakshi Babbar Paul, Saroj Bala
-
- 4791 Italia 3.0. An educational strategy to enhance food as Food Cultural Heritage
Monica Bortolussi, Martina Mitrione, Sonia Massari, Alessandro Spalletta
-
- 4792 Kairos: How Digital Culture Heritage can improve society and its development through Systemic Design
Giovanni Capoccia, Veneranda Carrino
-
- 4793 Kinetic calendar for tracking physical and emotional stress in women
Mariel Domínguez
-
- 4794 Knitted expressions. Movement as material in Textile Design
Faseeh Saleem
-

CONTENTS

-
- 4795 Love Leftovers - Useful fictions and what if we could put our memories on sale?
Teodora Ivkov, Luca D'Elia
-
- 4796 Mass media imaginary as a symbol. How image is revealing the crises of our time through cinematic design.
Celia Cuenca García
-
- 4797 Neighborhood Cowork (Cowork del Barrio): Co-creating agents for social change
Sandra Molina, Cynthia Jaramillo, Alejandro Ramirez
-
- 4798 Pen Your Thoughts: A Visual Design Language Study on Student's Learning Progression
Jennifer Samonte Aguilar
-
- 4799 Real-time snow information for tourists - Utilizing AI for tourism - Case Snowman
Marija Griniuk, Maija-Liisa Rautiainen, Jesse Talsi, Päivi Timonen, Michelle van Wyk
-
- 4800 Recycling, refusing plastic use and choosing biodegradable materials for new products
Alexandra Anghelache
-
- 4801 Shifting Mindsets, Bridging Generations
Shiu Heng Sin
-
- 4802 TellMi Ecosystem: an example of Design Process applied to didactic methodology.
Elisa Chiodo, Michele Aquila
-
- 4803 Time Well Spent. Facilitating mindful and meaningful screen use through a 'Design for Humansic Living' methodology
Ace Chia
-
- 4804 Trans/Feminist Critical Making – Design as Open-Source Opposition
Michelle Christensen, Florian Conradi, Marie Dietze
-
- 4805 Visual Exploration Method to Engage Art History with Practice-based Mindset in Design Education
Hanny Wijaya
-



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

About the conference

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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 referred, 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 "colère" 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 biodiversity, 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.

| TUE 08 JUNE | | | WED 09 JUNE | | | THU 10 JUNE | | | FRI 11 JUNE | | |
|--|--------------------------------------|-------------------|--------------------------------------|-----------------------------------|-------------------|--------------------------------|--------------------|-----------------|-------------|--|---|
| 9:30 CET DAILY PROGRAMME STARTS | | | | | | | | | | | |
| 6 X ITALIAN MEMBERS FAIR | 10 X TRACK SESSIONS | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 10 X TRACK SESSIONS | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 5 X WORKING GROUPS | POS TER SESSION | EX TRAS | | |
| 6 X ITALIAN MEMBERS FAIR | 10 X TRACK SESSIONS | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 10 X TRACK SESSIONS | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 5 X WORKING GROUPS | POS TER SESSION | | | |
| 6 X ITALIAN MEMBERS FAIR | 10 X TRACK SESSIONS + ROUND TABLE | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 10 X TRACK SESSIONS + ROUND TABLE | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 5 X WORKING GROUPS | POS TER SESSION | | | DESIS EVENT |
| 12:50-14:30 CET LUNCH BREAK DESIGN CULTURE(S) OF ROME: FOOD EXPERIENCE | | | | | | | | | | | |
| OPENING PLENARY | 10 X TRACK SESSIONS | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 10 X TRACK SESSIONS | POS TER SESSION | EX HIBITION SESSION | | | | | CLOSING KEYNOTE SPEECHES |
| KEYNOTE SPEECHES | 10 X TRACK SESSIONS | 1 X WORKING GROUP | 6X NEW MEMBERS FAIR | 10 X TRACK SESSIONS | POS TER SESSION | GENERAL ASSEMBLY | | | | | FREE BREAKOUT SESSIONS & 1:1 SPEED NETWORKING |
| 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 | | | | | |

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

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Dimitri Russo

Track ambassadors

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R O B O T I C

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Mathias Funk, Eindhoven University of Technology, Netherlands
Patrizia Marti, University of Siena, Italy
Giuseppe Mincoletti, 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

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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
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M A K I N G

P R O C E S S
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P O S T - I N D U S T R Y

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MULTIPLICITY

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

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NEW NORMAL

HEALTHCARE
EDUCATION
WORK/PLAY

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PROXIMITY

PLACES
PEOPLE
ECONOMY

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RESILIENCE

SOCIAL INNOVATION
CIRCULAR ECONOMY
SUSTAINABILITY

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REVOLUTION

CRITICAL THINKING
DISRUPTION
CHANGE

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THINKING

THEORY
HISTORY
CRITICS

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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 posthumansism 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
JUNE 08.09.10.11, SAPIENZA UNIVERSITY OF ROME

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 21st 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 13th 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 13th 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 13th 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 13th 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 13th 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 13th 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 13th 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 Makerspace – 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 13th 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 13th 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 13th 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 14th 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 14th 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-chemist”, 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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Acknowledgements: Special thanks go to those who have made an extensive contribution to the development of MATto, the Material library of Politecnico di Torino, and the advisory services provided to local businesses, as well as to all the companies and participants who have used the services and provided inspiration to further the research.

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