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Design contributions for the COVID-19 global emergency

PART 1
Empirical Approaches and First Solutions

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SPECIAL ISSUE EDITORIAL

Design Contributions for the COVID-19 Global Emergency (Part 1): Empirical Approaches and First Solutions

GUEST EDITORS

Emilio Rossi [a] | **Massimo Di Nicolantonio** [b] | **Fabrizio Ceschin** [c]
Giuseppe Mincolelli [d] | **Aguinaldo dos Santos** [e] | **Cindy Kohtala** [f]
Edu Jacques [g] | **Carla Cipolla** [h] | **Ezio Manzini** [i]

[a] University of Lincoln, Lincoln School of Design: Lincoln, United Kingdom.
[b] University of Chieti-Pescara, Department of Architecture: Pescara, Italy.
[c] Brunel University London, Brunel Design School: Uxbridge, United Kingdom.
[d] University of Ferrara, Department of Architecture: Ferrara, Italy.
[e] Federal University of Paraná, Department of Design: Curitiba, Brazil.
[f] Aalto University, Department of Design: Espoo, Finland.
[g] University of Vale do Rio dos Sinos, School of Creative Industry: São Leopoldo, Brazil.
[h] Federal University of Rio of Janeiro, COPPE: Rio de Janeiro, Brazil / DESIS Network.
[i] ELISAVA Barcelona School of Design and Engineering: Barcelona, Spain / DESIS Network.

This is a landmark publication for the field of design. It was catalysed by unprecedented circumstances, as designers around the world had to rapidly deploy their competencies in strategic problem-solving to help humanity in the fight against an invisible enemy during a global pandemic. In alliance with other disciplines, from medicine to mechanical engineering, from computing to anthropology, designers everywhere have addressed the challenges and produced remarkable results through a diversity of initiatives. This Special Issue presents a peer-reviewed sample of these initiatives.

The coronavirus pandemic can be considered as the biggest 'problem' faced by an entire generation of designers. It has produced a great many unexpected changes and demands, many of which neither governments, companies nor communities were prepared to handle. Although designers were able to gather existing knowledge and reapply it, it became clear that our ability to learn from the past was limited, considering the complexities presented by COVID-19. Hence, a wholly deductive or inductive approach was neither viable nor relevant, as, in last hundred years, humanity has never been asked to face a pandemic of such scale and gravity. The result was a rapid, earnest application of abductive reasoning, typical of the creative process inherent in design activity. In a short period of time, designers contributed, and in many instances led, innovation processes associated with products, systems, services and experiences to mitigate the impacts of the coronavirus.

The promotion of this Special Issue has brought together a coalition of the main global design institutions, which is in itself a remarkable achievement: **LeNS (Learning Network on Sustainability),** the **DESIS Network (Design for Social Innovation and Sustainability),** the **Cumulus Association,** and the **World Design Organization (WDO)®.** As a result of this collaboration, the number of submissions and their global geographical distribution would match a large international conference, a clear indication of the level of engagement of the design community around the world. Indeed, this Special Issue received 115 submissions by researchers from 26 countries located on 5 continents.

The Special Issue's Part 1, which contains 31 papers, is dedicated to empirical contributions, with direct accounts of the hands-on activities of designers in different contexts and from a variety of perspectives. Part 2, which will be published in early 2021, will focus on the theory underpinning the practical experiences as well methodological reflections concerning the role of design during the pandemic.

In Part 1, most papers present the knowledge generated during the process of designing specialized health-related products and equipment (e.g. isolation units, field hospitals, robots, personal protective equipment (PPE), and so on), including approaches to frame the problem, capture requirements, create and evaluate alternatives, manufacture and distribute these products during the pandemic (e.g. co-design, design of distributed networks, product-service system design, open design). It also includes propositions to alleviate the psychological aftermath of the pandemic, as well as alternative strategies to foster resilience via social innovation within communities during this worldwide crisis.

REFLECTIONS ON THEMES FOUND ACROSS PAPERS

Many have compared the COVID-19 pandemic to the one that affected the world with the Spanish Flu from 1918 to 1920. The two phenomena have in common a large number of infections and the impact they have had on the lives and economies of all nations. However, the world in 1920 was very different from the one we live in today. Traditional industry was in the midst of its expansion phase, telecommunications had just begun to develop, the United Nations and the World Health Organization did not yet exist, the world was generally much less interconnected, and each nation faced the epidemic on their own with very different strategies and consequences. Design was a tool at the service of industrial expansion, still not fully identified and with its potential impact on society limited to the sphere of the product. The Spanish Flu was a disease that hit younger people more severely and spread among a society where life expectancy was much lower than it is today.

The average age of the population has exponentially grown and the whole of humanity is ageing at an even faster rate today; the disease we are facing today, COVID-19, causes deaths especially among the elderly. The virus has diffused in a globalized scenario, in which infinite networks of relationships, both physical and immaterial, branch out and overlap; the economy of the intangible interpenetrates and dominates that of the product; and the digital revolution crosses geographical and physical boundaries continuously, changing the behaviours and identities of human communities. We live in a complex world, which we cannot fully perceive and understand with our natural abilities, which makes us more and more interdependent with the artificial environment that we are building up.

Design has taken on strategic value in strengthening the human capacity to govern this complexity and directing development in a way that can be sustainable for future generations: it is no longer considered a purely technical or artistic and independent discipline, and it is recognized as a humanizer and harmonizer of knowledge and skills in the development of all innovative processes that have an impact on society. This Special Issue was launched with the intention to report on the variety of interpretations of this role, as manifested during the pandemic emergency. Each crisis tests a community's ability to react and reveals its adaptation skills.

Resilience is the term that has been most frequently used to define the combination of these two characteristics. Far from being a measurable and intrinsic property, as in the case of

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materials science, where the term is also often utilized, in human society resilience is the result of the transformation choices that a community makes, more or less consciously. *Conscious transformation* choices are the substance of design research and practice: what is represented in the selected papers can possibly help to highlight how design has contributed to the development of social resilience during the pandemic.

The topics contained in this Part 1 range across diverse fields of design research, as evidenced by the keywords chosen by the authors: some of the topics and keywords recur, indicating which approaches were more often applied. For example, the theme of sharing and cooperation can be associated with terms such as *Open Source, Open Innovation, Clustering* which recurred in 13 papers. The awareness of the complexity of the scenario and the need for an articulated and harmonious design approach on multiple levels is well summarized by the term *Multidisciplinarity*, which is explicitly used in the keywords of 5 articles. The interdependence of new digital technologies and the possibility of exploiting virtual networks for the definition of new strategies or the proposal of new tools is a theme that crosses almost all the papers, emerging in terms such as *Distributed Manufacturing, Maker* and *Fab Lab.*

THEMATIC CLUSTERS

The papers contained in the Special Issue's Part 1 can be categorized into five thematic clusters.

The first group of papers critically **reviews and maps design responses and citizens' needs** in relation to the COVID-19 emergency.

Two papers offer a comprehensive analysis of international cases of design responses. Rodgers et al. documented over 500 design interventions that have been created by individuals, networks, amateurs, professionals, and public and private organizations and institutions. Moura et al.'s analysis resulted in 113 mapped cases, whose key features are discussed and presented through a range of infographics. With a focus on digital solutions, Cordeiro et al. offer a comparative analysis of applications that contact trace people or inform them about the disease. Xia conducted an analysis of the relationship between distributed systems and resilience, focusing on three representative cases based in the Chinese province of Wuhan. As a result, distributed system design strategies suitable for China were identified. Prado et al. map initiatives of social innovation that have promoted positive social capital in Brazil. This resulted in the analysis of 15 cases, which were categorized according to their field, coverage area and target. Fonseca Braga et al. focus on informal settlements' communities in Brazil, analyse their challenges and cluster their needs in six major themes: sources of information, prevention, diagnosis and treatment, support and change.

The second cluster of papers is the largest, and includes contributions presenting and/or reflecting on **specific design responses to the ongoing crisis,** ranging from physical artefacts (e.g. PPE, field hospitals) to digital solutions (e.g. apps to monitor the pandemic).

Three papers focus on hospitals and hospital facilities. Ribeiro et al. illustrate the requirements in the design and construction of the field hospital in Lagoa Barra (Brazil) and reflect on the lessons learned, considering a wide range of aspects including, for example, the configuration of the environments, the definition of the circulation flows and the typology of

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beds. Manrique et al. present the design of a portable epidemiological isolation unit: a pneumatic structure which permits the treatment of infected patients in aseptic and well ventilated spaces and allows the sanitary authorities to expand its hospital capacity when needed, as well to set up field hospitals in isolated areas. Fossati et al. present a telepresence robot designed to facilitate communication between patients isolated in COVID-19 hospital ward and their relatives.

The design, prototyping and manufacturing of innovative personal protective equipment (PPE) and prevention measures are explored in a range of papers. Pagnan et al. present a 3D printed individual protection mask combining a PLA (polylactic acid) filter mesh with Tourmaline and a triple layer with cotton fabric. Santos et al. provide insights on the need to design beyond the sole provision of physical artefacts and the importance of thinking in terms of product-service systems (PSS), with a proposal for a distributed PSS for mask provision for the state of Ceará, Brazil. Segura-Duque et al. reflect on the experience of two MSMEs (micro, small and medium enterprises) that adapted quickly to meet the demand for personal protection products, analysing the cases with a strategic design lens. Two papers, in addition to presenting PPE designs, also reflect on the importance of establishing networks of actors involving academia and public and private organizations. Rebola et al. describe how the University of Cincinnati mobilized and joined forces with local hospitals and organizations to quickly design and prototype a range of PPE, as well as developing a plan for material sourcing, production line and distribution. Dos Santos et al. describe the experience of creating an interinstitutional network, formed by universities and other organizations, to transform an academic design laboratory into a space for the production of PPE using 3D printing and laser cutting techniques, which made it possible to meet the high emergency demand for PPE in the city of Rio de Janeiro.

Three papers also focus on the role of open design and the 'maker movement' in the development and production of PPE. Tsuda and Sakuragi present a do-it-yourself face shield developed in Japan, reflecting on the benefits and challenges of personal fabrication. Li et al. illustrate a UK-China initiative on how open design and distributed manufacturing can be effective in producing PPE when there is a shortage of supply. García and Cuartielles provide insights on how the Spanish 'Coronavirus Makers' (CVM) group developed and supplied ventilators and PPE to hospitals and people in need.

More in general on prevention measures, Piccoli et al. present a hand sanitizer dispenser for public transport and other locations in the urban environment.

Finally, in terms digital solutions, Motta et al. analyse the Brazilian Ministry of Healthcare's Interactive Voice Response (IVR) system and its effectiveness in informing citizens about the pandemic.

The third group of papers addresses the **challenges of online education,** with a particular focus on teaching design in higher education.

Spitz et al. present a selection of educational experiences, strategies and methods to remotely teach design. Bernardo and Duarte reflect on the use of various technologies to support teaching and learning, but also the identification of positive aspects and pain points influencing the overall experience of staff and students.

The fourth cluster of articles focuses on the **psychological, emotional and experiential aspects of people** dealing with the pandemic's implications and consequences.

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De Paulo et al. address the topic of social isolation, in particular investigating the role of social media applications in affecting people's daily emotional experiences. Delgado and Sattele explore the construction of quarantine narratives related to the design of everyday public spaces and domestic artefacts in Mexico City and propose a set of values for Mexico City's New Normal to be adopted in urban and product design. Araya et al. analyse the implications of working from home, with a focus on the impact on well-being and behaviour. This provides insights into the relationship between the domestic built environment and certain elements that shape it, and the role they play in relation to the perception, emotional state and productivity of the users. Rocco et al. focus on how a positive environment plays an important role in the well-being of individuals, with effects on both physical and psychological levels. In particular the paper presents a range of graphic interventions for Hospital de Clínicas de Porto Alegre, Brazil. Finally, Conti et al. explore the psychological and physical therapeutic effects of knitting on people in isolation or self-quarantine.

Finally, the fifth group of papers provides **reflections on the design processes** adopted for the development of various design responses.

Three papers discuss the methods and tools that can be used by design teams in emergency situations like a pandemic. Mincolelli et al. present a methodological approach that integrates Human Centred Design (HCD) with Open Innovation (OI), conceived to enable design teams to quickly develop solutions during a pandemic. Methodological challenges are presented together with tools and methods developed to overcome those challenges. Cipolla explores the limitations that design teams face during a pandemic (e.g. lack of physical or face-to-face interactions with communities and citizens) with a particular focus on social innovation, service design and design for placemaking. As a result, and building upon a case study, the article puts forward a set of strategies to support design for social innovation processes. Freire et al. present a process for design services during the COVID-19 emergency, with a particular focus on the provision of essential benefits to homeless and other vulnerable people.

Two papers shed light on the role of design platforms on the design and dissemination of solutions. Argenton Freire and Ziggiatti Monteiro explore the role that design sharing platforms have on enhancing collaboration, continuous development and dissemination of design solutions tackling the COVID-19 emergency. Finally, Colombo and Ciuccarelli present the experience of conceiving, developing and implementing a specific design sharing platform, 'Design for Emergency', which started in Italy but soon became global, expanding to 11 countries on three continents.

DATA INTERPRETATION

The papers collected in this first Special Issue portray the complex scenario concerning empirical approaches and first solutions developed by designers and researchers to tackle the pandemic. The issue clearly reflects the collective effort performed by the design community.

By comparing the concepts discussed and the geographical distribution of studies, it is possible to illustrate **dimensions of the emergency in relation to regional priorities** (Figure 1). In particular, 6 studies deal with *Design for Social Innovation,* which is the most important research topic found across all papers. A large group of studies (18) explore the following topics: *Multidisciplinarity* (5), *Emotion, Psychology and Wellbeing* (5), *Human*

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Centred Design (4) and *Open Designs and Open Processes* (4). The remaining papers face issues related to *Distributed Manufacturing* (3), *Methodological Developments* (2), *Distributed Economies* (1) and *Innovation* (1). In terms of geographical dimension, more than two-thirds of studies are addressed to Brazil (11) and to Global scales (10). The remaining studies focus on Italy (2), Colombia (2), China (1), Mexico (1), USA (1), Spain (1) and Japan (1). Accordingly, the dimensions of the emergency oscillate between social and psychodynamic issues, with interesting projections toward innovation concepts at distributed scales; on the other hand, the applications of these dimensions document the need of researchers to act in those countries where the pandemic has generated significant disruptions in people's lifestyles (e.g. Brazil and Italy). Overall, the studies outline the strong regionalism of proposed interventions, which can be interpreted as the will of the community to operate at the regional level, where the impacts of experimentations are more visible and replicable.

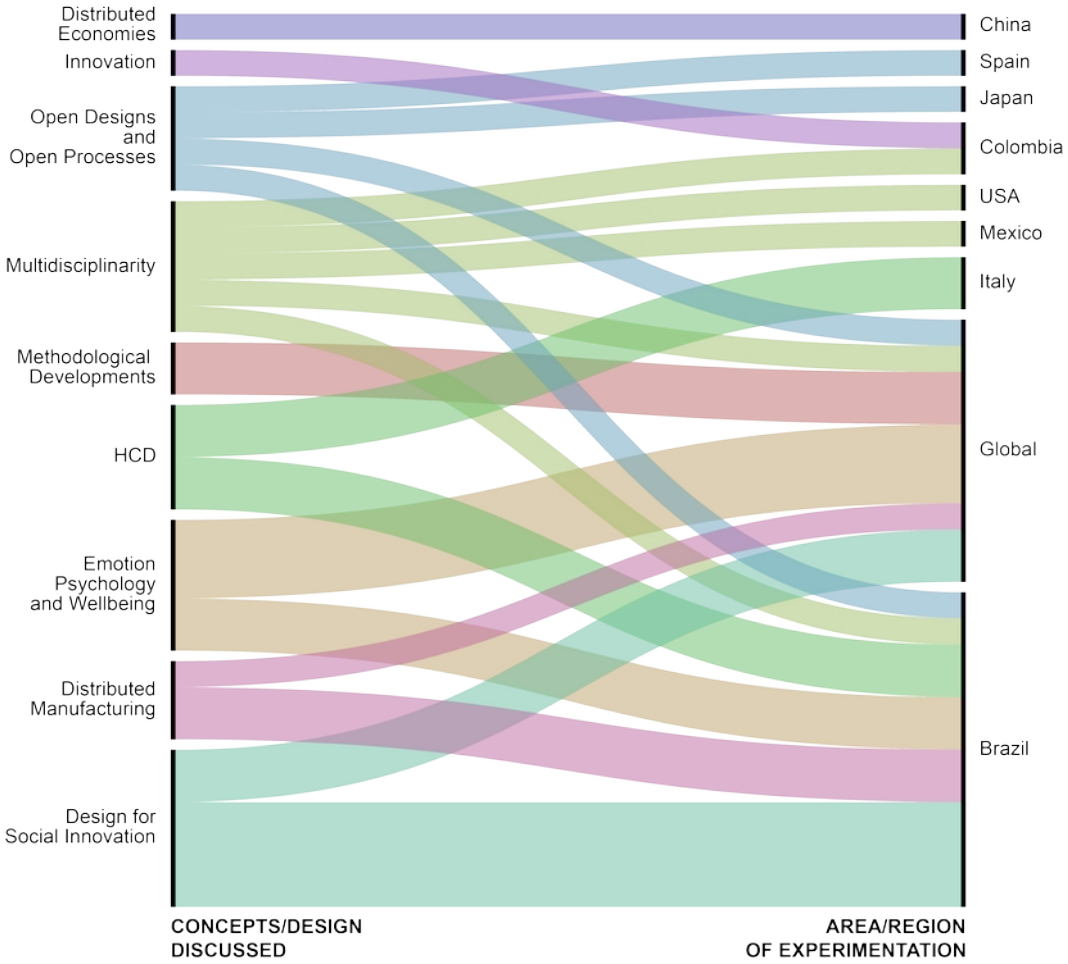

Figure 1: The dimensions of the emergency in relation to regional priorities.

Typologically examining the scales of intervention in the papers can be illustrated by linking the five clusters used to classify the papers with their domains of exploration (Figure 2). This analysis provides an overview on the scale of interventions in relation to the nature of the papers. In particular, it can be observed that the *Communities/Regions* scale covers the majority of the study presented in this Part 1 (19); only those that have worked on the *Challenges of online teaching* (2) have not considered this dimension. Therefore, clusters that have produced studies impacting on this scale are: *Specific design responses to the on-going crisis, Psychological, emotional and experiential aspects, Reflections on design processes,* and *Review and map of design responses and citizens' needs.* From the methodological point of view, this aspect seems very interesting because authors have directly and indirectly

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recognized that the medium scale is the most suitable dimension to operate effective interventions. Studies on the remaining dimensions – *Companies, Universities, Homes* and *Hospitals* – are important for the quality of design outcomes, but have a marginal relevance in terms of number of studies (altogether 10 studies). These patterns also reinforce the ones previously introduced about the regional priorities, confirming that *Design for Social Inclusion, Multidisciplinarity, Emotion, Psychology and Wellbeing* and *Open Designs and Open Processes* have a significant influence on the medium scale.

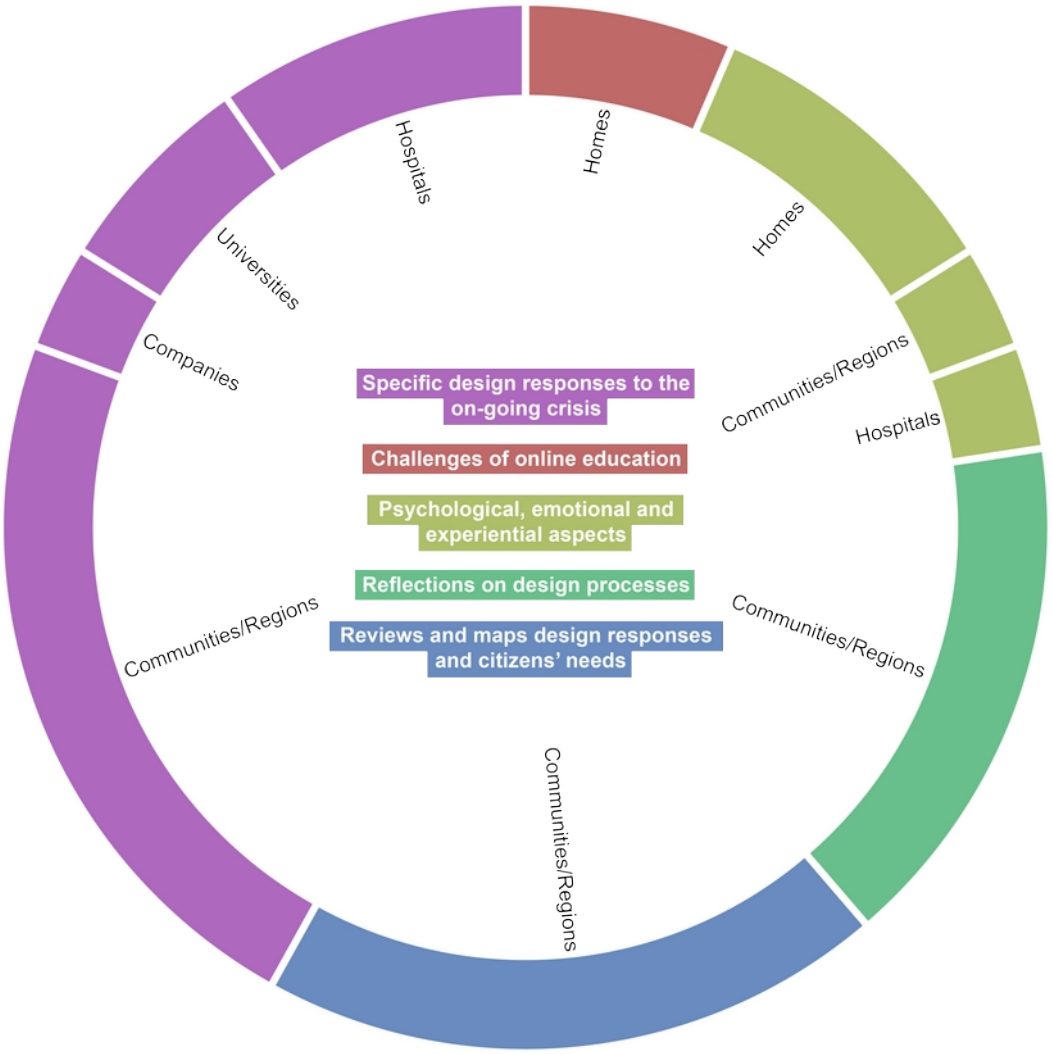

Figure 2: Typological examination of the scale of interventions.

Continuing with the investigation on intervention scales, interesting patterns concerning the **design-oriented research foci** can be identified (Figure 3). These data enrich the analysis with useful information about the design experiments carried out by authors represented in this Part 1. In general, it is possible to affirm that the nature of design outcomes follows the intervention scales. Therefore, the *Communities/Regions* dimension is the favoured testing ground for *Product Networks* (2), *Product Development* (2), *Design Platforms* (2) and *PSS* (1); on the level of processes and methodologies, this scale gathers *Maps of Design Responses* (3), *Product Analyses* (3), *Maps of Community Solutions* (2), *Methods and Tools* (2) and *Design Processes* (2). Moving toward the small intervention scales – *Companies, Universities, Homes* and *Hospitals* – it is possible to find *Specialized Products* (4+1), *Online Education* (2) *Product Networks* (1), *Environmental Design* (1), as well as a range of methodological insights (3).

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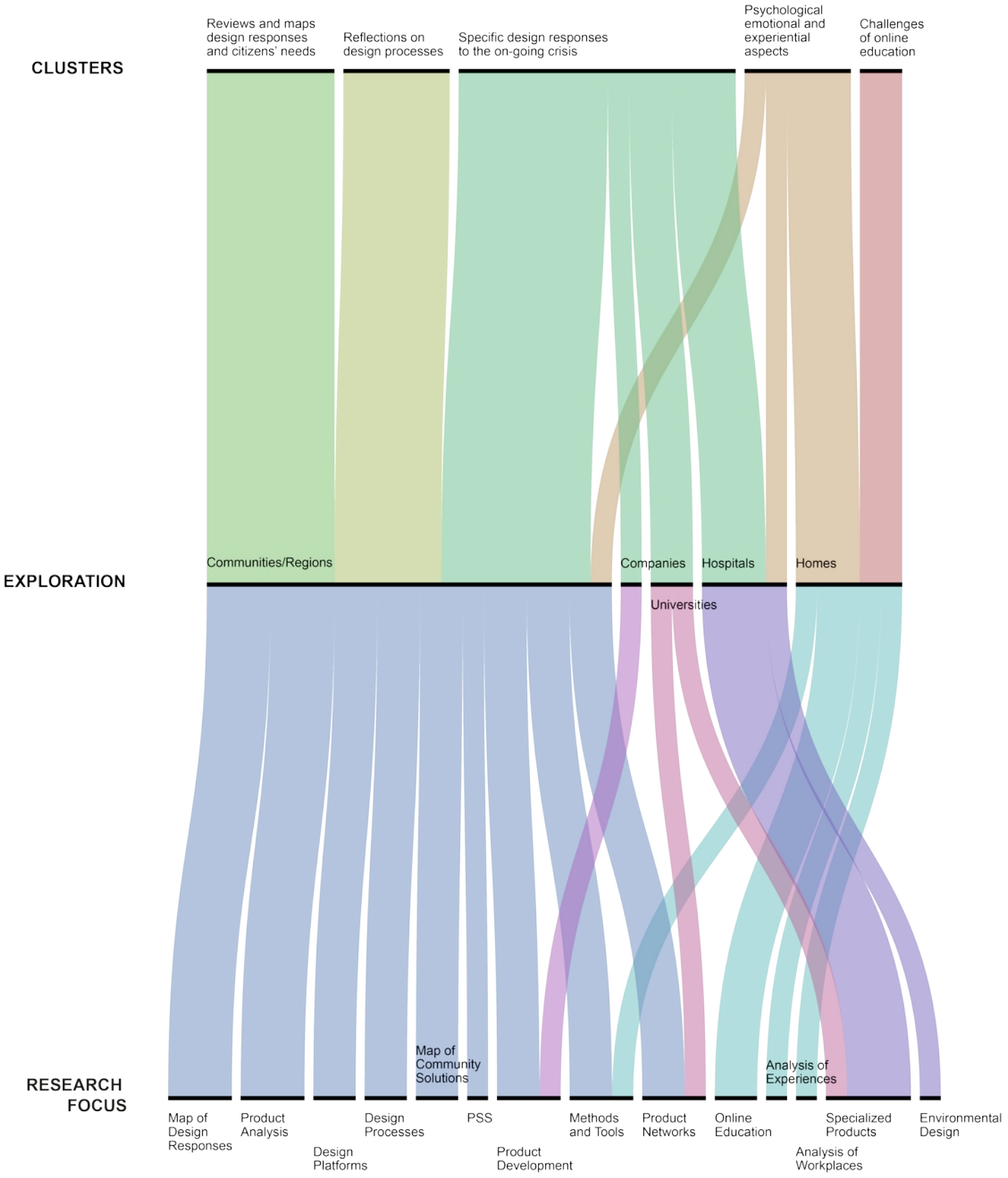

Figure 3: Correlation between the five Clusters (top), Domains of Exploration (middle) and specific Research Foci (bottom).

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The comparison between *Domains of Exploration, Clusters, Main Foci* and *Areas/Regions of Experimentations* provides a complete and holistic overview about the **explicit, implicit and hidden interrelations among papers composing the Special Issue's Part 1 and the emergency scenario of the COVID-19 pandemic.** The map (Figure 4) portraits all empirical approaches and first solutions developed in the last year to tackle the pandemic. As can be seen in the following diagram, there is not a direct and logical relationship between

Domains of Exploration, Main Foci and *Areas/Regions of Experimentations;* however, this apparently chaotic framework allows to enrich the strengths of the design discipline compared to both the scale of interventions and the geographical implications of the approaches used by researchers and designers involved in this 'collective effort'.

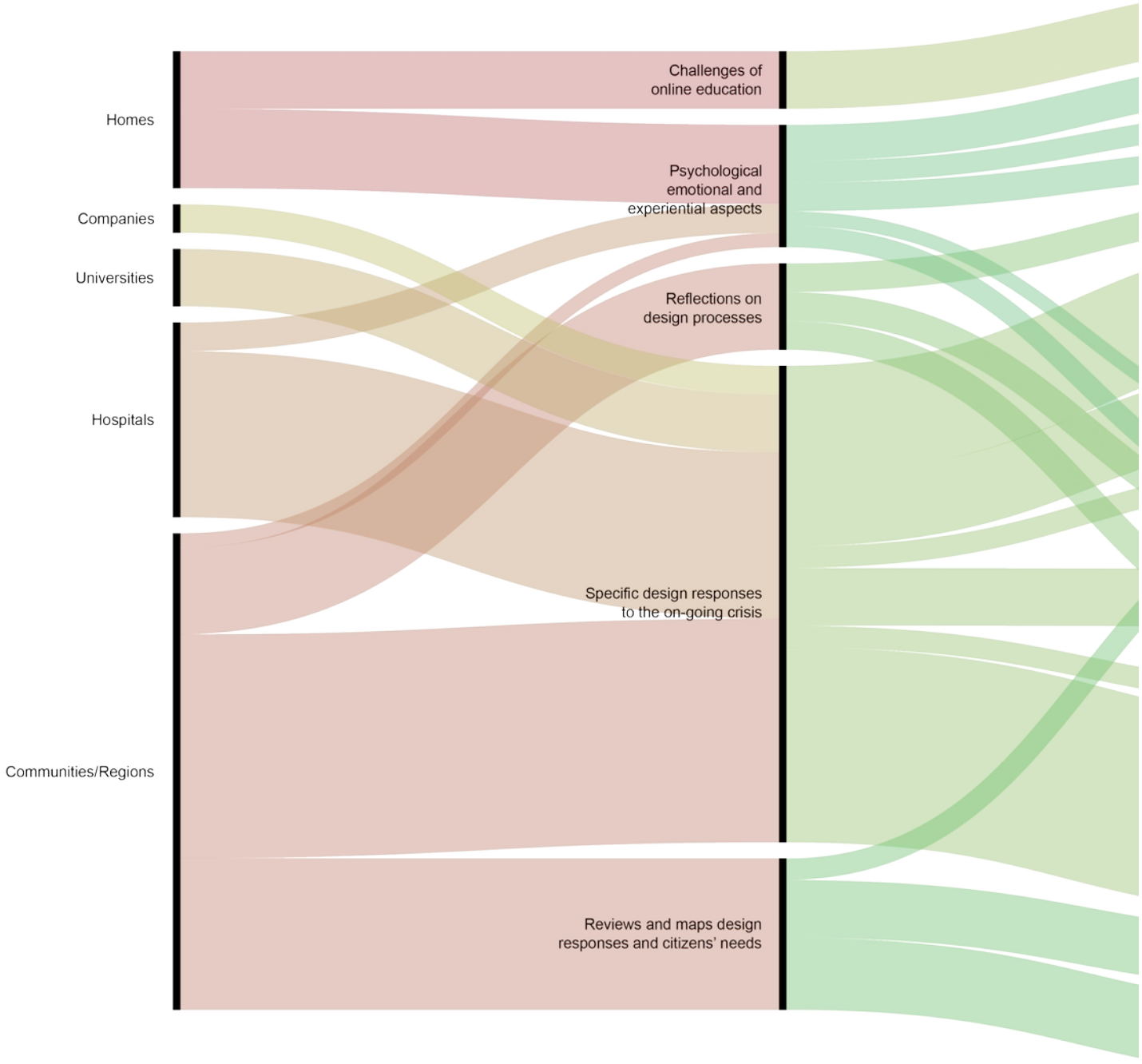

Figure 4: Map of research, design, thematic and geographical relationships composing Part 1.

This map is also useful for readers to apprehend the range of papers found in Part 1. In terms of intervention dimensions, readers will find a significant number of studies focused on *Communities/Regions,* followed by *Homes* and *Hospitals;* these papers will therefore present a comprehensive set of studies focused on the various domains of the discipline: from product design to service design, from design for social innovation to human-centred design,

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from the development of methodological tools to the development of complete sets of design-oriented analyses. Readers of this Special Issue can therefore navigate this map to find the various experimentations and understanding the specific areas of intervention considered by the design community as a first reaction to face the pandemic.

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The next two maps (Figures 5 and 6) have been created with the aim to **simplify the interpretation and the comprehension of papers** contained in this Part 1 in relation to all key topics used for their classification – *Clusters, Concepts Discussed, Main Focus* and *Area/Region of Experimentation* – as well as to give readers the possibility to find and readily

compare the papers using common interpretative lenses that could simplify the analysis of data and the understanding of field experiences.

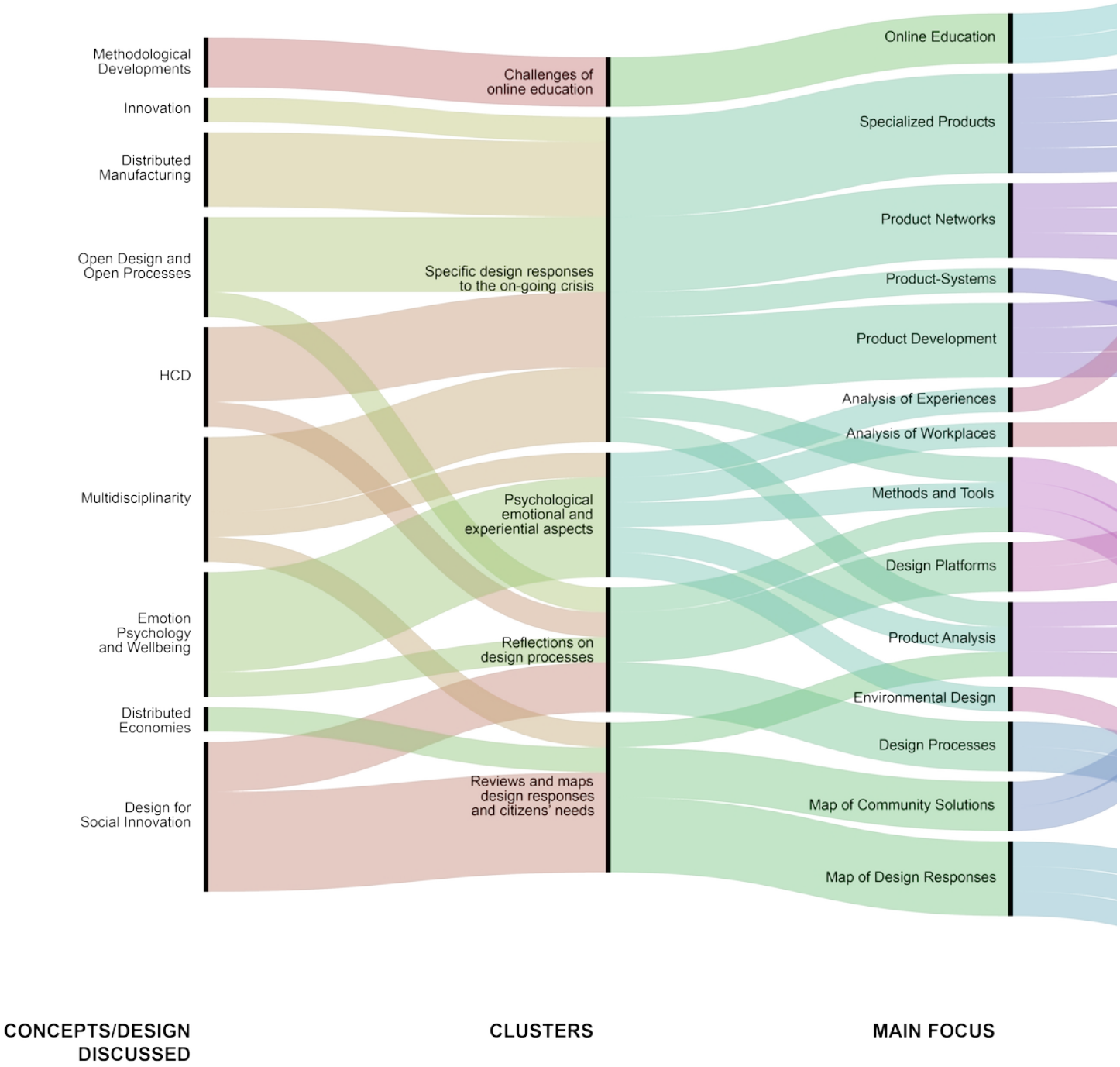

Figure 5: Map of links between papers, Concepts, Clusters and Main Foci.

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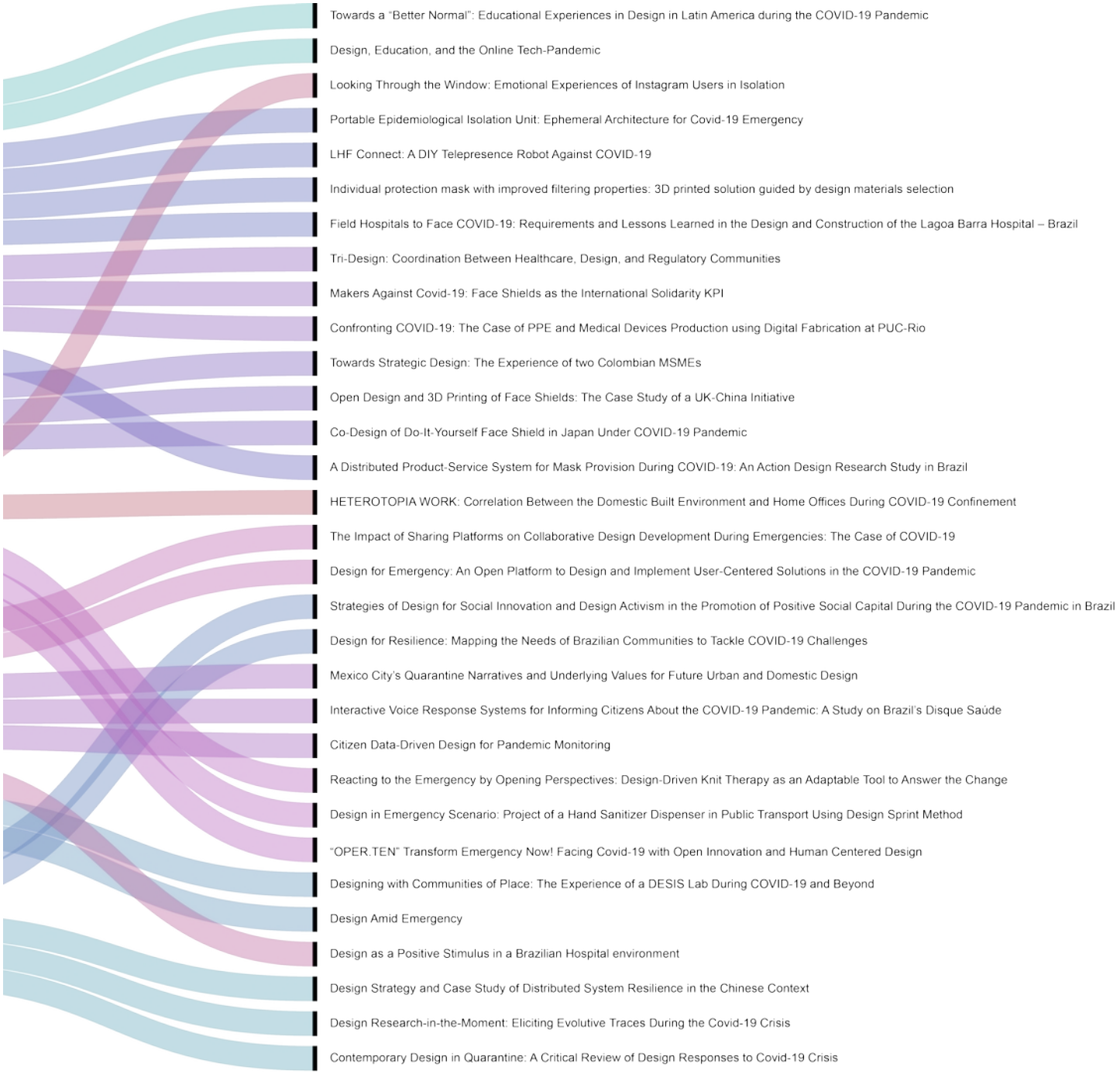

PAPERS

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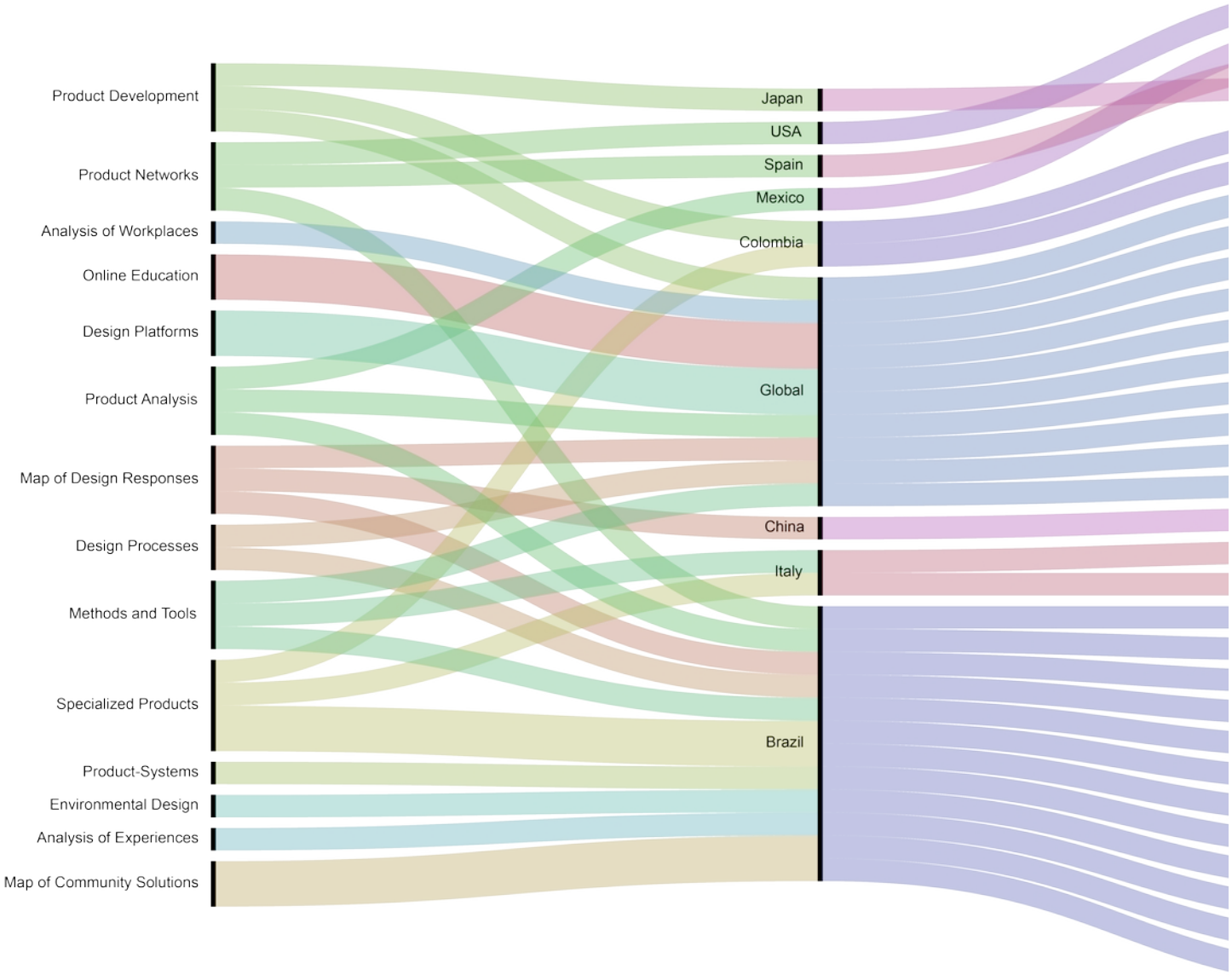

Figure 6: Map of links between papers, Main Foci and Areas/Regions of Experimentation.

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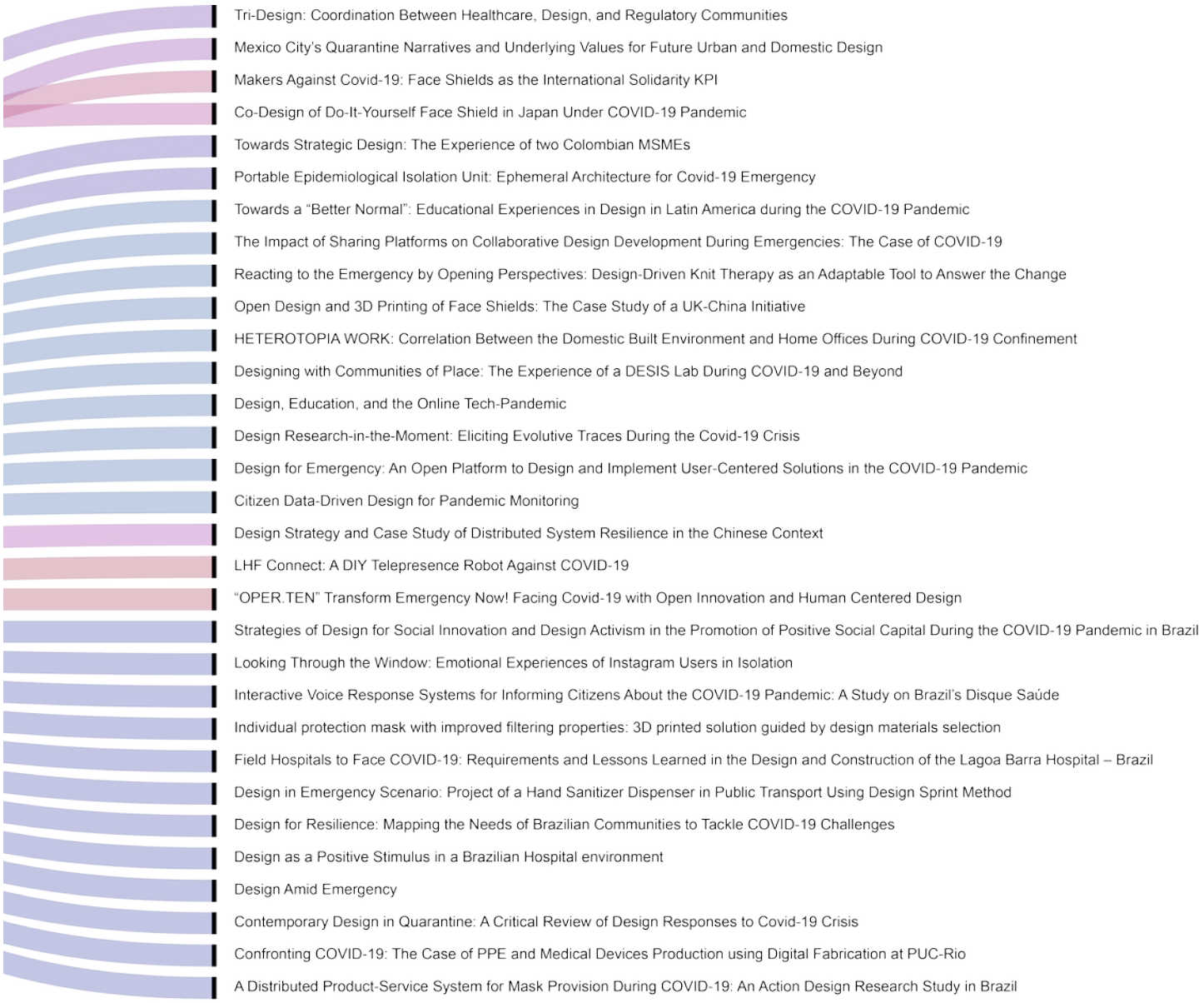

PAPERS

CONCLUDING NOTES ON ARTICLES COMPOSING PART 1

An overall view of these papers points to the conclusion that the pandemic produced a phenomenon of fast tracking various technological and societal changes that were already taking place but otherwise would have taken years to fully occur. The integration of remote working into urban lifestyles, a more intensive use of data-driven design and hybrid approaches for teaching and learning are some examples. At the same time, it shed light on new issues that were not on the radar of the design community.

Foremost, the articles show an active community working around the clock to frame new and complex problems, co-creating solutions with a variety of stakeholders, having limited time to put these ideas into the real world whilst at the same time having to deal with the limitations imposed by social isolation. The frenetic pace of design contributions during the pandemic, linked with the social isolation, provided reduced opportunities for reflection. Thus, this publication provides the necessary space for reflection by registering the lessons learnt during this period. It is a solid contribution to leverage our knowledge on how to

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engage design and designers during a global health crisis. It also provides insights for transition scenarios for the aftermath of the pandemic, with a contribution to build upon what we have learnt so far.

The design community, like any other profession, has been heavily affected by the pandemic. However, the articles presented in this Part 1 show that it was not powerless. When rapid innovation was required to deal with a global scale emergency, design was the discipline that was able to rapidly frame the problem, creatively shape ideas, and connect various fields of knowledge to deliver viable propositions. When the centralized and slow production systems demonstrated their incapacity to deliver results at the speed required by the pandemic, designers brought more distributed strategies for enabling production through digital fabrication. When collaboration and co-creation was necessary at global scale, designers put into place their know-how on open-design approaches, drastically accelerating the speed of knowledge sharing. Without doubt, design demonstrated its capacity to save human lives.

At the same time, the papers illustrate well that the pandemic has forced designers to realize that many assumptions they took for granted in the past were no longer in place: in order to reduce the spread of the virus most designers could not have direct contact with a user apart from digital channels; moving across the city to do a follow-up on the production of a prototype was not advisable; the synchronicity of people-to-people interactions become increasingly difficult if not impossible. This and so many other impossibilities were converted into new possibilities by the creative minds of the design community.

For all these reasons, the guest editors believe that this historical edition in two Parts of the Strategic Design Research Journal is a solid contribution to enrich the scientific debate regarding what we have learnt from the actions taken during the COVID-19 emergency scenario. We hope that this knowledge will contribute to develop further our collective capabilities and readiness to deal with present as well as future global emergencies.

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Carlos Aceves-González	University of Guadalajara, Mexico
Yoko Akama	Royal Melbourne Institute of Technology, Australia
Yekta Bakırlıoğlu	Koç University, Turkey
Martin Baláž	Slovak University of Technology in Bratislava, Slovakia
Débora Baraúna	University of Vale do Rio dos Sinos, Brazil
Marianna Boero	University of Teramo, Italy
Elivio Bonollo	University of Canberra, Australia
Angus Campbell	University of Johannesburg, South Africa
Zuzana Ceresnova	Slovak University of Technology in Bratislava, Slovakia
Paolo Ciuccarelli	Northeastern University, USA

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Hua Dong	Brunel University London, United Kingdom
Benny Ding Leong	The Hong Kong Polytechnic University, China
Albert Fuster	ELISAVA Barcelona School of Design and Engineering, Spain
Claudio Germak	Polytechnic of Turin, Italy
Alison Gwilt	University of New South Wales, Australia
Mugendi M'Rithaa	Cape Peninsula University of Technology, South Africa
Raffaella Massacesi	University of Chieti-Pescara, Italy
Neil Maycroft	University of Lincoln, United Kingdom
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Eugenio Merino	Federal University of Santa Catarina, Brazil
Richie Moalosi	University of Botswana, Botswana
Massimo Musio Sale	University of Genoa, Italy
Farnaz Nickpour	University of Liverpool, United Kingdom
Vesna Popovic	Queensland University of Technology, Australia
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Ravi Mokashi Punekar	Indian Institute of Technology Guwahati, India
Maximiliano Romero	IUAV University of Venice, Italy
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Martijn ten Bhömer	University of Nottingham Ningbo, China
Andrew Thatcher	University of the Witwatersrand, South Africa
Sarah Tranum	Ontario College of Art and Design University, Canada
Rosana Vasques	University of São Paulo, Brazil
Marta Więckowska	Academy of Fine Arts in Katowice, Poland
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Marcia da Silva	University of Vale do Rio dos Sinos, Brazil
Ana Paula dos Santos	University of Vale do Rio dos Sinos, Brazil
Victor Geuer	University of Vale do Rio dos Sinos, Brazil

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ENDORSING PARTNERS

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