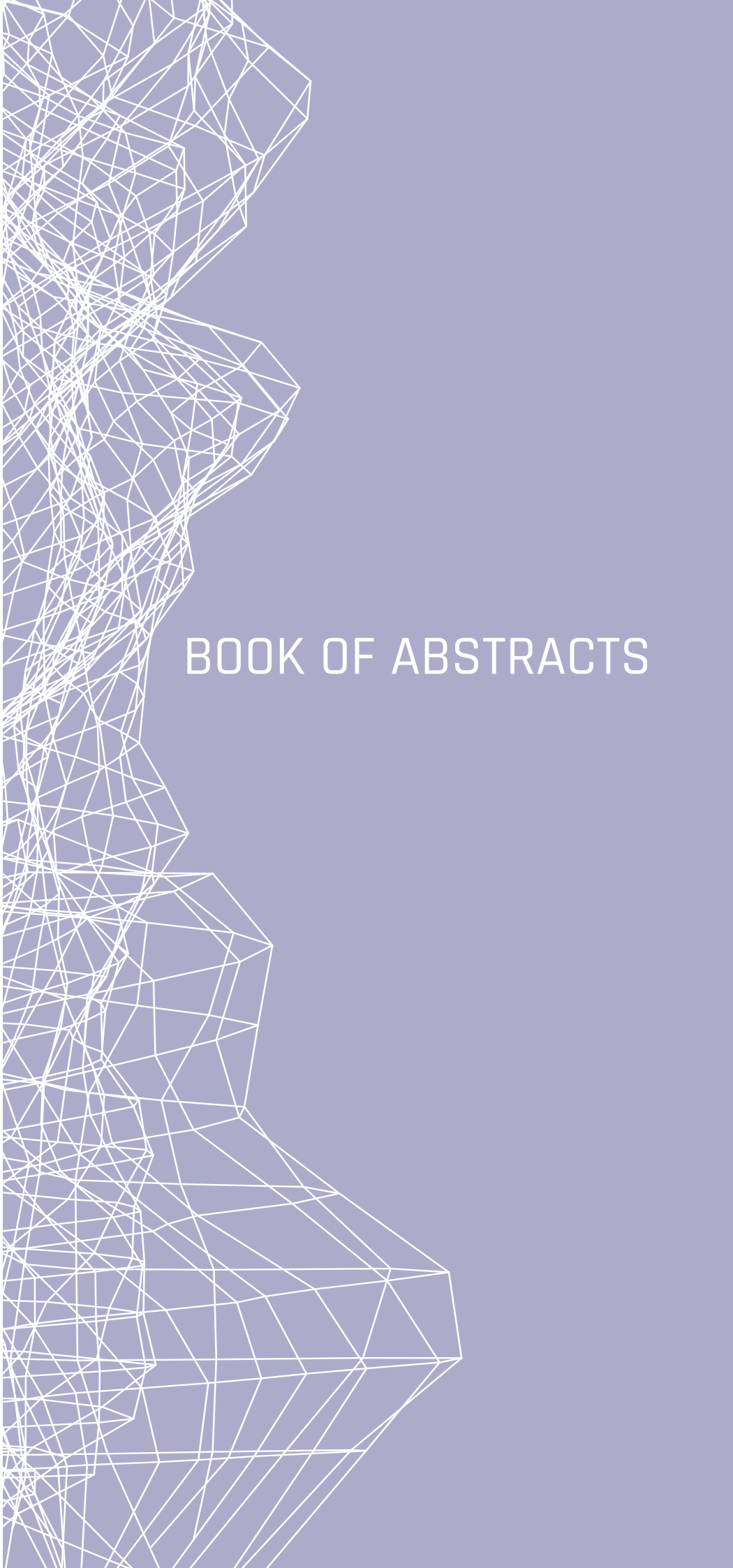
RSD7 2018

RELATING SYSTEMS THINKING AND DESIGN 7th SYMPOSIUM

CHALLENGING COMPLEXITY BY SYSTEMIC DESIGN TOWARDS SUSTAINABILITY



BOOK OF ABSTRACTS

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EDITORIAL

The seventh *Relating Systems Thinking and Design (RSD7) symposium* was held at the Politecnico di Torino, the 23-28 October 2018, for the first time in Italy, defining an important collaboration among the institutions that founded the informal group of Systemic Design Research Network (SDRN) in 2012. Not by chance, this symposium has seen the official establishment of the Systemic Design Association (SDA), with a public announcement during the first day. A new phase of the association and of the RSD symposiums started by proposing an inclusive approach to expand the membership and engage different systems- and design-oriented professionals and researchers, while looking after a strong identity of systemic design as a discipline.

The proceedings show the huge amount of contributions we received from all over the world that have inspired more than 200 people in Turin. The aim was to promote international debate on the multiple applications and purposes on which the systems thinking in design is developed towards sustainability. The symposium generated nurturing interdisciplinary collaborations and discussions, involving academics, designers and professionals. *"Challenging complexity by Systemic Design towards sustainability"* was the leitmotive of all RSD7 starting from the workshops, through the keynotes, the plenaries and the parallel speeches, and closing with the de-conference at Monviso Institute.

Four workshops were organized by international experts, coming from *Smart Circular Economy Network*, *University of Brighton*, *Ellen Mac Arthur Foundation*, *Namahn center* and *ShiftN*. Around 100 attendees had a full day workshop in which they investigated the theme of complexity, declined through different areas: IoT, material/immaterial places, Circular Economy and Systemic Design. At the end of the the day, the workshops' results were shown in a plenary session and discussed all together with a breaking ice kick-off.

From 24th to 26th October, we had the proper symposium with 6 inspiring keynote speakers, 3 plenary sessions, and 76 presentations in the parallels sessions. We evidenced all the contents through abstracts, presentations and working papers, as well as videos and sketch-notes.

The RSD7 keynotes offered an inspiring range of perspectives on systemic design, emerging from different disciplines and experiences from all over the world. They brightly explained how Systemic Design can effectively integrate systems thinking with design to address complexity, by creating new resilient and sustainable systems in very diverse contexts. We decided to interview them and provide to the whole community a short video to have a glance of their contribution.

The plenary speakers were invited to explore special themes of interest for the community: the newborn Systemic Design Association, the pioneering activities run by Ellen Mac Arthur Foundation and the stimulating Systemic Design Toolkit.

The presentations in parallel sessions were dense and reflected the tracks we proposed. Here we have condensed the wide variety of contributions:

- **Policy design and decision-making** (Innovation in territorial governance, Strategies for sustainable innovation, Design thinking for decision-making, Democracy and responsibility);
- **Industrial Processes and Agrifood Systems** (Industrial ecology in a Circular Economy, Sustainable innovation in industrial development, Sustainabili-

ty of agro-industrial systems);
- **Socio-technical Systems in the Digital Age** (User interaction and enhancement in the age of AI and autonomy, Internet of Things for sustainability, Information technologies in the design domain, Systemic Design for learning from data);
- **Territorial Metabolism and flourishing economies** (Local resources innovation transitioning to a Circular Economy, Sustainable development of regions and bioregions, City metabolism and urban ecologies, Interdisciplinary models for economy-design, New ways of communicating economic systems)
- **Social Care and Health Systems for Sustainable Living** (Sustainable innovation for health systems, Patient empowerment and caregiving, Systemic innovation in social care, Social Flourishing & Cultural Sustainability);
- **Models and Processes of Systemic Design** (Systemic Design theories, Innovation processes in complex systems, Systems and design thinking in education, Historical perspectives on Systemic Design).

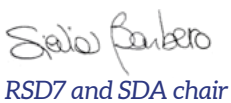
The process to select the best presentations was crucial and it required double (and in some case triple or more) reviews, trying to provide a wider spectrum of experiences. In the end, the success rate was 48%. About two third of the presenters have submitted working papers.

The conference was also enriched by the exhibition "Visualizing Complex Systems". The ability to collect, cross-check, visualize and study quantitative and qualitative information about phenomena and their patterns is itself at the core of the project, becoming strategic for enabling new systems thinking and their design application. Identifying the relationship between components, thus guaranteeing personal expression, horizontal communication and visual thinking, is the first step to enhance a more conscious and transparent decision-making process with a perspective of sustainability.

During the 7th edition of RSD we also experienced some moments of relaxed "learning-and-doing time", during the "Books and Beers" events and the De Conference Event. In fact, at the end of each day, 3 decompressing "Books and Beers" were hosted in the close venue of Eataly. On that occasion, 5 recently published books were introduced to the audience and discussed in a more informal environment.

After the conventional RSD symposium, for the first time in its history, we proposed a 2-days De-Conference event, to favour networking, deepen conference topics and have a relaxed "learning-and-doing" time in a beautiful natural environment. It took place at MonViso Institute, in the community of Ostana, and it was organised in collaboration with ETH Zürich.

Lastly, I would like to take the chance of this publication to thank the international scientific committee because in the preparation phase they always pushed me towards higher and higher goals. A special thank goes to all the keynote speakers to have been central actors of this conference, sharing their inspiring experiences and knowledge. Finally, I would like to thank the local organizing committee because they supported me in every request and with great confidence in our capacity.



RSD7 and SDA chair

Turin, 29.03.19

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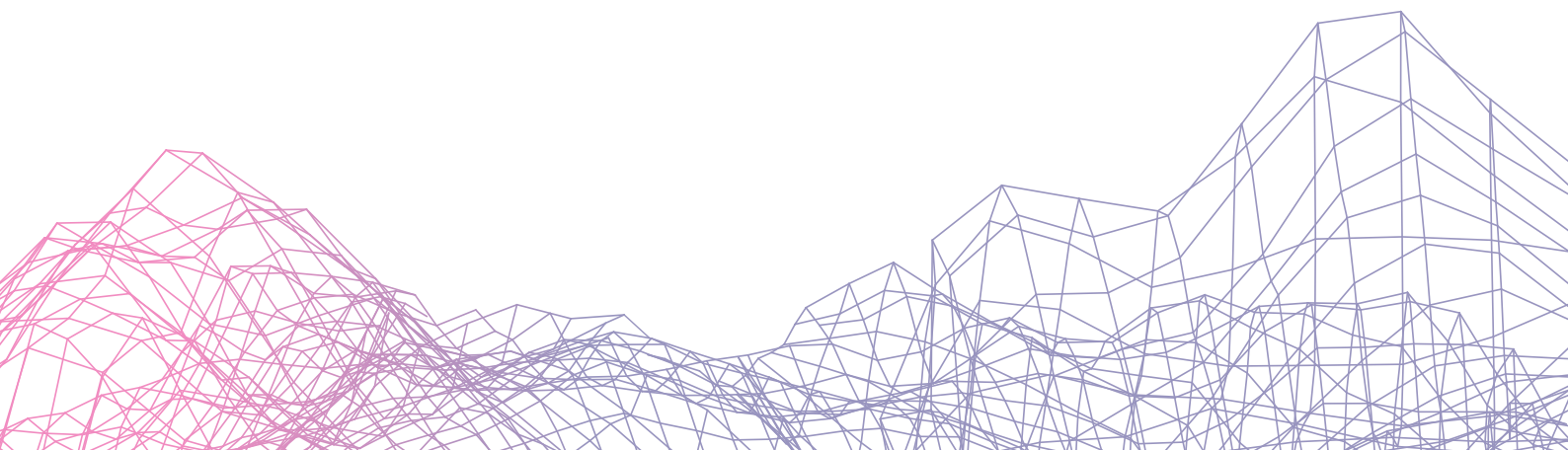
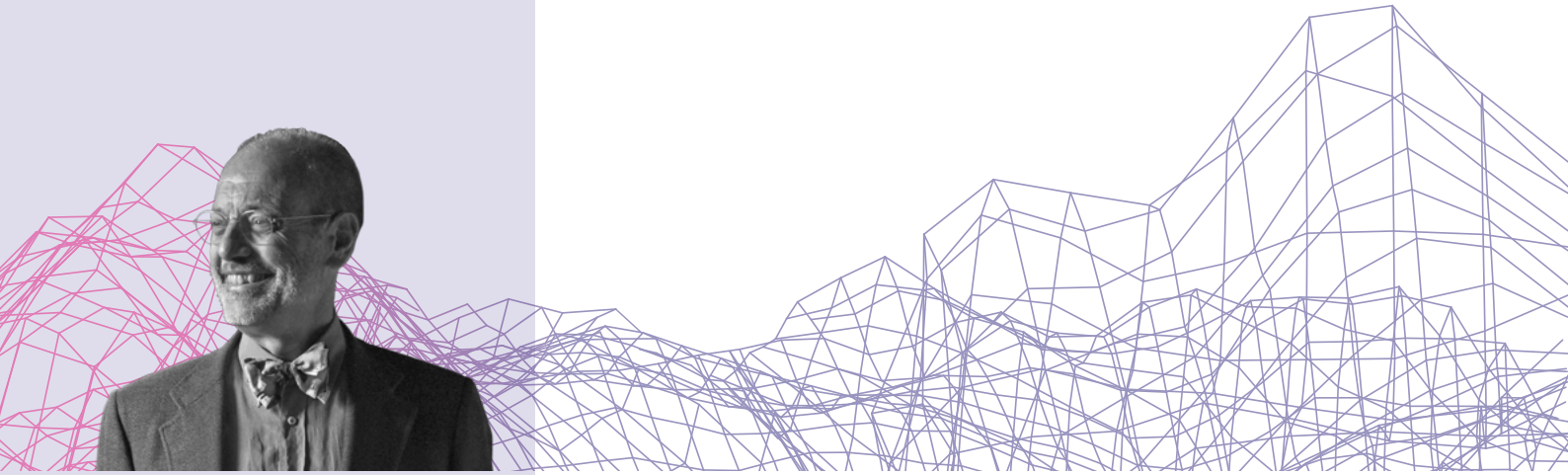
KEYNOTE SPEAKERS





Luigi Bistagnino

Systemic Approach generates a new cultural paradigm

Luigi Bistagnino is an architect and designer, based in Turin, Italy. Founder of the research group on Systemic Design at Politecnico di Torino (POLITO) aimed at developing products and processes in order to obtain zero emissions. He is founder of the Systemic Approach Foundation (www.systemicfoundation.org.) and he contributed with numerous essays and articles to many important national and international journals. He designed objects currently in production and won national and international design prizes such as "Il Compasso d'Oro ADI". Among his main publications: Systemic Design, Slow Food (2011); microMACRO, Edizioni Ambiente (2016).

KEYWORDS: Systemic Approach, Mutual Relationships, Input - Output

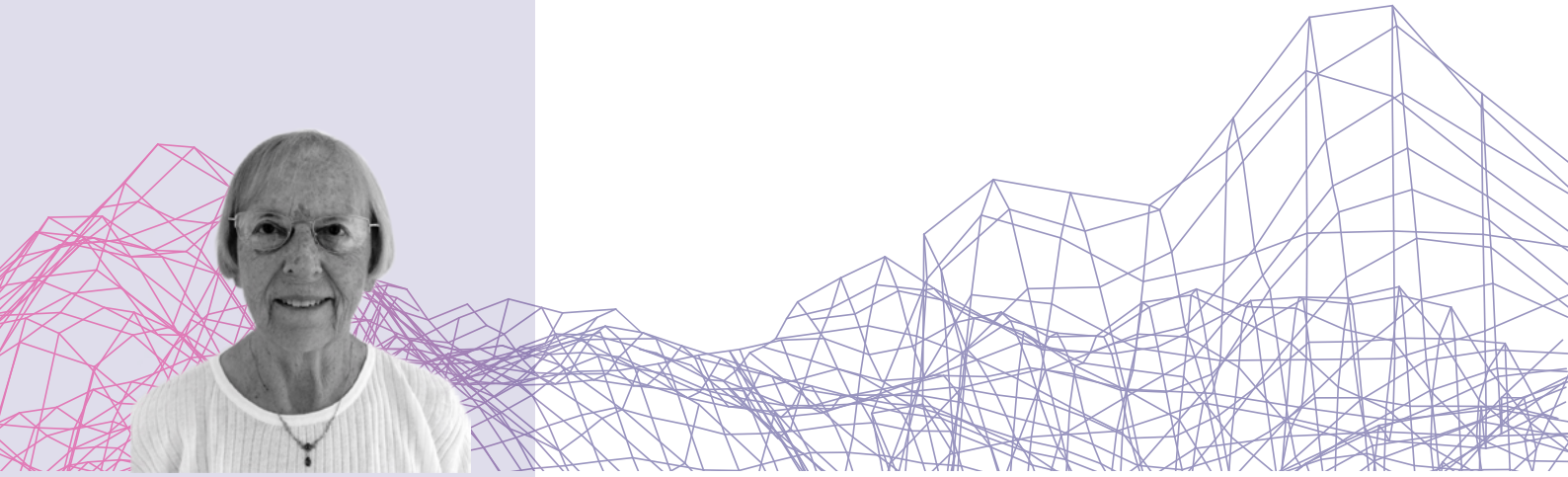
The Fibonacci's sequence (also called "golden ratio"), indicates a sequence such that each number, starting from the third, is the sum of the previous two. The beginning of the sequence is thus:

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1.597, 2.584, 4.181, 6.765, 10.946. 17.711, 28.647 ...

This sequence (present in various natural forms such as in beehives, in the arrangement of leaves on a branch, in sunflower seeds and in the development of the shell spirals) surprises us with its rapid development, which quickly achieves truly considerable numbers. Each number represents itself a quantity, or a specific dimension, which however acquires a different value in the whole of its continuous additive relationships. In the same way, the actions we daily perform seem to concern only us or a limited area of interest. Rather, they are part of a totality of actions that grow on a context, from a little region to the whole world. On that view of mutual relationships, the value of what we do is essential and the approach we have becomes fundamental. If we adopt an individual perspective, people, things and situations will be separated both from each other and from their context, generating acquisitions, strong contrasts, conflicts, speculations and destruction. On the other hand, by achieving a more spontaneous vision of relationships with the others and the surroundings, a new positive system of life and use of resources is obtained, aiming at the common good and not just at the individual.

The Systemic Approach, in fact, is a new way of acting based on two simple guidelines:
- to activate positive relationships between the various subjects (people, activities),
- to manage resources, so that the outputs of a system are the input of another one.

In this way, the totality of relationships and flows of matter in transformation generates a new social, cultural, ethical and productive system. This will create a new economy in which everyone is involved and actively participates. Consider the relationships in a collaborative way connects the single units into a cohesive whole, in which the strength of all becomes the strength of each one. The different components, linked in collective action, perform a single little action that exponentially becomes great.



Pille Bunnell

With a Grain of Salt

Pille Bunnell is a systems ecologist and a second order cybernetician specialised in the integration and explanation of complex concerns. Pille worked with Holling applying Adaptive Environmental Management before becoming the Director of Environmental Literacy for ESSA Technologies Ltd. She became involved with the American Society of Cybernetics (President for 3 years), worked with Maturana and began writing and teaching. Pille is particularly interested in the implications of thinking and acting in a second order science epistemology, and thus continues to explores the ramifications of how our premises and path determines how we relate to each other and the world around us.

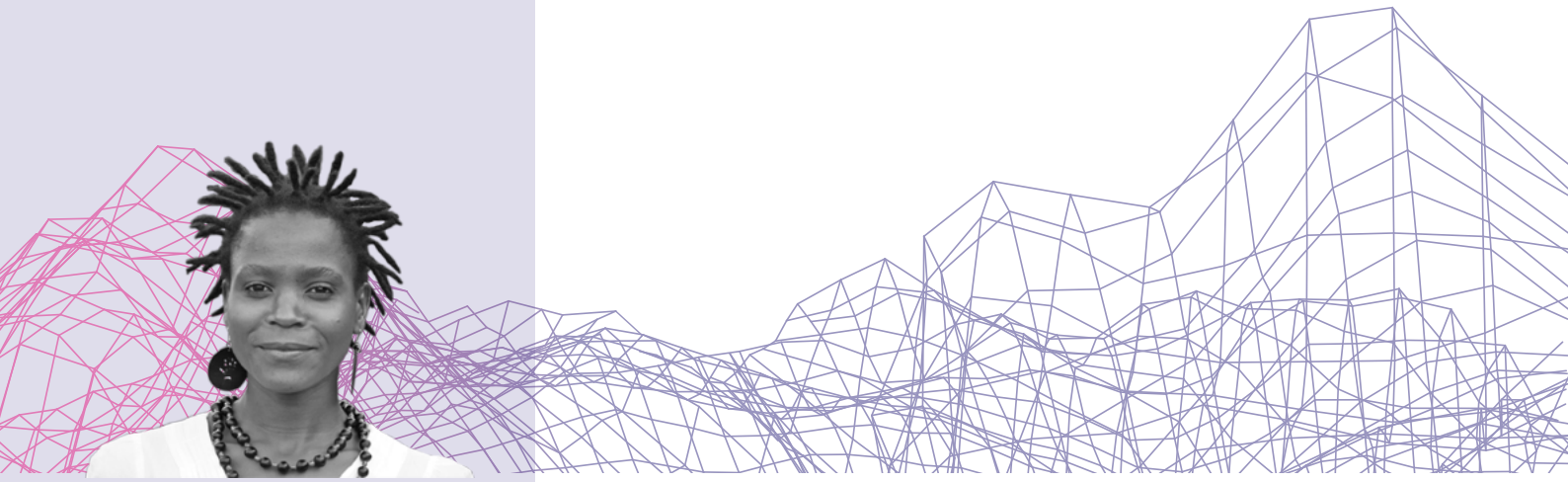
Keywords: Adaptive Cycle, Resilience, Panarchy, Reality, Reflection

My intent with the title is to evoke a listening through the double meaning of "salis" implicit in Pliny's original phrase "addito salis grano." The word "salis" not only refers salt, it also refers to wit. I am exploring the idea that acting with wit and intelligence means we should not take our models of the world too seriously. Models and frameworks enable us to make sense in the same way that a map helps us navigate, but unlike physical maps where there is a correspondence between land and notation, our conceptual territories are cultural and dynamic, so our maps (models, frameworks) should be used with a grain of salt and we should be willing to adapt them. This adaptive cognitive process is evident in the evolution of ideas related to the adaptive cycle, namely around patterns of the development and disintegration of systems.

I thus follow the evolution of some of the insights associated with the adaptive cycle. Resilient systems arise through an interplay of transformation and persistence in a shifting balance between the internal connections required for the system to be a system, and the external ones that enable it to persist in a context. As systems arise and disintegrate they do so embedded in and interacting with other dynamic systems at other spatial and temporal scales. As they intersect and interact they become a panarchy rather than a hierarchy.

As a second thread I weave in an awareness that we humans are the ones who develop the concepts that I present, (including this one about developing concepts) and that we do this through our recursive and recurrent consensual coordinations of actions and ideas in language and culture. In tracing how we may have developed ever more complex sets of distinctions and how we live these as our various realities, I note that we can easily find ourselves living in a name-based and somewhat rigid sense of reality. Thus our realities may also be seen to exist as adaptive cycles. Further, in any of these realities those regularities of experience that are not named disappear from our thinking and are very difficult to re-evoke or define in language. However, I note that our cognitive abilities are not limited to language, we also exist in an internal panarchy of relationships that resonate with the external panarchy in ways that we may become aware of as we implicitly operate in a panarchic interplay of design cycles.

I conclude the presentation with a deeply held desire. I would like us humans to remain the kind of beings who live in reflexive awareness of our systemic dynamic flow in a relational embeddedness.



Chido Govera

The Future of Hope: Social care for sustainable living

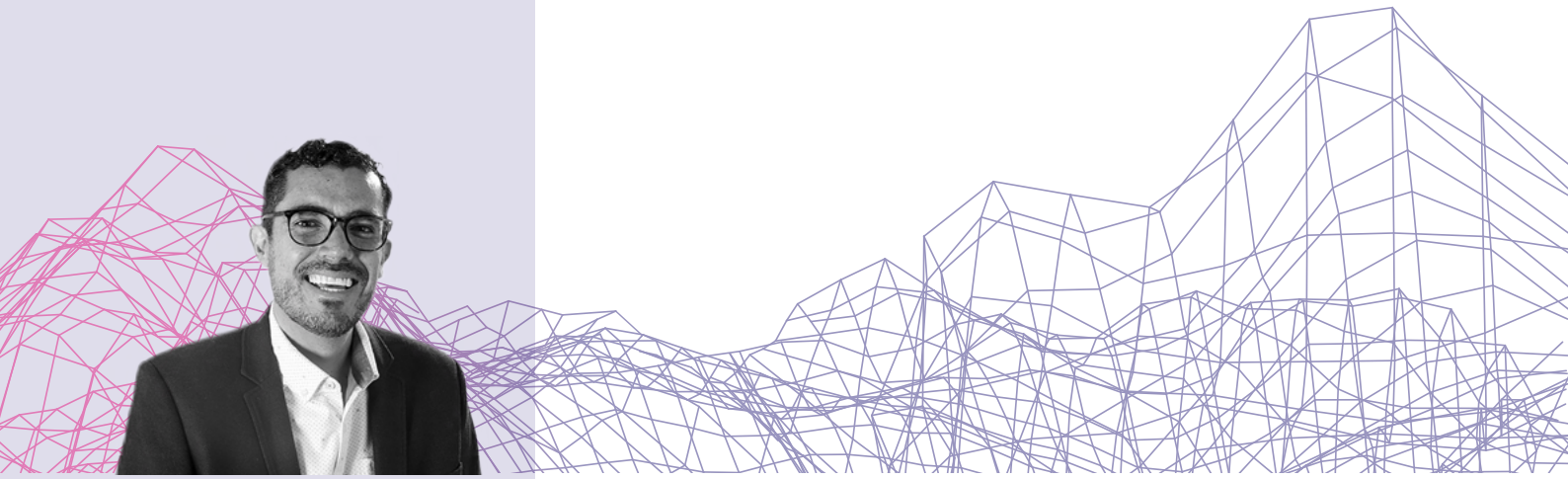
Chido Govera is a farmer, human rights campaigner, and founder of "The Future of Hope Foundation" (Zimbabwe). She has promoted mushroom cultivation as a sustainable source of food and income in impoverished regions, focusing on zero waste. Very active in the network of Blue Economy, she brings the vision of system thinking in developing countries. Over the years, Chido reached out to more than 1.000 orphans and women in communities in Africa and all over the world. Today her dream is to inspire people from these countries to become change agents for a better society by taking responsibility for changing their circumstances.

KEYWORDS: Design for all, Sustainable Living, Sustainable business model, Agro-biomass, Community.

The presentation explores approaches and interventions implemented by The Future of Hope Foundation (TFoHF) to engage marginalized members of society, specifically women and girls in Zimbabwe. With limited resources and many heavy responsibilities as well as lack of exposure to innovative initiatives, vulnerable women, girls and orphans in communities are unable to engage in socio-economic development and to reach their full potential. They are in a continuous struggle just to survive. In a country where almost 10% of the population is orphans, 70% of the population lives in extreme poverty and political and economic turmoil are on the rise there is need for innovative interventions to enable these vulnerable groups to sufficiently provide for their primary needs and concerns as this is the foundation to achieve sustainable living.

TFoHF leverages agro-biomass, the most abundant resource in most poor communities, to secure sustainable livelihoods and incomes through their Mushroom based Integrated Food Production System (Mushroom based IFPS). The Mushroom based IFPS addresses many challenges facing vulnerable women and girls. Of special note are issues relating to land ownership, control of own food and income source as well as access to market. By harnessing the power of collaboration, TFoHF is able to mobilize community women as mentors for young girls orphans and community leaders to support community Mushroom based initiatives from initiation stage to market linkages. These collaborations provide the base for building healthy Communities where children, women and all of life, can thrive in peace, freedom and happiness - healthy Communities that nurture and promote good ethics, good education, good health and care for the natural ecosystems. Responsible engagement, accountability and proactivity are modeled and prioritized over self-pity and victimhood.

To date, TFoHF has reached over 2000 people in Zimbabwe and built a model that can be easily replicable across the African continent and beyond. The work carried out over the years does not only serve to mark an end to victimhood through responsibly engaging orphans and vulnerable groups to become change agents and leaders but, it provides basis for research and further improvements of this initiative that has such great potential.



Roberto Iñiguez Flores

Advanced Design cultures, a learning system perspective

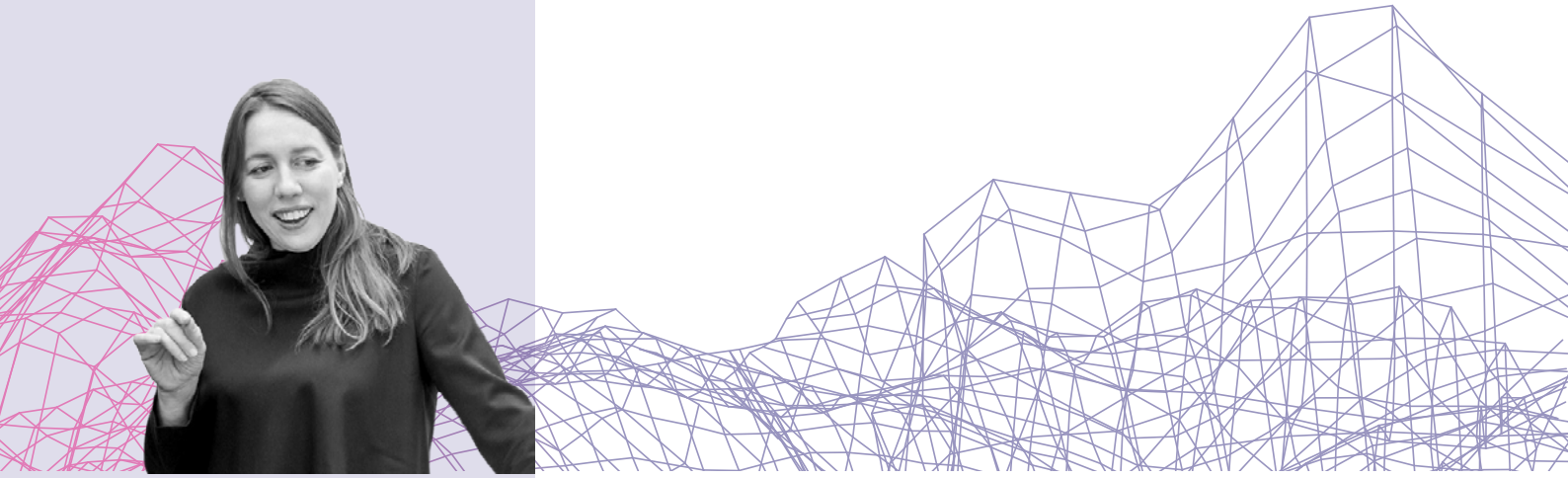
Roberto Iñiguez Flores is dean of the School of Architecture, Art and Design of Tecnológico de Monterrey in Mexico. Designer and consultant with more than twenty years of experience in innovation for industrial sectors. Member of different academic boards and Conferences: Project Oriented Learning Environment (POLE) global platform, the London Design Embassy, the Latin Design Network, the European Academy of Design, the Systems and Design Network, etc. His research focuses on the Advanced Design cultures, with particular interest on anticipatory processes, the relations between systems and design, and how individuals and organizations develop "advanced" design competencies.

KEYWORDS: Advanced Design, Design Knowledge, Design Processes, Systemic Design

During the past decades the praxis of design has been extended, it has been increasing its areas of focus, from its traditional territories of a problem-solving activity that shapes products, communication and environments, to a broader practice that approaches more complex subjects, such as the social, territorial and organizational issues. In order to address the complexity of these new approaches design is evolving into a new cultures that are very diverse and emergent, these design cultures require a new characterization for its understanding. A way to approach this phenomenon is to observe the areas of focus or the "new" outputs that these practices are producing, certainly some authors have pointed out on these possible two ways to give understanding about them; I propose a third way to approach this issue, focused on its processes, carrying out qualitative and quantitative research methods to give understanding on how these advanced design cultures are generating new kind of design processes.

Some of the keys to give light on the advanced design processes are anticipation, strategies and competencies; advanced design processes are more anticipatory, they have a longer-term look because the design focus is on paradigms changing, they operate in the strategy level, because they switch from the traditional problem-solving approach to an opportunity-finding approach, and by doing this anticipatory, strategic processes they require (and develop) new skill and competencies. These advanced design competencies can be discriminated from the traditional design competencies, by using a learning system perspective we can be able to comprehend how design operates on this extended (or advanced) territories, and how individuals, groups and organization develop knowledge and expertise from its practices.

Making a historical review on the different points of view about design learning, this conference go from the seminal approaches of Schön´s reflection-in-action postulates, passing through the design management approaches form the 90´s, and Nelson´s expertise propositions, or Cross and Leifer design thinking examinations, this conference presents the framework for the competencies and knowledge generation inside the design processes. And by introducing the systems and information theory references presents a series of tools to observe and understand the phenomena of learning situated within the confines of the advanced design cultures.



Chelsea Mauldin

Policy Design & Decision Making

Chelsea Mauldin is a social scientist and designer with a focus on government innovation. She directs the Public Policy Lab, a New York City NGO that partners with government agencies to design better public policy and social services with low-income and at-risk Americans. Public Policy Lab projects include efforts to improve New York City's social housing application process, design family-friendly transportation services for students with disabilities, create new policy for digital service delivery, expand access to mental-health care, better help in-need families with public-benefits enrollment and the application of human-centered methods to homeless services.

KEYWORDS: Policy-design; Decision Making; Public Policy Lab; Social services; Co-design

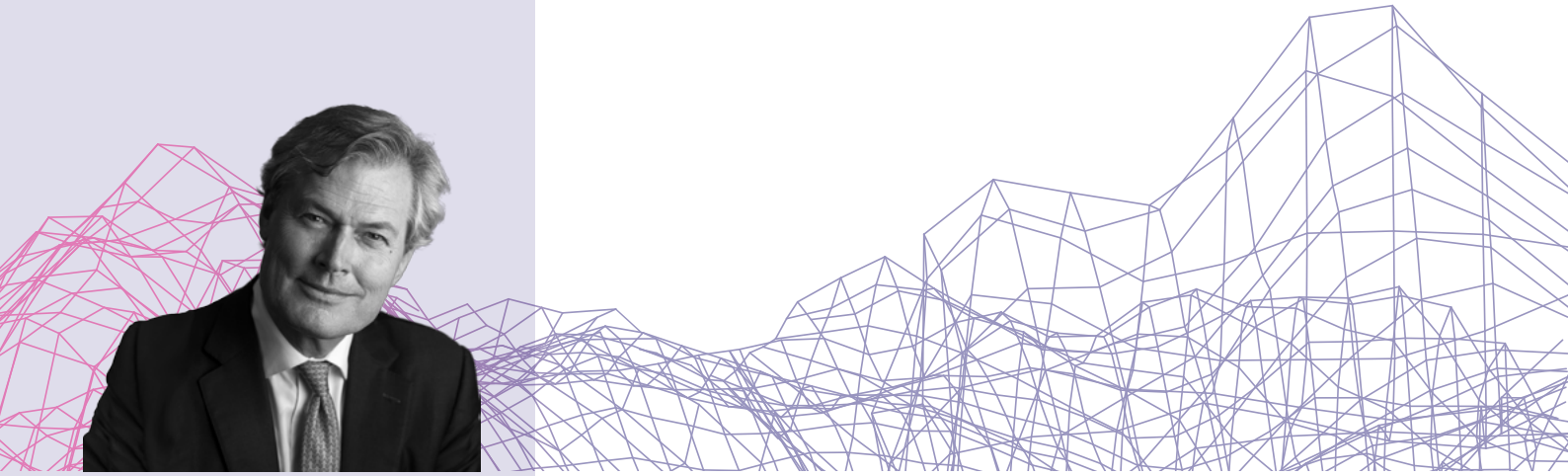
There's a gap between the intended outcomes of policies and the lived experiences of people affected by those policies. This gap arises, in part, from differences in the decision-making of policymakers and members of the public. Policymakers are empowered – they control public resources and have a mandate to deliver services. Their professional training and the culture of government tends to be progress-minded, rational, and technocratic.

Meanwhile, the public they serve is often disempowered – by class, race, neighborhood, or life circumstance. Even privileged citizens often have limited engagement with government decision-making. Further, members of the public approach policy issues pragmatically, informed by both their cognitive load and their biological experience – both factors that policy is often loath to engage.

I discussed how designers attempt to bridge this gap though interventions in the policy decision-making cycle – from preliminary problem recognition and agenda setting to policy implementation and evaluation – with specific reference to Public Policy Lab's work with veterans dealing with mental-health issues, with low-income families seeking social services, and with applicants to social/affordable housing.

Next I described shortfalls of current design interventions in policy and service-delivery systems. First, designers often amplify complexity – but complexity burdens the poor, who have fewer resources to spend navigating it. Second, designers seek to reform the state's engagement with the public, but replicate the state's extractive posture: we collect peoples' stories, harvest their life experiences for our gain, even engage them in co-design, where their labor becomes our deliverable. Third, by working inside systems, designers accept status quo inequality. At our best, we engage in meaningful research and design with marginalized peoples. But collaboration does not compensate for systemic racism and poverty.

To conclude, I proposed that designers engaged in policy and systems change design new, adjacent policy systems, rather than to continue to renovate broken policies; recognize the primacy and requirements of the human body, as mechanism through which people engage with and are affected by policy systems; and more consciously identify and address imbalances in power in the systems in which we intercede.



Gunter Pauli

Re-designing the framework: think natural, think local

Gunter Pauli is a entrepreneur and economist, he was the founder and Chairman of more than ten companies worldwide. His entrepreneurial activities span business, culture, science, politics and the environment. He started the Global ZERI foundation that redesign production and consumption into clusters of industries inspired by natural systems. His visionary approach of "Blue Economy", has landed him to be visiting lecturer and professor at universities, as well as advisor for governments and industries worldwide. Gunter has a doctorate in System Design and he is a member of the Club of Rome. He has published 20 books translated in more than 30 languages, the last one is "The Third Dimension", and 365 fables bringing science and emotions to children.

KEYWORDS: Advanced Design, Design Knowledge, Design Processes, Systemic Design

During the past decades the praxis of design has been extended, it has been increasing its areas of focus, from its traditional territories of a problem-solving activity that shapes products, communication and environments, to a broader practice that approaches more complex subjects, such as the social, territorial and organizational issues. In order to address the complexity of these new approaches design is evolving into a new cultures that are very diverse and emergent, these design cultures require a new characterization for its understanding. A way to approach this phenomenon is to observe the areas of focus or the "new" outputs that these practices are producing, certainly some authors have pointed out on these possible two ways to give understanding about them; I propose a third way to approach this issue, focused on its processes, carrying out qualitative and quantitative research methods to give understanding on how these advanced design cultures are generating new kind of design processes.

Some of the keys to give light on the advanced design processes are anticipation, strategies and competencies; advanced design processes are more anticipatory, they have a longer-term look because the design focus is on paradigms changing, they operate in the strategy level, because they switch from the traditional problem-solving approach to an opportunity-finding approach, and by doing this anticipatory, strategic processes they require (and develop) new skill and competencies. These advanced design competencies can be discriminated from the traditional design competencies, by using a learning system perspective we can be able to comprehend how design operates on this extended (or advanced) territories, and how individuals, groups and organization develop knowledge and expertise from its practices.

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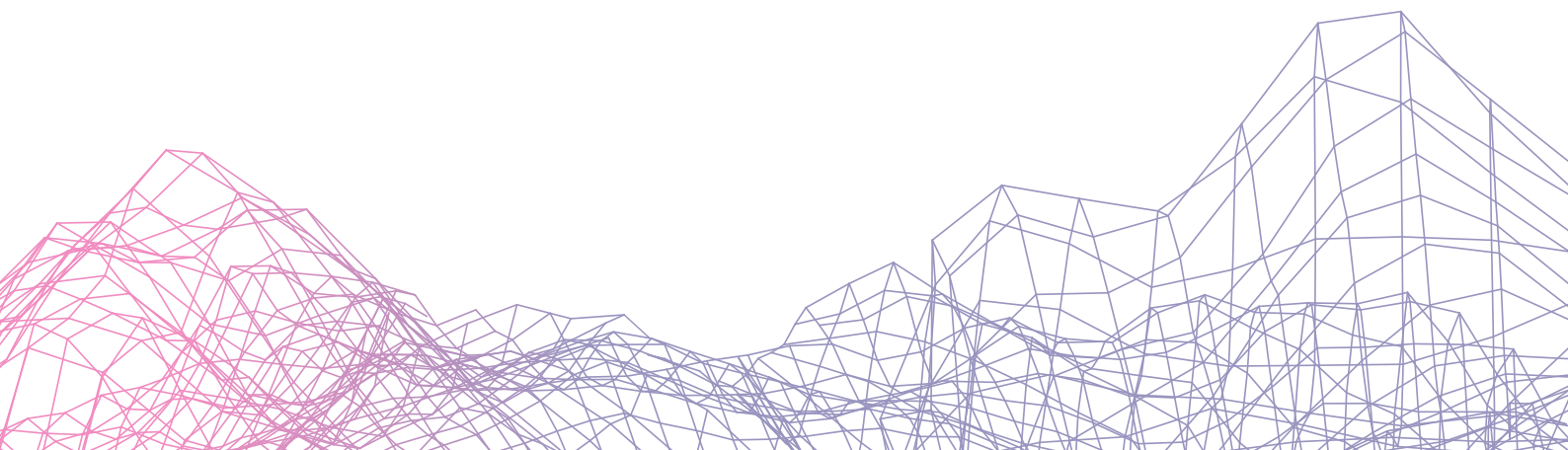
2 | INDUSTRIAL PROCESSES AND AGRI-FOOD SYSTEMS



Natural fibers insulation panels: an adaptive production

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KEYWORDS
LCA;
Sheep wool;
Hemp;
Insulation panels;
Circular economy;
Textile fibers.

The research team recently developed an innovative system with low environmental impact for the production of semi-rigid panels for thermal and acoustic insulation, obtained from recycled sheep's wool, from Piemonte region (Cartonlana insulation panel). Starting from the previous work, a new semi-rigid panel has been produced, combining sheep wool with hemp technical fibers (Fitness insulation panel). The researches activities have been developed by a multidisciplinary group, which includes a textile company, Davifil (owner of the Cartonlana patent), the Biella CNR ISMAC (specialized in macromolecules and the textile fibres), the Department of Architecture and Design - Politecnico di Torino (expert in low-environmental-impact building components), and Assocanapa, which promotes the cultivation and valorisation of hemp.
Both the sheep wool and the hemp used for the insulation panel production derive from agri-food systems and are wastes from already existing production chains. Wool comes from Piemonte region sheep breeding; it cannot be used in textile industry, due to its dark color and/or poor quality: fibers are too thick, and irregular length also. Sheep wool is usually washed and dried, but still contains plant debris trapped amongst fibers. As for hemp, treatments on the raw wool are reduced to a minimum, in order to minimize the energy consumption for the production of the panels.

Cartonlana and fitness

The panels have two main innovative features: unlike the already existing hemp and wool insulation mats, they are semi-rigid products and they has a low environmental impact, as shown by the Life Cycle Assessment. Their stiffness comes from the production process, where the keratin of wool fibers works as a binding matrix and constitutes a rigid structure. The panels have been tested to measure their thermal and acoustic absorption, both in the laboratory and in real use conditions, demonstrating excellent performance, in line with the natural products currently on the market. In particular, the laboratory measurements showed a thermal conductivity of 0,041 W/mK for Cartonlana and 0,040 W/mK for Fitness. As for the sound absorption coefficient, Fitness panels have a better performance (aw=0,75 MH compared to aw=0,55 MH of Cartonlana).

Starting from that experiences, a further phase of experimentation of the production process of insulating materials is being implemented, in order to improve the degree of adaptability to the real availability of wasted natural fibers from local agri-food systems. The objective is to create and test an "open recipe" for insulation panels production, able to keep as low as possible the environmental impact, thanks to the adaptive use of natural fibers available in a specific context and time.

New panels, as those already tested by the research group, consist of two main components:
- a "matrix" based on sheep's wool chemically treated according to a process patented by the research group capable of constituting the rigid keratin structure of the insulating panel;
- a "charge", made up of waste materials and by-products of textile and agri-food chains; natural fibers that are not used on the market, but also artificial waste materials.

In the "open recipe" the binding matrix (sheep wool) is mixed with different quantities and proportions of the "charge", fixing the appropriate rules and variables to keep the thermal and acoustic performances suitable for the use

in building sector as insulations.

The "charge", a selection based on "low environmental impact" requirements

With the aim of keeping the environmental impact related to the production of the panels low and with a view to circular economy, it has been suggested the use, as "charge" selected with the intent to explore the possibility of obtaining panels with different performances.
The contribution presents the methodology adopted for the research in progress, the "open" Technology Assessment to be adopted for the production of the panels.

For the "charges" selections, to be tested in the new thermal-acoustic insulation panels, the research group defined some principles, in order to keep as low as possible the environmental impact of the insulation panel. The selection was oriented to:
- wasted materials, from already existing production chains in the reference territory, where sheep wool is available but currently discarded;
- materials without any others specific uses;
- materials available in sufficient quantities in the reference area, without any economic value for producers;
- natural materials, in order to facilitate the end-of-life disposal, assuming, ultimately, a thermo- valorization as biomass scenario;
- preferably fibrous materials, or however easily aggregable with wool fibers, in order to produce panels with an homogeneous composition.

Considering these requirements, the research group selected the following materials as possible alternatives: corn bracts, dried bean plant - referring to the Piedmont region territory - and almonds shells - referring to Puglia region. Therefore a production-chain study and an availability scenario, in parallel to the production of panel specimens, have been developed.

Corn bracts can be considered a by-product of corn cultivation harvesting and are single sheath leaves, protecting the corn female inflorescence, an ear that grows sideways to the stem, at the height of the 6-7th node below the male inflorescence (Università di Sassari, Dipartimento di Agraria). Corn plants generally present a single ear 10 – 20 long, but occasionally can reach 42 cm longness, and 3– 5 cm large (Assomais), carrying about 1000 dry one-seeded fruit, the caryopsis, each. The female inflorescence is supported by a peduncle generating the bracts, generally in number of 5-6 each flower and representing about 7% by weight of a mature whole corn plant.

Corn is highly widespread in North Italy, while Piedmont is one of the four regions with the highest corn production in Italy, with a production area of about 148,855 ha (ISTAT 2016) and a 1,441.5 thousands tons of crop yield, despite suffering a sensible decrease of cultivation area of about 33%, after 2014. In Italy, corn harvesting happens in September-October, generally using a combine harvester machine. A square meter corn plantation area is likely to make about 6-8 corn ears, about 30 – 48 bracts, 40 – 65 t/ha of chopped plant, in north Italy. As a corn plantation by-product, bracts have quite no use, excepting, together with other corn residues, as biomass and boilers fuel. Moreover the large widespread on the regional area, its fibrous nature and low protein content, make it a potentially interesting product to be tested as a "charge" for the panels recipe.

Almond is a deciduous tree of medium height (from 5 to 7 metres in its adulthood) and slow rate of growth but very long-lived. It generally goes into production around the age of 5 and achieves maximum productivity no earlier than 20 years of age. It well tolerates drought and high temperatures in summer and adapts to dry and poor soils. Its fruit is an ovoid and elongated drupe, with a fleshy, light green coloured and hairy (sometimes also glabrous) exocarp (mallo), which detaches when ripe. The endocarp (shell) is woody, whose consistency can be hard or brittle.
Inside the shell are contained seeds (almonds) which are utilized mainly

by the confectionery industry and, partly, consumed as dried fruits. The harvesting period goes from the end of August to the end of September, depending on pedoclimatic conditions and cultivar, when the hull is completely open and almost detached from the shell. Currently, more than 93% of national production comes from two regions: Sicily (60%) and Puglia (33%). The total amount of the national production of shell fruits is about 79,600 tons (source Istat, year 2017). Given a yield of 25-30%, remain about 55,000-60,000 tons of non-edible parts that are merely used in cosmetic and soap industry or become fuel that could be employed, instead, as "charge" for making panels.

The opportunity of using the dried bean plant comes from the great availability of that material in the Piedmont region, where 23% of the beans cultivated area in Italy is concentrated (ISTAT 2010). In particular, the province of Cuneo can be considered the most suitable area for designing panels because both sheep wool and dried bean plants are widely available. In that territory the beans production is also identified by the IGP denomination "Fagiolo di Cuneo" (Protected Geographical Identification). Moreover, referring to the IGP denomination, another research group from Department of Architecture and Design has recently developed a production-chain and valorisation scenario, thanks to the project EN.FA.SI.2, funded by Piedmont Region.

The beans are harvested by hand or through threshing in different phases during the autumn season. In the threshing-harvest, the thresher collects the beans, leaving the rest of the plant (stem, leaves pods) in the field, where it completes its drying process. The plant is rarely harvested, more often it is turned in the field, with the risk of soil contamination by parasites. In few cases is used as cattle litter (with lower yield than straw) or burned as biomass to produce energy. The research group propose to use the entire dry plant for the production of the panels as aggregate charge from sheep's wool. The production of the sheep wool and dried bean plant panel specimen gave a positive result, highlighting, however, some difficulties in separating the dried plant fibres.

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