

Design and Innovation for Made in Italy

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In January 2023, one of the most ambitious research challenges to advance innovation within the Made in Italy production system began. Within a large interdisciplinary research partnership known as MICS (Made in Italy Circolare e Sostenibile), universities, research centres and companies funded by the Ministry of University and Research through resources provided by the European Union under the NextGenerationEU programme (PNRR) were able to collaborate for three years on shared projects. These projects were grounded in bodies of knowledge and disciplinary domains that do not usually interact –engineering, chemistry, economics, marketing, as well as social and natural sciences. MICS is composed of 25 partners, including 12 public institutions and 13 industrial partners operating in three key sectors of the Italian industrial landscape, namely Clothing and Textiles, Furniture and Wood, Automation and Mechanics. Within the project activities carried out by the partnership, research groups belonging to the CEAR/08-D Design disciplinary area have led and collaborated on multiple projects with the aim of integrating the cultural, scientific and technical knowledge of the design discipline.

This special issue of DIID brings together the broadest possible reflection on projects that, with a low Technology Readiness Level (TRL), have attempted to translate years of ongoing research within the sector towards unexplored directions, towards renewal processes framed by sustainability and circularity. All of this is pursued with the aim of enhancing the sustainable competitiveness of Made in Italy through concrete actions developed in collaboration with companies involved from the very beginning, as well as with other firms interested in the relevant themes.

The projects were developed within the following universities: Politecnico di Bari, Politecnico di Milano, Politecnico di Torino, Università degli Studi di Napoli Federico II, Università degli Studi di Palermo, Università di Bologna, Università di Firenze e Sapienza Università di Roma.

The overall picture that emerges from this overview of research activities is rich in insights and demonstrates how our scientific sector, when compared with fields that have a longer historical tradition in research, is nevertheless capable of making a significant contribution. It also shows that scientific research in the field of Design is able to generate incisive and relevant reflections and solutions for the driving sectors of Made in Italy.

To facilitate the reading of the contributions included in this special issue, the twenty two papers have been grouped into four main research areas, with the aim of identifying lines of development that collectively indicate a strategic perspective for the future. These are the four areas of investigation that emerged over the three years of research.

Systemic and Strategic Design for Industrial Transitions investigates industrial transitions, systemic design, strategies, servitisation processes, new business models and complex ecosystems.

Material Circularity and Regenerative Approaches focuses on research into circular and bio based materials, regeneration processes and the analysis of pre consumer waste, with the aim of territorial valorisation and the strengthening of local supply chains.

Digital Transition, Advanced Design and Hybridization centred on digital transition, the use of immersive technologies, the development of new digital tools for design, additive manufacturing, hybrid physical digital systems and digital archives.

Design, Culture, Territorial Memory for Sustainable Regeneration investigates territories and the identities that characterise them through material culture, narratives that construct memory, and the reactivation of marginal contexts and intangible heritage that are difficult to preserve for the future.

In light of these four thematic areas of investigation, this issue of DIID provides a starting point for reflecting on and shaping future strategies, with the aim of enabling the transition of the production system towards a circular and, more generally, sustainable model for Italian industry.

Systemic and Strategic Design for Industrial Transitions

This first research area has investigated the reasons that hinder effective transformation processes within Made in Italy, addressing sustainability as a radical transformation of industrial production systems, organisations and supply chains. Within this transition, the role of design plays a strategic role as a guide and coordinator of processes, a seeker of innovative solutions, an enabler of collaboration among different forms of expertise, and a mediator between bodies of knowledge.

Within this renewed recognition of the importance of the designer, the theme of the Transitional Designer emerges as a professional figure capable of developing systemic models for production through servitisation, also aimed at extending product life cycles as a lever for sustainability. This process leads to the development of integrated strategies for complex supply chains, where the pursuit of distributed and multi stakeholder governance assigns the designer a key role as an orchestrator of sustainable transitions.

The main contributions that investigated this research area include the following studies:

- Experimenting with Servitization in the Contract Furniture Sector. A Strategic Design Pilot for Sustainable Transition
- Advanced and Systemic Design Approaches to Smart Packaging for the Made in Italy Fashion Transition.
- Designing Fashion Transitions: Toward Sustainable, Circular and Digital Futures
- Design-driven Sustainable Manufacturing. Enabling Multi-Stakeholder Knowledge Exchange for Circular Furniture Production.
- From Mutation to Mutuation: The Role of Design in Enterprise Futures-Driven Execution.
- Made in Italy Towards Sustainability. From Tradition to Futures.
- The Infrastructural Turn in Material Design: Material as a Service and the Future of Sustainable Industry.
- Challenging Circularity in Product Design. The Circular Sofa Platform Outreach.

The new identity of the Transitional Designer is no longer focused on the product as a physical and tangible artefact, but on innovation ecosystems: infrastructures, relationships, values and anticipation processes. Supported by a new governance oriented towards circularity, this perspective highlights the need for a radical shift in Italian design cultures, traditionally based on product,

as well as in the education of new designers, to enable this transformation.

Material Circularity and Regenerative Approaches

This second research area brings together contributions that address the material dimension of sustainability: regeneration of various forms of waste, development of bio based materials, valorisation of local resources, remanufacturing processes, and reinterpretation of production supply chains. Circular design, Design materials, regenerative design and bioinspired design can therefore be understood as articulations of the design phenomenology.

Recurring themes include the reconfiguration of textile waste, wool, stone materials and construction waste as resources. From this perspective, experimentation with local natural fibres such as hemp, bamboo and Sicilian wool investigates circularity as a form of cultural as well as environmental regeneration, also in terms of synergies between manufacturing, natural supply chains and agri food systems.

A transversal theme across all projects concerns processes of archiving and reorganisation of resources as a form of regeneration of material heritage, enabling the reuse of circular feedstock in fashion and valorisation of territorially rooted supply chains, with their specific cognitive and material characteristics. The main contributions that investigated this research area include:

- Re-Waste. Designing Futures from Textile Scraps.
- Sicilian Native Wool. From Waste to Resource: A Circular Supply Chain for Made in Sicily.
- Connecting Natural Fibers and Territories Through Design: The Case of Hemp and Bamboo for a Sustainable Made in Italy.
- Closing the Loop: A Pilot Study on Circular Feedstock in the Fashion Industry.
- Circular Design and Material Regeneration: The STONE Project as a System Paradigm in the Stone Industry.
- Designing with Nature. Interdisciplinary Approaches for Bioinspired and Sustainable Solutions in the Living Sectors.

This group of research activities opens up reflection on a new paradigm in which material constitutes the core of the sustainable transition, understood not only as a physical artefact or a commodity to be transformed into new industrial products, but as a cultural, relational and territorial entity, carrier of stories and values, capable of activating circular ecosystems and communities that provide the foundations for the pursuit of effective circular and sustainable processes.

Digital Transition, Advanced Design and Hybridization

This third research direction within MICS gathers studies that interpret sustainability as a phenomenon that is intrinsically connected to digital transition. It includes computational tools, simulations, intelligent archives, platforms, digital living labs, immersive technologies and new interaction models.

Key themes characterising these studies include the integration of advanced technological innovations with design cultures. The virtualisation of materials

and intelligent archives becomes fundamental to innovation processes, both as a means of accessing knowledge and as a mechanism for democratisation and service accessibility. The technological gap within the Italian system is addressed through a new vision of knowledge access, no longer conceived as an individual competitive asset, but as a distributed resource that can be recognised as a product of Italian design culture.

New challenges for design in hybrid physical digital environments, the intelligent and systemic use of additive manufacturing as a lever for production flexibility, and digital tools for anticipation and systemic management all become relevant within a symbiotic relationship between design and digital technologies. Particular attention is also given to extreme environments, prefiguring near future scenarios. Within this area, the following contributions provide a significant input:

- Designing the Digital Transition: Tools and Approaches for Italian Textile Heritage Virtualization
- Flexible Customization of Large-Scale Yacht Components through a Design-Driven Approach
- New Technology Relationship Paradigms in Industry: The Transformation of Human-Machine Interaction Through Design-Driven Approaches
- Designing in Microgravity: Digital Living Lab as an Enabler of Knowledge and Innovation through Extreme Design

A new identity is emerging in which design acts as a cognitive mediator between complex systems, data, technologies, and cultural heritage, generating new ways of conceiving sustainability as a responsible digital transition.

Design, Culture, Territorial Memory for Sustainable Regeneration

The final group of projects focuses on practices aimed at valorising the socio cultural and territorial dimensions of sustainability. The role of design emerges in activating communities, regenerating marginalised areas, reinterpreting material and intangible heritage, and narrating new values by drawing on historical narratives and productive knowledge embedded in the Italian manufacturing system.

Recurring themes often revolve around the concept of “regeneration”, articulated across multiple domains, from inner areas to depressed or declining regions where social action plays a fundamental role within the Italian territory. The theme of narrative unfolds across multiple modalities, ranging from traditional forms to more technological and immersive ones, in order to articulate cultural identities, productive memory, and archives in new ways. What emerges is an understanding of sustainability as a socio cultural phenomenon as well as a technical environmental one, with implications that in some cases extend into the political sphere. The main contributions:

- New Narratives for Made in Italy: Communication Design Through Disruptive Technologies
- Challenging Social Desertification: Design Tools and a Theoretical Framework for Inner Areas
- Value Taxonomy: Towards the Cultural Sustainability of the Upholstered Product Made in Italy
- Design for Post-Circularity: Reframing Circular Eco-Design Strategies

- through Speculative and Plural Epistemologies
- Remanufacturing textile archiving. Sustainable practices for the reactivation of material culture and heritage

From these recent studies, visions of design emerge as a civic, cultural, and narrative practice, capable of grounding sustainability within territories, communities of both traditional and emerging stakeholders, and the productive identities of Made in Italy, with strong attention to memory and to the transformations of places, in order to avoid abandoning productive sectors that still have much to contribute to the future of Made in Italy.

Conclusions

Scientific research in the field of design can rarely be confined to a low TRL, as required by PNRR projects, and in many cases experimental activities have reached TRL levels higher than four, which was considered the upper limit within which research was expected to operate. This has made it possible to generate, within these experiments, data and analyses that highlight key principles for envisioning the development of these research activities. The transfer of innovations to a broader system of companies will therefore characterise the future activities of MICS.

The first guiding principle is that materials lie at the core of processes that can enable circular and systemic approaches. However, from a contemporary perspective, the idea of materials as entities simply to be transformed into products is reductive. Recycling, reuse, and recovery are instead designed processes, integrated and stabilized within a supply chain conceived from a transformative standpoint.

The second guiding principle focuses on the role of digital technologies, which at first glance may appear foreign to the product system and to the high quality artefact traditionally associated with Made in Italy. However, within a context governed by narratives and social media, digital technologies become a necessary pathway for every artefact.

Across all the research documented here, the specific contribution of Made in Italy to sustainability challenges clearly emerges. This includes the close relationship between production districts, in all their transformations, and models of symbiotic economy; the role of territories, including marginal ones, as repositories of specific forms of knowledge; the ability to operate under conditions of scarce resources, also by practicing resilience; the theme of personalisation - advanced customisation as a contribution to extending product life cycles, not only from a technical functional perspective but also in communicative and symbolic terms; the tradition of civil enterprise, opening towards social sustainability; the connection with nature, continuously reinterpreted and expressed through experimentation with bio-based and bio-inspired solutions; and the capacity for storytelling as a further contribution to the creation of affective value.

And, in such a scenario, the role of the designer becomes a crucial one in its ability to synthesize and catalyze different contributions, to give meaning to technological innovation, to make innovation marketviable, and to anticipate the future. All of this contributes to defining an “Italian pathway” to sustainability.