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Proceedings of IASDR 2023: Life-changing Design

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THE 2023

IASDR Congress

Life-
changing
design

Milan 9th–13th October

PROCEEDINGS OF IASDR 2023

EDITORS:

Daniela De Sainz Molestina

Laura Galluzzo

Francesca Rizzo

Davide Spallazzo



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Life-Changing Design

Proceedings of the 10th Congress of the
International Association of Societies of
Design Research (IASDR 2023)

EDITORS:

Daniela de Sainz Molestina

Laura Galluzzo

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The Tenth IASDR congress. An Introductory Address from the IASDR Board

IASDR 2023 is the 10th biennial congress of IASDR, and the first to take place after the crisis of COVID-19. With this congress we re-confirm the importance of discussion and debate for the network of researchers in design, as well as the importance of developing younger researchers for the future of the Association.

The International Association for Societies of Design Research (IASDR) was established in 2005 through a collaboration of four academic societies: Chinese Institute of Design (CID), the Design Research Society (DRS), Korean Society for Design Science (KSDS) and Japanese Society for the Science of Design (JSSD).

The history of international collaboration in Design Research in the Asian region can be traced back to 1996 when JSSD organized the first Japan-China Industrial Design Symposium which was hosted by Beihang University in Beijing, 1996. This started a series of international conferences in design research known as the Asian Design Conference. Conferences took place in 1997 (Daejeon, Korea at KAIST), 1998 (Taichung, Taiwan at National Taichung University of Science and Technology), 1999 (Nagaoka, Japan at Nagaoka University of Technology), 2001 (Seoul by National Seoul University), and 2003 (Tsukuba, Japan at Tsukuba International Congress Center). At the 2003 congress – the 6th Asian Design Conference – the three Asian academic societies agreed to welcome the Design Research Society into a new association.

We thus began the International Association of Societies of Design Research for the field of design research in 2005, in Taiwan. Since that time, we have enhanced the network of researchers and fields of design research and promoted design research education. We will continue to build this incomparable network of design research as we move towards our 2025 congress, at Tapei, Taiwan.

Our deepest thanks go to Luisa Collina, and the entire Politecnico Milano team who have worked so hard, as hosts for IASDR2023, to ensure its success. Your leadership throughout the process has been excellent and we think the result will be much appreciated by the IASDR design research community.

Toshimasa Yamanaka
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On behalf of the IASDR Board
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Byung-Keun Oh
Rebecca Cain
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Life-Changing Design.

Introduction to the Tenth IASDR congress

The International Association of Societies of Design Research (IASDR) has long been at the forefront of advancing design research, providing an international platform for researchers, scholars, and practitioners to engage in robust discussions, share insights, and explore the ever-evolving landscape of design research. IASDR 2023, the association's 10th Congress, stands as a pivotal juncture in the trajectory of design research, offering a comprehensive perspective on its current state while charting its future directions.

Over the past decade, design research has witnessed a remarkable transformation. From its roots in aesthetic considerations and form-centric approaches, design research has evolved into a multifaceted discipline, extending its influence beyond traditional boundaries. Contemporary design literature now encompasses a wide array of facets, each addressing critical aspects of design's impact on diverse domains, including organisational culture, public policies, product development, and the creation of immersive spaces, services and systems. This transformation underscores the dynamic nature of design research, as it continuously adapts to our society's changing demands and challenges.

The central theme of IASDR 2023, "Life-Changing Design", resonates profoundly in the wake of global events, particularly the unprecedented disruptions caused by the COVID-19 pandemic. This theme invites us to reflect on the profound transformations that have unfolded and continue to reshape our world. The pandemic has brought to the forefront questions about the role of design in navigating these changes, challenging us to explore how design can facilitate adaptation, resilience, and innovation in a rapidly changing world.

IASDR 2023 has been organised and host by Politecnico di Milano, where design keeps strong roots in the made in Italy tradition and where at the same time design opens up to the new territories of design research and to the new trajectories of innovation.

IASDR 2023 encompasses an array of thematic tracks, each dedicated to exploring critical dimensions of design research. These tracks serve as focal points for discussions and investigations, providing a framework for researchers to delve into specific areas of interest.

The following thematic tracks guide our exploration:

[Changing] Organizations and Policies

This track examines the transformative potential of design in the realm of public sector organisations and policies. It aims to foster social justice and sustainability by challenging traditional notions of prosperity. Researchers investigate how design equips itself with tools, methods, and frameworks to support systemic transformation, thereby promoting well-being and addressing complex societal challenges.

[Changing] Products and Production

This track focuses on the transformation of manufacturing processes and their impact on products and

systems. It explores the proliferation of digital fabrication and digital craft, analysing their potential to revolutionise product development, sustainability, and business models. Researchers delve into how design can envision emerging materials, artefacts, and future scenarios from a sustainable perspective.

Identities and [Changing] Identities

Cultural identities and their evolution in an increasingly multicultural world take center stage in this track. Researchers delve into the roots of design's influence on identity, considering factors such as authorial identities, identity hegemony, and the implications of design on gender, class, and religion. Additionally, this track explores the role of design in translation processes, which involve revising systems, tools, and programs for communicating and preserving identity.

[Changing] Ecosystems

Addressing the imperative transition toward sustainability, this track examines how design contributes to the socio-ethical and economic dimensions of sustainability. It explores design for sustainable materials, energy, business models, and transitions, focusing on fostering positive environmental and social change.

[Changing] Communities

Community empowerment and sustainable behavioural change through design interventions are central to this track. Researchers investigate how design can enhance collaborative processes, co-design knowledge, and tools while addressing urgent public interest issues. The track emphasises shared decision-making, democratic participation, and the evolving roles of individuals, communities, and entities in supporting systemic transitions.

[Changing] Education

This track reflects on the evolving landscape of design education, recognising the complexities and challenges inherent in this domain. Researchers explore the inspirations for change in design education, the transformations it engenders, and the existing gaps and issues. This track seeks to foster clarity, identity, and adaptability in designing educational goals while embracing diversity and differentiation.

[Changing] Spaces and Services

Integrating spatial and service design to create innovative living environments and services is the central concern of this track. It explores how design interventions across various scales, from micro to macro, can drive transformative actions, enhance public participation, and guarantee inclusivity and diversity in service offerings.

[Changing] Interactions

The dynamic interplay between technology, social changes, and design forms the core of this track. Researchers investigate how digital technologies, augmented reality, virtual reality, and mixed environments impact interactions, communities, processes, and professions. This track emphasises the role of Interaction Design in shaping technology-based innovations responsive to social and contextual changes.

[Changing] Heritage

Preserving and reinterpreting cultural heritage in the face of global change is the central focus of this track. Researchers explore how design research can offer novel approaches to knowledge preservation and cultural experiences related to tangible and intangible heritage. This track seeks to activate participation dynamics that reintegrate relevant portions of cultural heritage excluded from current development paradigms.

IASDR 2023, with its overarching theme of "Life-Changing Design" and its diverse thematic tracks, presents an exceptional opportunity for researchers, scholars, and practitioners to engage with the dynamic landscape of design research. The conference serves as a platform for robust discussions, knowledge sharing, and the exploration of innovative solutions to society's complex challenges.

By examining these thematic tracks and their intersection with the central theme, “Life-Changing Design,” we aim to contribute to the ongoing dialogue surrounding design research and its transformative potential, fostering a deeper understanding of design’s role in shaping our world.

Luisa Collina
Alessandro Deserti
Francesco Zurlo

Contents

[Changing] Organizations and Policies

Front Matter

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A layered approach to designing public health communication diagram for improved information accessibility

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Are service designers positioned to design for sustainability?

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Change management by design. Design as a flow improver in turbulent times

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Changing perspective on social inclusion and design: exploring the concept of designing for inclusive attitudes

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Codesign facilitation for workforce satisfaction

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Design making its way to the city hall: Tensions in design capacity building in the public sector

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Design-driven poverty alleviation: an approach that turns Poverty Alleviation from a cost perspective to a resource perspective

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Design-Led Sustainable Transition in Organization: A framework to guide and evaluate employee change

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Designing Longevity Planning Blocks through experimental participatory observation and interviews

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Establishment of regional industry assessment system and design of Transformation path in the perspective of sustainable Transformation: The case of Huaihua City, China

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Experience design's transformation towards experience-driven transformation: a practical perspective

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Exploring the Relationship between Customer Experience and Loyalty in Digital-Only Banking

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Features of Chinese design research: an “object-paradigm” interactive relationship perspective

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How Design Thinking can support the establishment of an EU GovTech ecosystem

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How do PSI Labs establish legitimacy? Dynamics, approaches, and knowledge creation

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<https://doi.org/10.21606/iasdr.2023.160>

Inspiration for developing Service Design prototypes through Speculative Design - a case study in the field of carbon neutral in the UK

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Introducing design for public sector innovation in nigeria's federal government

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<https://doi.org/10.21606/iasdr.2023.318>

Living entanglement: toward an entangled design nexus

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Mapping the Research Landscape of the Gig Work for Design on Labour Research

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Meet me at the local shop: designing community anchors for customer engagement

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More than the process, exploring themes in Dutch public service design practice through embedded research

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Participatory Design of Service Innovation to Support People and their Carers in Moray

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Rediscovering Mental Health intervention methodologies through Design

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The information visualization to increase the usefulness of public PHR services

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The ripple framework: a co-design platform (a thousand tiny methodologies)

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Themes for an airport hub in the transition towards a multimodal transport hub – an embedded researcher’s perspective

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Unlocking the experience economy: Integrating design for experience knowledge into fast moving consumer goods (FMCG) product innovation

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When ‘doing ethics’ meets public procurement of smart city technology – an Amsterdam case study

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Why design matters in local business commoning

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[Changing] Products and Production**Front Matter**

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AI Logic of Care: premises for upgrading the smart bandages for diabetic chronic wounds

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Analysis of the Menotech and Femtech markets for menopausal women in Japan

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Assessing a mobile and modular negative pressure ward (Mobile Clinic Module) for COVID-19 outpatient treatment

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Co-creation through digital fabrication technology: A systematic literature review

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Design principles for a workshop using 3D food printers: participatory digital food design research

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Designing Ambi-Bracelet - an Interactive Bracelet for Ambient Communication between Partners

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Differences in the use of analogies by designers at different stages of conceptual design

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Dynamic personalities for elderly care robots: user-based recommendations

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Exercise Characteristics of Older Adults and Considerations for Exercise Equipment Design for them

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Exploring the design applications of key emerging materials from natural Sciences through a design ideation workshop

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Exploring the effect of softness and weight of materials on positive emotion regulation: a case study of LEGO

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Forming bacterial cellulose: a research activity exploiting digital fabrication technologies

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From Bio-inspired Design to Microbiology-inspired Design: a Conceptual Model-based Case Study on biological Materials informed by Emotions

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Haptic aesthetics in product design: designing headphones that feel beautiful

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Head shape design of Chinese 450 km/h high-speed trains based on pedigree feature parameterization

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Prototyping a 7-meter frameless dome as emergency shelter: Test build viability and devise team strategies

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<https://doi.org/10.21606/iasdr.2023.297>

Raising the ceiling: the impact of design-based differentiation on product pricing

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<https://doi.org/10.21606/iasdr.2023.128>**Shifting Spaces in Fashion: Approaching digitised design spaces from a bodily perspective**

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<https://doi.org/10.21606/iasdr.2023.507>**Identities and [Changing] Identities****Front Matter**

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<https://doi.org/10.21606/iasdr.2023.894>**Community voices in visual identity. A reflection on the social significance of dynamism in Visual Identity Design**

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<https://doi.org/10.21606/iasdr.2023.373>**Contributions of Slow Design to the valorization of local identities in sustainable processes**

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<https://doi.org/10.21606/iasdr.2023.569>**Decolonizing creativity in the digital era**

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<https://doi.org/10.21606/iasdr.2023.307>**Evolving Identity: A Study on changing choices in the Clothing of Tribal Women of Tripura India**

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<https://doi.org/10.21606/iasdr.2023.499>**Fictional Brand Design. Evolution, Strategies, and an Attempt to a History of Visual Identities in Audiovisual Narratives**

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<https://doi.org/10.21606/iasdr.2023.278>**Is gift a token of gratitude or an imposition of identity? Facilitating positive consequences of gift-giving with receiver-centred design**

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<https://doi.org/10.21606/iasdr.2023.329>**Pursuing positionality in design**

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<https://doi.org/10.21606/iasdr.2023.371>

Shifting identities: new materialities of power and control

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<https://doi.org/10.21606/iasdr.2023.501>

Speculating gender in conversational interfaces

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<https://doi.org/10.21606/iasdr.2023.394>

Textile Autobiographies: Crafting shifting identities with refugee communities

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The Brand as a Place. For a Model Interpreting Identity in the Digital Age

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<https://doi.org/10.21606/iasdr.2023.288>

The impact of identity construction and diversification of Chinese craftspeople on the design innovation of traditional handicrafts – a case study of Dong Brocade in Tongdao, Hunan

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<https://doi.org/10.21606/iasdr.2023.420>

Wearing Black when feeling Blue: An exploration of the relationship between clothing and mood

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[Changing] Ecosystems**Front Matter**

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An explorative multiple case study of smart-circular PSS – status quo in industry

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<https://doi.org/10.21606/iasdr.2023.191>

An investigation into the product attachment between single-person household and their home appliances

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Aqueous logics: Towards a hydro feminism approach to sustainability

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Arousing “Arts of Making” in design: cultivating growing material societal meanings for sustainable transitions

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<https://doi.org/10.21606/iasdr.2023.558>

Bio-Brutalism; five case studies framing the emergence of new raw aesthetics at the intersection of material regeneration, environmental design, and craft

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Circular Futures: how can design nurture more sustainable production and delivery systems for social micro enterprises?

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Collaborating with an Amazonian tree: a bio-product design experiment with ancestral references

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Creating national strategy for circular design through co-design: An Australian perspective

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Digital transition, Sustainable Product-Service System (S.PSS), and environmental sustainability - A systematic review

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Exploring a framework in designing smart circular ecosystems in the waterborne passenger mobility

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Exploring and facilitating Daoism's contributions to design prototype, a case study from a "More-than-Human" social innovation project: Hokkhi

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Global goals, local future stories: unpacking contrasts and visions of circular economy activities in neighbourhood makerspaces

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Material connaissance as a tacit knowledge co-creation method

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More than human empathy: a caring approach to ecosystemic design

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Navigating circularity in practice: proposing a decision-making tool for guiding circular product development

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<https://doi.org/10.21606/iasdr.2023.324>

Out with the new, in with the old: Future directions for Design for Sustainability

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<https://doi.org/10.21606/iasdr.2023.378>

Planet-Oriented Design: a proposal for new ethical transitions in Design Education

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<https://doi.org/10.21606/iasdr.2023.506>

Small fish in a big pond: Product Longevity Design Strategies for Smart Speakers

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<https://doi.org/10.21606/iasdr.2023.290>

**Sustainable design strategy of Chinese old Town community based on landscape ontology:
A case study of Daojiao Community in Chongqing**

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The social influences of digital technologies in the Design of S.PSS and DE: A literature review

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The use of life cycle assessment for lightweight product design based on functional unit

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Emerging decentralized infrastructure networks

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**User decision making for end of use product: Exploring the reasons for keeping and care
motivations for responsible sharing**

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<https://doi.org/10.21606/iasdr.2023.362>

[Changing] Communities

Front Matter

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**A design-driven approach to distributed ledger technologies for small farmers communities:
A case study in Portugal**

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Against the norms: designing violence prevention through engaging men

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**Approach or Avoid Away from Kiosks for the Elderly? A Study on Acceptance and Behavioral
Intention of Self-Service in Hospitals**

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'Becommoning': a design-framework for the initiation of new commons

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Breaking barriers to sustainable costume design: a community-driven approach with German theatres

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Can't spell 'medicine' without 'me': Finding the spirit of co-design in multidisciplinary collaboration

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Co-design for interdisciplinary research communities

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Co-designing for whom? Exploring the benefits of city-led participatory art practices in disadvantaged neighbourhoods of Madrid

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Co-designing strategic ritual in craft beer: Churches, Denominations, Sects, and Mystics

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Community Empowerment: Lessons learned from a Local Health Programme

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Design activating agency: a study on rural community co-creation in China under non-anthropocentrism

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Embedding and embodying narratives in the collaborative development of life-changing healthcare technologies

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Design for social imagination

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Design Interventions are not Received Equally: SSI and Mediated Influences in Decision-Making

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Design sprints for assistive technology; a discussion advocating co-creation between design, lived experience and occupational therapy

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Design teams' behaviors and idea development in using "IDEATOR"

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Designing chatbot as observation media of elders' cognitive health in daily activities

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Developing a child-friendly outdoor public playground for children aged 4-8, through co-creation mindset

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Developing a community-engaged homemaking approach to elicit a sense of belonging in people with dementia

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Dualities of co-design in the context of dementia: Can handover approaches provide an answer?

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Embedded actors in design objects: reflexivity in design for social innovation

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Fostering social inclusion: empathic approaches for migrant-centred design

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Future Systemic and Value Mapping as a Tool for Peace and Deliberation

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Immigrant Integration through Codesign – A Journey Map of integration into working life

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Inclusive harmonies: Co-creating accessible music experiences with deaf or blind advisors through interdisciplinary design workshop

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Increasing preventive care through increased access to healthy foods

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Innovative collaboration and co-designing with Santhal and Mohli tribes of Dumka, India

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Offline and online collaboration in providing service design projects for social innovation to villages: a co-creative action in Quanzhou

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Relational design practices in design for social innovation: a place-centred approach

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Seniors with early AD in China: study of a Design for All (DfA) approach for a transformed, happier family life

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Shaping Social Design with communities

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Social innovation for climate neutrality in cities: actionable pathways for policymakers

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Social innovation through regenerative perspectives: a theoretical approach on gender-based violence system

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Systemic design for sustainable community care for older adults: A case study in Turin, Piedmont, Italy

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The role of participatory transition design in mitigating erosion of participatory democracy

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Transformative effects of co-design: The case of the “My Architect And I” project

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[Changing] Education**Front Matter**

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A production pipeline for an AI-powered design course

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An analysis of international design education programs training students' competencies and skills for tackling complex social challenges

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An interdisciplinary design framework for creative collaboration

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Building design agency through bodystorming

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Climate Adaptation in Design Education: Applying a four-step Research by Design Strategy

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Combination of Experiential Learning to investigate design students' design thinking ability

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Compass for the Voyage of Ideation: Unlocking the Stimulation Potential of Service Design Heuristics

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Confidence and doubt in doctoral research: The temptation of certainty

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Design Education 4.0: Technology-driven design futures & the future of design education

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Design fiction and the art of anticipation

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Design Futures to support Sustainable Food practices

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Design laboratories system as a tool to enable interdisciplinary design learning: analysis of common approaches and new perspectives

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Designerly activity theory supporting research-through-design

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Designing collective racial healing spaces

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DIP into the Future: Building a Design Curriculum to Enable Design Students to Work with Machine Learning

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Enhancing design competencies for students with special educational needs for future career development

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Explore the online interdisciplinary co-design in higher education

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Exploring an innovative apprenticeship model in design education : a case study in transportation design

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Guiding into the unknown. A dialogue between design and yoga for mindful design education

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How might we design alternative worldviews? Assessing a design education program for business professionals

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How students perceive lecturers' gestures? An exploration in gesture-meaning matching toward embodied pedagogical agent design

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Investigation of creativity and Experiential learning composition in design teams

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Learning technology with beginner-friendly software: design students' on attitude towards software alternatives

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Next generation textile designers. A research project to connect the textile-knitwear manufacturing system with future design talents and its impact on education

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PhotoReflexivity: supporting Reflexivity for Students in Design Education

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ProVi – a transforming vision emerging from reflective practice

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<https://doi.org/10.21606/iasdr.2023.361>

Teaching to transfer causal layered analysis from futures thinking to design thinking

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<https://doi.org/10.21606/iasdr.2023.383>

The challenge of facilitating short-term Design Thinking Workshops for Higher Education in the New Normal Era

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The challenge of hyperdistraction for Design Education

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The problems of design-based interdisciplinary learning

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<https://doi.org/10.21606/iasdr.2023.289>

The role of human-centred design in promoting understanding of local contexts: a study of Japanese students addressing social issues in Bangladesh

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<https://doi.org/10.21606/iasdr.2023.508>

Towards a Design Observatory in Portugal – results, reflections and future steps

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Uncovering key aspects of process gains and losses in team-based design thinking workshops

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Unleashing a creative explosion: channeling expert strategy into Service Design Heuristic Cards

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Unlocking creative potential: idea generation training for design students

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<https://doi.org/10.21606/iasdr.2023.409>**Usage of Service Design Pattern Language as a method for beginners to effectively acquire their behaviors towards design**

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<https://doi.org/10.21606/iasdr.2023.505>**[Changing] Spaces and Services****Front Matter**

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<https://doi.org/10.21606/iasdr.2023.892>**Data Challenge. Re-thinking the library as a learning space to intersect youth, culture and gender diversity**

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Valentina Gianfrate, University of Bologna, Italy

Simona Colitti, University of Bologna, Italy

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<https://doi.org/10.21606/iasdr.2023.471>**Design Characteristics in Outdoor Seating Areas – A study of coffee shops in Hong Kong and Copenhagen**

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<https://doi.org/10.21606/iasdr.2023.216>**Designing therapeutic and social spaces for older adults facing Mild Cognitive Impairment: Priorities in spatial and furniture layout**

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Machry Herminia, University of Kansas, USA

Leandro M. Tonetto, Georgia Institute of Technology, USA

<https://doi.org/10.21606/iasdr.2023.174>**Mapping urban regeneration through multiple dimensions of temporality: A visual analysis of three approaches to Theory of Change**

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Luca Simeone, Aalborg University, Denmark

Amalia de Götzen, Aalborg University, Denmark

Nicola Morelli, Aalborg university, Denmark

<https://doi.org/10.21606/iasdr.2023.105>**Metro interior design to reduce the occurrence of metro congestion**

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Yuxin Wen, Hunan University, China

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<https://doi.org/10.21606/iasdr.2023.548>

Office space design based on Kano Model, AHP, QFD Methods

Yilan Jin, University of Edinburgh, UK

<https://doi.org/10.21606/iasdr.2023.166>**Visual and spatial design for proximity healthcare: the meta-design book of “Case e Ospedali di Comunità” of Regione Lombardia**

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<https://doi.org/10.21606/iasdr.2023.430>**Yearning for Revival_Using Healing as the Linking Strategy to Recreate Emotionally Resilient Communities**

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<https://doi.org/10.21606/iasdr.2023.148>**[Changing] Interactions****Front Matter**

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<https://doi.org/10.21606/iasdr.2023.887>**A personality-centred design approach for virtual humans on correspondence with roles and behaviors**

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<https://doi.org/10.21606/iasdr.2023.411>**A Study on the Sense of Being Alive Expressed in Motion**

Ongon Witthayathada, Fukui University of Technology, Japan

Youngil Cho, Hokkaido University of Science, Japan

<https://doi.org/10.21606/iasdr.2023.463>**AIXE. Building a scale to evaluate the UX of AI-infused products**

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Davide Spallazzo, Politecnico di Milano, Italy

<https://doi.org/10.21606/iasdr.2023.355>**Colour in virtual classroom: Effects of colour schemes and interior elements on students' preference and attention**

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Design considerations for supporting social interaction in algorithmic social media feed

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Designer Empathy in Virtual Reality: transforming the Designer Experience closer to the User

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Designing an interactive system based on pose-estimation to support rhythmic gymnastics basic coaches in enhancing their learning

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Designing interfaces for text-to-image prompt engineering using stable diffusion models: a human-AI interaction approach

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Designing the interaction between humans and autonomous systems: The role of behavioral science

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Designing the prosthetic appearance in virtual reality with the collaboration of participants and users

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<https://doi.org/10.21606/iasdr.2023.177>

Designing visuo-haptic illusions for Virtual Reality applications using floor-based shape-changing displays

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E-Motioning: Exploring the Effects of Emotional Generative Visuals on Creativity and Connectedness during Videoconferencing

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<https://doi.org/10.21606/iasdr.2023.101>

Elderly's Perceptions of a Meaningful Interaction with Voice-Based Conversational Agents: Integrate into daily routines, Support relatedness, But do not hamper autonomy

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<https://doi.org/10.21606/iasdr.2023.344>

Embracing digital offboarding as a design challenge

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<https://doi.org/10.21606/iasdr.2023.393>**Examining the affordance effect of shifting symbols on the virtual buttons of smartphones**

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Hsi-Jen Chen, National Cheng Kung University, Taiwan

<https://doi.org/10.21606/iasdr.2023.482>**Exploring multimodal technologies to engage elderly people in remote communication with their family**

Baihui Chen, Southern University of Science and Technology, China

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<https://doi.org/10.21606/iasdr.2023.441>**Fixing the Future: Cultivating a Capacity to Repair IoT Devices through Experiential Futures**

Matthew Pilling, Lancaster University, UK

Michael Stead, Lancaster University, UK

Paul Coulton, Lancaster University, UK

Thomas Macpherson-Pope, The Making Rooms

<https://doi.org/10.21606/iasdr.2023.474>**For who page? TikTok creators' algorithmic dependencies**

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<https://doi.org/10.21606/iasdr.2023.576>**How smart is the Italian domestic environment? A quantitative study**

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<https://doi.org/10.21606/iasdr.2023.206>**How to promote consumption in city metaverse? Research on XR experience design and consumer behavior of commercial streets**

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<https://doi.org/10.21606/iasdr.2023.103>**Human-AI system co-creativity for building narrative worlds**

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<https://doi.org/10.21606/iasdr.2023.293>**Identifying meaningful user experiences with autonomous products: a case study in fundamental user needs in fully autonomous vehicles**

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<https://doi.org/10.21606/iasdr.2023.434>**Improving the healthcare experience: Developing a comprehensive patient health record (PHR)**

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Introducing the third space of design for well-being: Exploring the intersection between problem- and possibility-driven design through a design case on online dating experience

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Investigating the effectiveness of Peripheral Vision in reading digital speed limit information displayed in AR-HUD technology

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Multi-view visualization layout design method for large displays based on quantitative analysis of situation awareness

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Olfactory Stimulus as Design Material: designing an engaging interaction between user and AI chatbot

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Performance evaluation of QWERTY keyboards on foldable smartphones: keyboard layout and phrase complexity

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Plant Playmate: exploring effects of interactive plants for mental wellness microbreaks during knowledge-based work

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Play with data: Using haptic properties of artifacts to augment data representation

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Post-pandemic era: evaluation of Quality of Life and Usability Testing for elderly rehabilitation app design

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Preserving theoretically-grounded functions across media platforms in interaction design

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Research on user needs for gesture interaction of foldable smartphones: comparison between current and potential users

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Rethinking designer agency: A case study of co-creation between designers and AI

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Scalable eHMI: Automated vehicles-pedestrian interactions design based on gestalt principles

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Techno-social correlations in responsive environments

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The Dronetic Moment: Future of drone light show & lighting design in concerts

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The Russia-Ukraine war and climate change: Analysis of one year of data-visualisations

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Threshold space design: Using water element for phase transition from physical space to virtual space with different law of gravity

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Touchy-feely: A designerly exploration of haptic representations of three mood states

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<https://doi.org/10.21606/iasdr.2023.325>

Transforming resilient healthcare systems: mapping the pathway forward with healthcare 4.0 technologies

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Understanding the relationship between in-car agent's embodiments and information with different criticality

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Using AR HMD in exhibition: Effects of guidance methods and spatial relative positions

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What's the Social Trust Mechanism Blending Virtual and Reality in the Context of Digital Media?

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<https://doi.org/10.21606/iasdr.2023.425>

When to say bye: A qualitative study of older adults' discontinuation of technology use after the pandemic

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<https://doi.org/10.21606/iasdr.2023.351>

[Changing] Heritage**Front Matter**

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AI Promotes the Inheritance and Dissemination of Chinese Boneless Painting—Research on Design Practice from Interdisciplinary Collaboration

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Applying generative art to cultural and creative product design to construct human-product relationship

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Design and the reframing of participatory approaches in Cultural Heritage and museums beyond pandemic crisis

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Digital for Heritage and Museums: Design-Driven Changes and Challenges

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Educating the attention of museum visitors through non-verbal art mediation

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GIAHS Metaverse: innovative digital transformation of agricultural heritage

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Graphic standards in graphic heritage: Scope, scale, and unity through multiplicity in Islamic design

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Inheriting the Intangible Cultural Heritage and embracing innovation: Digital Rubbing leads a new Experience of Audience Interaction in museums

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Museums at a crossroads

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Museums on-chain? A designerly contribution in the development of blockchain-based digital strategies in cultural institutions

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Places of worship digital information dissemination design strategy in communication ritual view

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Product design proposal for a relaxation space with 'Mindfulness' meditation

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Research on Urban Brownfield Landscape Design from the Perspective of Environmental Interaction - Taking the Former Site of Jiangnan Cement Factory as an Example

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Review: design reshape the relationship between museum collections and visitors in digital age

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Danhua Zhao, Hunan University, China

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Service co-design to envision the transformation of museums

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Study on key elements of kids cartoon design in Min-nam (Hokkien) language

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Study on the development strategy of HuiShan clay figurine from the perspective of urban symbolism-taking the design strategy of NANIMOMO blind box series as an example

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Study on the Status Quo and Sustainable Renewal Strategies of the Zhoutie Historic District in Wuxi, China

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Pictorials**Front Matter**

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Convergence research and participatory design of a study furniture system for small living environments

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Domestic infrastructure of food: thoughts on community engagement through food, furniture, and architectural exhibition

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Exploiting co-design, game thinking and citizen science in a workshop-like experience for stimulating reflections with teens

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From Urban Development to the Pluriverse – Ontological Design for Natural and Cultural Heritage

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Glitch Pluriverse

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Hitonami: Speculative design for overcrowded mobility arenas in the 6G era

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Hydrogen aviation: Imagining future air travel experience scenarios

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Making a scene: Representing and annotating enacted interfaces in co-performances using the screenplay

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Pedagogy of Experimental Design: Scientific research methods in architectural education

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Picturing interactivity: design exploration of a highly interactive picturebook

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ShapeChips: Value formation in material ecosystem using buffer materials generated from wood chips

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<https://doi.org/10.21606/iasdr.2023.694>

Stories from an unfinished prototype: a seemingly never-ending loop of practice and research

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<https://doi.org/10.21606/iasdr.2023.131>

Sync: Novel BCI design for neural synchrony, connectedness, and empathy

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The full and the empty. A dialogue between Chinese painting and design

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The future archives: a speculative approach for visualising the impacts of 6G-enabled infrastructure in Japan

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Tools for a Warming Planet

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Towards a Design Toolkit for Exploring and Specifying Close-proximity Human-robot Collaboration as Leader and Follower: the Case of Collaborative Drawing

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Using cultural probes to understand students' mental wellbeing

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UX design approach to guide parametric product customization: a case for eyeglass frame design

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Short Papers**Front Matter**

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A field guide to visualisation-supported information disorders for media and information literacy

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A holistic co-design model engaging multi-stakeholders for the rural revitalization in China — A case study of Qingshan Village, Hangzhou

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A study on Technology Acceptance Model of AI speakers among middle-aged people

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A systematic thinking on evaluation of community service facilities in the context of design

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A systemic perspective on designing for well-being in dementia care: learning from the case of Dementia Friendly Communities

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A systems thinking approach to codesign at a Montessori School

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Adapting future designer curricula: A comparative analysis of design future skills in learning outcomes

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An investigation of empathy in face-to-face and remote co-creative design processes

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Archives of dyeing katagami used in the inheritance and creation of traditional patterns

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Are all Pokémons created equal? Assessing the value-neutrality of Pokémon TCG design process

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Changing the Narrative: Co-designing awareness about Environmental Sustainability with children in Denmark

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<https://doi.org/10.21606/iasdr.2023.660>

Co-Designing Mental Health Futures: A case study on the development of a Residential Eating Disorders Facility

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Co-designing with children with cerebral palsy: context and co-design principles

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Cocreate: a co-design toolkit to design with and for adolescents together

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Combining Evaluation Grid Method to investigate the attractions of traditional crafts in Taiwan

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Cross-device system design based on stylized 3D map for intangible cultural heritage in Yunnan of China

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Design for expanding interaction and cognitive enhancement in virtual reality

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Design intervention to aid young Indians in identifying triggers of generalised anxiety disorder (GAD)

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Designer-researcher’s positionality; materialities matter

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Designing adaptable consumption: a new practice to foster food system transitions

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Designing effective interventions to encourage older adults proactively participate in physical activity and promote sustainable behaviour change

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Developing future kitchen for older adults: a model and participatory design approach based on literature review and ethics framework

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Development of “Amamizu Drink” as a Tool for Awareness regarding Rainwater conservation, and Investigation of the Effectiveness of Different Label Designs

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Development of a “Facial Rock-Paper-Scissors” Program for Rehabilitation of Swallowing and Cognitive Functions that Has Psychological Effects

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Development of an interactive teaching tool for woodworking course on components arrangement and sawing techniques using Augmented Reality technology

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Digital cultural heritage conservation: sampling stilt houses in Tai O Village

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Digitalized intangible cultural heritage preservation – reinventing the design practice of Hong Kong men’s cheongsam

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Educating the mindful designer: Exploring Mindfulness Practices in Design Education

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Enhancing elderly with Communication impairments: Exploring visual and voice communication tools

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Envisioning sustainable smartphone alternatives: a plurishop approach

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Expanding the boundaries of service design to assist re-design the short-term strategy for sustainable development

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Exploring the Influence of Aesthetic interaction using Personal Information Devices at Work

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Exploring the use of a digital twin in theatre stage design

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Fears, Desires and Visions of Prague Residents: Transition to Age-Friendly Community Centres in 2050

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Fostering collaboration between start-ups and students for mutually beneficial inspiring learning

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From Bodies in Technology to Digital Subjectivity: Research on the Identity Construction of Digital Humans

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From the mothers' movement to cradlr: an interaction design for refugee children

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Generative AI in creative design processes: a dive into possible cognitive biases

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How the GenAI sex education advisor became feasible: exploring the future design principles for child sex education in the community

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How to adopt Design Thinking within organizations? Mapping facilitators to activate an organisational transformation path

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Ideal model and everyday life: interior decoration of the modern home in early twentieth-century Shanghai

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(im)Mobile gendered identities: The relationship between mobility and identity

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Improving the patient-doctor relationship to fight antimicrobial resistance through data literacy promoted by a women-centred participatory practice

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In-house designers to break out public sector auditing in a manageable way

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Influence of lighting colour on visual evaluation of landscape paintings - Focus on some Claude Monet's artworks

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INTO: a remote communication tool featuring body language and the fusion of the real and the virtual

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Introducing hope in design for health and well-being

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Investigating the Impact of Digital Fabrication on Architecture Design Practice through a Taxonomy

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Kirisense: making rigid materials bendable and functional

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Living the Life: Evidence-based design and evaluation of psychosocial interventions with people with dementia

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Looking for the true nature of academic research on design: a systematic review of 27 PhD theses

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Measuring designers 'use of Midjourney on the Technology Acceptance Model

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Ontological design approach for Alternative soil-human relations

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Optimizing user experience in online payments: the relationship between wait time and psychological uneasiness

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Particling Night: The Design of an Emerging Media Artwork as a Tool for Reflection on Superficiality of Social Media

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Perception change for circular economy through the practice of plastic recycling system with local residents

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Preliminary study of participatory and nature-inclusive design approaches

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Product design for cultural digitization - the example of salt-making portrait bricks from the Han Dynasty in China

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Promoting Sustainable Practice through Video-Based Social Media: an Exploration of Food-Oriented R-Strategies for Domestic Consumption

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Sonic memories: towards a participatory memory archive

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Sparking Creative prowess through a peculiar design challenge: a mocktail design charrette

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Stairway to Heaven: Designing for an Embodied Experience with Satellite Data

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Taller than the trees: Growing a biophilic sensibility in a photo-graphic design studio course

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The agency of graphic design towards promoting collective awareness of heritage inscriptions: A study on the erosion of Palestinian traditional iconography

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The designer's role in fashion system transitions: A critical review of transition design

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The existence and potential of woven banana stalks furniture in Trangsan village Indonesia

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The Language of Tables: Pneumatic Interface Design for physical-digital experiences

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The lonely island: A design game to explore loneliness through co-creation

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The role of service design in designing and developing AI applications: Scoping review

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The use of collaborative media in societal crises – towards a conceptual framework

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The value and impact of stakeholder networks in exploring the complexity of government public services: A case study of Stray Dog Population Management

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Towards a framework for innovation in craft-design practices

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Tracking Acts of Kindness through Comics: an Experimental Study

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Unpacking Dominant Design: A critical analysis of power and dominant discourse in Design

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User-Centred Study on Over-the-Counter Medicine Purchasing System Design from the Perspectives of Consumers and Experts in Japan: A Codesign Case

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Utilizing ambiguous visual stimuli for creative expression in collaborative teamwork

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We've never learned to talk about it': Considerations for design researchers to address intimacy and sexuality

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Weighting key driving forces of consumers choosing coffee chains in different scenarios

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What is the Effect of a Slant Shape in the Design of a UGV Delivery Robot? - UGV Robots and the Effect of Shape on the Perceived Safety

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Doctoral and Postgraduate Consortium Abstracts**Front Matter**

Paola Bertola, Politecnico di Milano, Italy
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Clorinda Sissi Galasso, Politecnico di Milano, Italy
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A time-based approach for the social spatialization strategies in retail design

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Changing People's behaviour toward Littering in the Egyptian Community

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Co-Creating Narratives of Usefulness

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<https://doi.org/10.21606/iasdr.2023.816>

Co-Designing with Immigrant Women to imagine an Equitable Mental Health Service Ecosystem

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<https://doi.org/10.21606/iasdr.2023.796>

Design mediating printing technology and food culture: a small paper box linking "eating" and "mobility"

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<https://doi.org/10.21606/iasdr.2023.632>

Designing Healing from Eating Disorders: Systemic and imaginative approaches

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<https://doi.org/10.21606/iasdr.2023.803>

Digital patient experience: understanding, improvement, and evaluation from a human-centered design perspective

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Digitally fabricated Design Interventions for ALS/MND

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From E-waste to Jewellery: creating emotionally durable jewellery with the metal recovered from electronic waste

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Immersive Reading in VR

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Investigating strategies for delivering change through the practice of co-design with communities in the Northern Ireland context

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Investigating the adoption of autonomous processes in the context of organizations

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Longing for: Exploring intimacy and sexual expression in long-term care through Participatory Design approaches

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Mindfulness for designers. An integration of mindfulness, design education and reflective practices

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Participatory design for craft sustainability in rural areas: a multi-sited approach

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Personhood: defined, collected, and integrated

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Queer cities. Designing inclusive public spaces through participative and social innovative actions and practices

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Queering Futures with Data-Driven Speculation: the design of an expanded mixed methods research framework integrating qualitative, quantitative, and practice-based modes

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Service Design to promote a systemic and dynamic perspective of well-being in dementia care

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Snapping (identities) through design forward

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Responsible tourism experiences: Designing solutions to improve communities-based tourism services from global to local scale

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Technological mediation analysis on Constructive Design Research: A case study of trust

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The body gets the notion: performative design practice for human computer integration to encourage innovation in the domains of health and well-being

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Tools for opening the lonely black box and changing young adults' perspectives of their loneliness

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Utilizing patent data for enhanced design creativity and reduced fixation in product design

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The socio-ethical influences of digital technologies in the Design of S.PSS and DE: a literature review

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Digital technologies have become essential in most parts of the world. Being leveraged by the covid-19 pandemic, they have been used to scale up and create new products and services in different sectors. It is a shared understanding that these disruptive technologies have caused profound changes in the structure of society and, particularly, opening discussions about ethics and democracy. The Sustainable Product-Service (S.PSS) and Distributed Economy (DE) systems models are win-win opportunities for sustainability, not only in the economic and environmental but also in the socio-ethical dimension, which is sometimes neglected. Despite the growing application of digital technologies, there are few discussions about their socio-ethical interferences with the design of S.PSS and DE. This article is a systematic literature review to map the benefits and risks of digitisation for the socio-ethical dimension in these models. The selection criteria are based on six design strategies for the socio-ethical dimension developed within a set of projects conducted by the Learning Network on Sustainability (LeNS). This study aims to understand the interaction of digital technology with the socio-ethical dimension of S.PSS and DE design, mapping and reflecting on what is presented in the articles through the strategies. As a result, the founded papers presented a diversity of disciplines, and it is suggested to reformulate the strategies and models to comprise socio-ethical issues of the digital era.

Keywords: *design for sustainability; sustainable product-service system; distributed economy; digital technology*

1 Introduction

Digital technologies have become essential in most parts of the world, transforming contemporary societies and have been leveraged after the quarantine caused by the pandemic of Covid-19. The necessity of remote communication increased the use of data worldwide, reaching an exchange of more than 64 zettabytes (10^{21} bytes) in 2022 (Taylor, 2022). The spending on digital technology reached \$1.6 trillion in the same year (Sava, 2022). Moreover, the recent development of Artificial Intelligence (AI) technologies is considered one of history's most significant technological advances (Parker, 2018; Vincent, 2017). Nevertheless, before 2020 digitalisation was already causing discussions



about its interferences in contemporary society, especially in privacy and democracy (e.g., Han, 2017; Lanier, 2018; Zuboff, 2020). Scandals such as NSA documents leaks (Greenwald, 2013) and Cambridge Analytica's influences on the US elections (Cadwalladr & Graham-Harrison, 2018) provided concrete proof that any country is vulnerable to democratic and privacy threats. The General Data Protection Regulation (GDPR, 2016) created by the European Union in 2016 changed the course of discussions on ethics in the digital era, which must continue on this path of improvement. At the time of writing this article, 200 new applications developed with the latest AI technology have been launched in the market (GenerativeAI, 2023), and the ChatGPT AI chatbot has been blocked in Italy for privacy breaches (Pollina & Mukherjee, 2023).

Businesses have permanently appropriated new technologies to remain competitive. From steam engines to today's smart equipment, being up-to-date is essential, and new technology development is accelerating to respond to this demand. In Sustainable Product-Service Systems (S.PSS), the digitalisation process started with the advent of the Internet and data transmission efficiency in the 90s (Zheng et al., 2018). With the 4th industrial revolution, smart products and services have further evolved in connectivity and intelligence (Zheng et al., 2018). Data collected through sensors and the Internet of Things (IoT) started to be used to understand users' necessities to improve and develop innovative services and products (Li & Found, 2017; Valencia et al., 2015).

The design of S.PSS combined with Distributed Economy (DE) model is a promising strategy to diffuse sustainability for all, recognised to have win-win opportunities, thus, with economic, socio-ethical, and environmental advantages (Vezzoli et al., 2021). Therefore, these strategies are necessary to face the crises affecting all three dimensions and search for more sustainable opportunities. An S.PSS model can improve, for example, access to low or middle-income people and businesses, such as a computer in a leasing offer by the producer where the user pays a monthly plan and can have access to the product (the computer) and services (maintenance, updates) at a lower initial cost. At the same time, the producer remains in ownership of the product, increasing its interest in developing environmentally sustainable products. In the digital age, DE takes a "multi-local" structure, especially concerning knowledge-based DE (i.e., Distributed/Open Software and Distributed/Open Design) (Vezzoli et al., 2021). These are communities connected virtually, sharing and developing knowledge collaboratively. The two models can assist each other in improving their structures and sustainable advantages, such as an S.PSS offer of a computer at a lower cost for software developers and open software with a remote maintenance network for the computer.

However, there is a growing awareness of the socio-ethical implications of digital technologies, and few studies have focused on their interaction in S.PSS and DE. The existing literature reviews that address some of these three subjects, the system models, digital technologies, and socio-ethical dimension, do not focus on the intersection between them. For example, Corsini & Moultrie (2021) discuss Design for Social Sustainability for S.PSS does not approach digital technology. Pirola et al. (2020) analyse digital technologies in S.PSS but present a focus on the environmental dimension. Therefore, this article intends to understand the interactions of digital technology in the socio-ethical strategies of S.PSS and DE design. Interactions here imply positive or negative exchanges brought by digital technologies. To better understand socio-ethical benefits or risks in the design of S.PSS and DE, six design strategies developed within a set of projects conducted by the Learning Network on Sustainability (LeNS) are presented as a basis.

2 Theoretical basis

The following sub-items provide an understanding of the socio-ethical dimension in the design of S.PSS and DE for this research and definitions presented in the literature for digitisation and these models.

2.1 The socio-ethical dimension in the design of S.PSS and DE

The sustainability concept is commonly balanced between three interlinked dimensions: economic, socio-ethical, and environmental (UN, 2023). The socio-ethical dimension (or social dimension) can be approached by two pillars: equity and cohesion (Vezzoli et al., 2022). Raworth's (2012) "Social Foundation" concept further characterises what this dimension comprises. It encompasses international human rights in a framework with the following categories: food security, income, water and sanitation, health, education, energy, gender equality, social equity, voice or freedom of expression, jobs and resilience (Raworth, 2012).

Product-Service System (PSS) is an offering model that mixes products and services to meet specific customer demands (Tukker & Tischner, 2006). When the provider takes ownership of the product or is responsible for its lifecycle, the value is detached from the consumption of material resources. Therefore, the PSS is considered a win-win opportunity for the three dimensions of sustainability (becoming S.PSS), developing the provider's interest in improving the environmental sustainability of its products and services, as well as reducing acquisition and/or maintenance costs for customers, providing differentiation of this offer in the market (Vezzoli et al., 2022). Specifically in the socio-ethical dimension, the S.PSS model, thus, can improve access to its products and services in low or middle-income contexts.

Parallel to this concept, DE can be described as a local-global economic system comprised of interconnected autonomous productive units established near its final customers to provide goods and services (Chaves et al., 2019), transferring control of crucial activities towards or by the end-user, such as production, maintenance and repair (Ranjani et al., 2021; Vezzoli et al., 2021). This assists in an equalitarian distribution of control of essential activities and income and strengthens social cohesion. Combining S.PSS with DE, they complement each other, improving their structures and strengthening strategies towards more sustainable designs.

The field of Design for Sustainability has been developing practices towards all dimensions. On the Socio-Ethical dimension, Clark et al. (2006), in the Design for Sustainability project for the United Nations, provided an initial approach to the social aspects of products. Tukker & Tischner (2006) also presented social/ethical sustainability aspects of the first European Network on Sustainable Product-Service Development (SusProNet). The Learning Network on Sustainability (LeNS) - an international network of higher education institutions for developing and diffusion design for sustainability as a discipline - has diverse works in this practice and functions as a distributed knowledge research community. In this sense, the network has been compiling and sharing its knowledge on literature and practices, such as Chaves et al. (2019), that provide six principles to design S.PSS and DE for socio-ethical sustainability based on social cohesion and equity. More recently, Vezzoli et al. (2022) presented an updated version of the following S.PSS design strategies for socio-ethical sustainability:

1. Improving employment and working conditions.
2. Favouring/ Integrating low-income, weaker, and marginalised.
3. Improving equity and justice between stakeholders.

4. Improving social cohesion.
5. Empowering/ enhancing local resources.
6. Enabling/ promoting responsible, sustainable consumption.

Improving employment and working conditions (1) implies an offer to small-medium business access to equipment rather than ownership; improving and sustaining and promoting healthier and safer conditions; providing adequate hours and payment; enabling job satisfaction; ensuring training and education; avoiding alienation; involving workers in decision-making processes; considering suggestions; and collaborating with colleagues and their work.

Favouring/Integrating low-income, weaker, and marginalised (2) involves improving their quality-of-life conditions, offering users access rather than ownership or shared property and complementary services to reduce running costs (maintenance, repair, update, etc.) rather than ownership. Also, systems that have easier access to credit and which facilitate foreigners and their settling in the social context.

Improving equity and justice between stakeholders (3) is related to promoting fair partnerships and just and equitable relations with suppliers, clients, communities, and institutions.

Improving social cohesion (4) involves the development of solutions that bring together those with different characteristics and foment tolerance and convergence towards a group with common goals and values. Implies promoting systems that enable integration between neighbours, different cultures, generations, and genders; for sharing and maintaining common property among neighbours; for co-housing or coworking; and for residents to participate in developing common goods (codesign).

Empowering/enhancing local resources (5) aims to enable the protection, regeneration, and enhancement of resources and local skills, increasing the perceived value associated with cultural values and identities and improving the social well-being of their communities; to offer access and/or complementary services for equipment to benefit low-medium income local entrepreneurs and for distributed/decentralised production systems (energy generation, food production, water management, manufacturing, software development, information/ knowledge generation, design).

Enabling/ promoting responsible, sustainable consumption (6) implicates fostering the comprehension of the concept of sustainability and the design for Sustainable behaviour, with strategies to guide, sustain and ensure positive behavioural changes towards sustainability; enhancing socio-ethical sustainability, increasing stakeholder transparency, complementing offers with learning experiences, and sustainable behaviour choices; and enabling the clients to participate responsibly by involving them in decision-making.

These six strategies were applied as criteria in the literature review to find where technology interfered with socio-ethical sustainability. The method is further explained in section four.

2.2 The digital era of PSS and DE

Digitalisation is a process of converting information from analogue to digital format (Negreiro & Madiaga, 2019). This format is organised into units of data (bits). Digital technologies are electronic devices, resources, and systems that aid data generation, storage, and process (Mtshalia et al., 2020). Consequently, Information Communication Technologies (ICT) are vital to its development (EU, 2023). The World Economic Forum (2023) points out five technologies as highly attached to the

contemporary digital economy: Artificial intelligence, the Internet of Things, Virtual and Augmented Reality, 3D Printing, and 5G. All these technologies impact the development of products and services and, consequently, on the design field and its competencies (Ogg, 2019).

Recently, it has been argued that these technologies disrupt the social structure, altering business operations. Through data collection, user profiling, identification of behaviours, and identification of patterns, services and products are personalised, being much more responsive (Zuboff, 2020). However, this has led users to be in a state of constant vigilance, leading to behavioural manipulations (Zuboff, 2020) and resulting in solutions subject to biases (Crawford, 2021). Nonetheless, legislation has been created and developed in different parts of the world to face these radical changes, aiming for an inclusive and democratic future. In Europe, the GDPR is activated when digital technologies involve personal data (UE, 2023). Personal data is any identifiable personal information about an individual (UE, 2023). Hence, all projects dealing with human-produced data in the European Union must demonstrate GDPR compliance.

Following these trends, PSS is increasingly applying digital technologies. Zheng et al. (2018) state that this can be assumed on three levels, progressing over time onto two axes: connectivity and intelligence. First, the model benefited from Internet use, improving communications. Around 2010, with the advent of Industry 4.0, IoT was widely adopted (Zheng et al., 2018). From 2015 until today, Valencia et al. (2015) introduced the smart PSS concept as a PSS that embraces disruptive ICT. Kuhlenkötter et al. (2017, p.1) provide a simple definition of Smart PSS as a “digital-based ecosystem of value creation characterised by high complexity, dynamics and interconnectedness among stakeholders.”

Smart technology enables data collection through sensors and users' input, monitoring the device conditions and user behaviour in real-time (Negash & Sarmiento, 2023). They are mainly applied to enable the customisation of offers and the development of service innovations assisting value co-creation (Li & Found, 2017; Negash & Sarmiento, 2023; Zheng et al., 2018). It can also improve technical decision-making, enhancing control and reducing risks. Scaglione et al. (2021), when analysing the use of data in the design of products and services, structure big data into two main concepts of data science and business intelligence (BI). For the authors, data science can be composed of data generators that record user activity (smart objects, computers, etc.), big data servers where it is stored (clouds), and data mining that finds patterns and creates mathematical models (i.e., algorithms). Along with that, there are three different types of BI: business analytics, data analytics, and machine learning. The first is used to provide insights that enable strategic business decisions. Data analysis is further ahead, predicting future scenarios. In an even more advanced form of BI, these strategic decisions are made through a more accurate predictive analysis of future behaviours with machine learning (Scaglione et al., 2021). Therefore, product and service systems are increasingly using data and more advanced forms of BI for their decisions.

In DE, digital technology has been an enabler for communication, self-improvement, and open data, especially leveraging distributed knowledge systems, forming virtual communities that make their projects and information available, where anyone can study, test, modify and sell solutions based on the community knowledge (Menichinelli, 2018). For example, distributed design is a system where different actors can participate in the design of a product by sharing ideas and blueprints virtually and 3D printing it locally (Perez & Santos, 2017). Although the concept of DE is strongly related to local, in

the digital economy, this model may not be well defined geographically, and people from different parts of the world can develop a solid social cohesion and become a type of distributed system (Santos, 2019; Vezzoli, 2018), what can be perceived as multilocal. Moreover, the characteristics of virtual or multilocal communities and shared knowledge approximate the distributed knowledge system to open innovation strategy concepts. Open innovation can be described as integrating collaboration and co-creating shared value to cultivate innovation ecosystems (Curley & Salmelin, 2013). Institutions search for external, collaborative innovation where the user is seen as a participant (Curley & Salmelin, 2013).

In both models (S.PSS and DE), it is possible to see that digital technologies have created a disruption. It has changed how they work by improving connectivity and collecting user data. In PSS, the smart technology incorporated into products and services allowed a closer look at users' behaviour, allowing companies to respond better to their demands. In DE, virtual platforms shorten the distances between groups and provide a space for knowledge management.

3 Methodology

This research has a qualitative approach with an exploratory goal of the subjects through a critical literature analysis. The adopted method was based on a systematic literature review (SLR) suggested by Conforto & Amaral (2011), divided into 3 phases (input, process, and output). The diagram below represents the process with each phase:

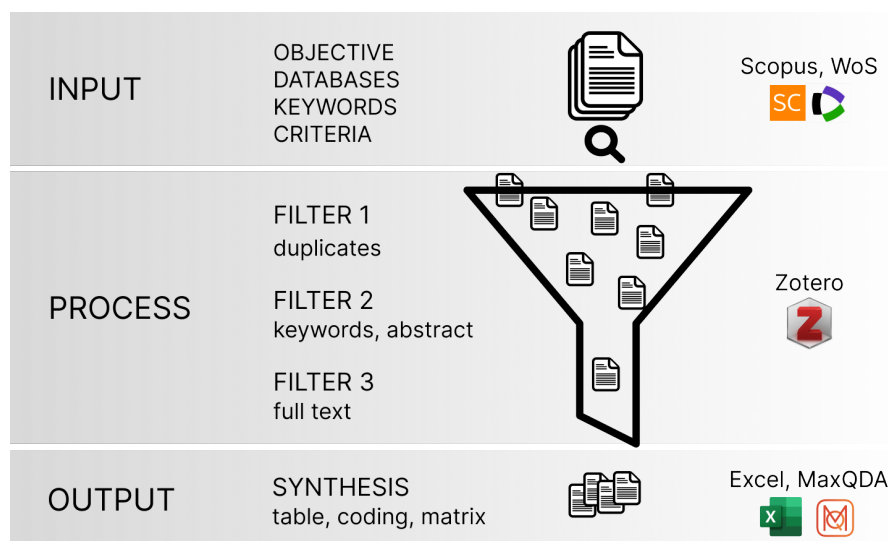


Figure 1. Literature review visual diagram.

The entry phase deals with the preparation for the research, where the objective, databases, keywords, and criteria are defined. The selection of keywords was realised through an initial literature review and the theoretical basis presented on the preview item. Therefore, the keywords representing Digital Technologies, Design for Sustainability, and Socio-Ethical Dimension compose a string to be searched in Scopus and Web of Science online databases (see Table 1).

The string brings the sequence of keywords interconnected by connectors (e.g., or, and), containing some search specifications where these words should be looked for (e.g., title). It was revised until the results shown on the first page of both sites were relevant to the subjects. In addition, some pre-

selection factors were used. For this research, peer-reviewed articles, and conferences, in English were considered. Moreover, it considered papers from the last ten years, from 2013 to 2023, focusing on more recent publications due to digital technologies' rapid development and changes. In total, eighty-nine articles were found.

In processing, the articles found in the databases were downloaded in software (Zotero) to organise and select them through three filters. First, the duplicates were deleted, as two databases were used. Next, the title, keywords, and abstract were read, seeking elements aligned with the selection criteria. Finally, the full text was read, extracting the final selection (seventeen articles).

The contents were synthesised in phase three (output), bringing the results. For this, a table (Excel) helped to compile information about articles, such as authors, year, and country. In addition, coding software (MaxQDA) was used to collect evidence to explore possible interconnections between the abovementioned strategies and the articles. For this selection of evidence, the text elements related to the strategies were attributed a weight from 1 to 3, with the paper receiving the highest number. In this classification, 1 is a citation of an element (weak evidence), 2 is an acknowledgement of some aspect, and 3 is an element inherent to the article that involves the approach (more substantial evidence). The numbers corresponding to each article in each strategy were assigned in a matrix presented in subitem 4.2.

4 Results

4.1 Systematic literature review

Through the search into the two databases, 89 articles were found. Their references were uploaded in Zotero software for control. In the second phase, the three filters were applied to sort these documents. The selection criteria were to identify evidence in the articles connected to the strategies. The articles were marked as they were related to the strategies, such as “yes” and “uncertain,” which were maintained, and “no” were then eliminated. In the first filter, 36 duplicates were eliminated, followed by the second filter, where 13 articles were eliminated. Finally, 17 remained as the final selection. Below is the string that was applied and the output of articles in each database:

Table 1. String and results in each database

String	Database	Total
(TITLE (digital* OR smart OR data* OR "artificial intelligence" OR ai OR "machine learn" OR "augmented reality" OR ar OR "internet of things" OR iot OR "virtual reality" OR vr OR 5g OR "information and communication technology" OR it OR ict OR "3D printing") AND TITLE (spss OR pss OR "product service system" OR "distributed economy" OR "decentralised economy" OR "design for sustainability" OR "open design") AND TITLE-ABS-KEY ("social sustainab*" OR socio-ethic* OR equity OR "for all" OR inclusion OR democratic OR social OR surveillanc* OR privacy OR "digital literacy" OR transparen* OR "social dimension" OR decolonial* OR pluriverse)) AND PUBYEAR > 2012 AND PUBYEAR > 2012	Scopus	53
	WoS	36

Of the selected documents, there is a slight indication of growth in the studies of these disciplines in the last ten years. However, most publications are from 2020 and 2021.

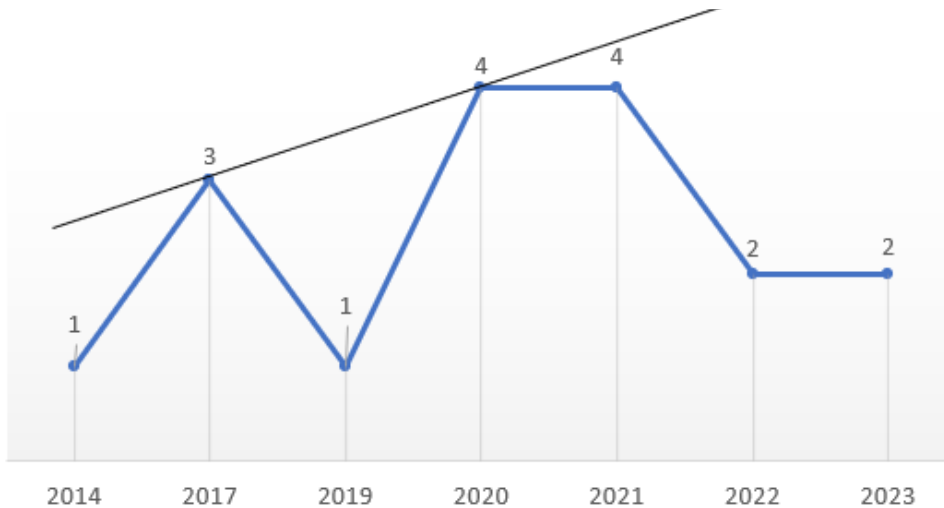


Figure 2. Graph of the publication of the selected articles per year.

In assessing the geographical location of authors and co-authors, the United Kingdom and China are the leaders, with four articles each, followed by Japan with two. Nonetheless, the selection contains a diversity of countries, with also Finland, Sweden, Swiss, Germany, Italy, USA, Equator, Turkey, Singapore, and Taiwan.

The main authors/co-authors were Ai Qiang Li and Pauline Found, with three articles each, followed by Maneesh Kumar, Pai Zheng, and Kentaro Watanabe, with two articles each. Most of the documents were from journals (11). However, the field of study was also diversified. For example, Li and Found (Li & Found, 2017) and Kumar (Li et al., 2020, 2023) have publications from the business and administration field and are strongly related to the co-creation of value through the data analysis concept. Watanabe's articles (Tsunetomo et al., 2022; Watanabe et al., 2020) are from engineering and design, bringing study cases on the development of products and services. Pai Zheng's articles (Zheng et al., 2019, 2020) are from industrial and systems engineering, discussing more general structures of smart PSS.

PSS was addressed in 14 articles, in which two mention a distributed or decentralised production type. Zheng et al. (2020) mentioned the use of Smart technologies allied with open innovation. The three articles on DE talk about forms of open knowledge, such as open design and maker communities (Beltagui et al., 2020; Cangiano et al., 2017; Menichinelli, 2017). Two mention an offer of products and services. This demonstrates the interconnection between subjects.

Furthermore, the diversity presented by the countries of the authors and fields of the journals and congresses affirms the importance of the subject since it has been approached in different disciplines and cultures.

4.2 Strategies for socio-ethical sustainability in the documents

4.2.1 Strategies matrix and benefits

For the selection of evidence, as already presented, the text elements related to the strategies were weighted from 1 to 3. The numbers corresponding to each strategy in each article were assigned in a matrix. Figure 2 represents this matrix showing the importance of each strategy per article and the strategy total score percentage as a strategy weight over the total sum of the scores:

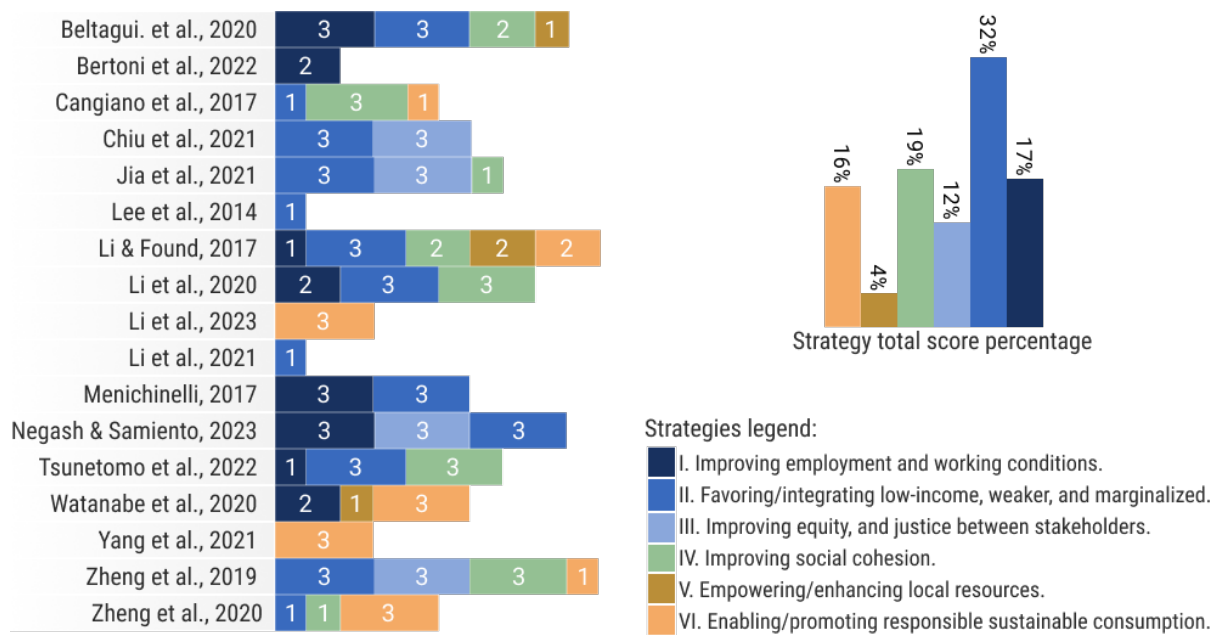


Figure 2. Evidence weight per article and strategies total score percentage.

Empowering/ enhancing local resources (5) had the fewest and weak connections (4%). In the evidence found, Beltagui et al. (2020) and Li & Found (2017) explain that the presence of local 3D printing can assist in production closer to the consumer, providing spare parts for maintenance or customised ones, allowing local stores to offer specific products and assist local workforce in delivering better maintenance services. Watanabe et al. (2020) cite a digital payment in a tourist area that provides better structure to the visitors with easy access to toilets and public baths and to purchase food and souvenirs. Conveniences like that can improve the site's attractiveness, being more prepared for new visitors who do not speak the regional language.

On the other hand, the strategies with more substantial evidence were Improving equity and justice between stakeholders (3) at 32% and Improving social cohesion (4) at 19%. A point related to DE and both strategies is the concept of open innovation described by Zheng et al. (2020) as a shared vision of different actors towards value co-creation to meet their demands, aiming for economic sustainability and well-being improvement by leveraging smart technologies to provide products and services. Menichinelli (2017) explains that digital technologies have blurred the lines between amateur and professional designers using open design platforms. Moreover, the open design enables small businesses to share resources and reduce investments (Beltagui et al., 2020; Cangiano et al., 2017).

One of the primary connections in both strategies is related to improving communication. Closer to Improving social cohesion (4) Digital technologies can engage different people in a community together through a virtual platform (Cangiano et al., 2017; Zheng et al., 2020) or connect consumers in a new channel such as a smart product for monitoring elders with a feature of video call to connect elders with their adult offspring presented in Tsunetomo et al. (2022). While more relative to Improving equity and justice between stakeholders (3), connecting providers and consumers, the idea of value co-creation through data was present in many articles (Chiu et al., 2021; Li et al., 2023; Li et al., 2021; Li & Found, 2021; Jia et al., 2021; Zheng et al., 2020; Zheng et al., 2019). From users' data collection, it is possible to obtain information to create customised services and products that better

correspond to clients' preferences and necessities (Jia et al., 2021). Li et al. (2021) claim that clients are no longer passive in the creation of value processes. Instead, they can actively participate in the process of new services, being data a bridge between stakeholders towards value co-creation. In Zheng et al. (2019), one of the definitions of smart PSS provided is an IT-driven value co-creation business, positioning this idea as a key factor for Smart PSS.

Closer to these strategies, strategy 2 for Favoring/ Integrating low-income, weaker, and marginalised was related to improving communication between client and provider. Through smart products and telemonitoring services, an S.PSS can deliver prompt remote maintenance despite users' location (Chiu et al., 2021; Jia et al., 2021; Negash & Sarmiento, 2023; Zheng et al., 2019) or remote consultancies for patients with a diverse necessity, including motion limitations such as elders (Jia et al., 2021; Negash & Samiento., 2023) with advanced remote diagnosis (Negash & Samiento, 2023). For Lee et al. (2014), data collected through these devices can also empower users by giving information about themselves and providing more control, allowing autonomy and choices.

Improving employment and working conditions (1) and Enabling/promoting responsible, sustainable consumption (6) had medium correlations found in the texts, with 16% and 17% total scores. The sixth strategy was connected to emotional design and design for sustainable behaviour. The user-affective connection was seen as an advantage for expanding the life cycle of products since it can prolong its use through personal attachment (Zheng et al., 2020; Yang et al., 2021). In Yang et al. (2021), eye-tracking data, such as pupil dilation and eye movement, was used to understand the attractiveness of a product compared to others. Another point was regulating solutions and options in response to monitoring data (Li & Found, 2017; Li et al.,2023; Zheng et al., 2019). Zheng et al. (2019) exemplify traffic regulation to reduce air pollution or provide remote maintenance to avoid physical transport of on-site services. Moreover, Li et al. (2023) mention a service of carbon calculation for customers, allowing a more conscious choice of use.

In strategy for Improving employment and working conditions (1), as smart products and services can provide information, they also can assist workers by providing better resources to execute maintenance (Li & Found, 2017; Zheng et al., 2019). Digital platforms can also assist professionals by sharing information and foment peer collaboration (Menichinelli, 2017). Another point was the use of technology to optimise work. Watanabe et al. (2020) presented a case where sensors provided data to improve exhaustive trajectories of employees in a restaurant coming and going from back to frontstage, a problem identified through a discussion with staff and managers. Some aspects of safety also arise in two other articles. For Negash & Sarmiento (2023), in the health sector, providing remote diagnosis is safer for the patient and workers due to contagious disease cases. Updating equipment can also provide safer environments, Bertoni et al. (2022) give an example of changing to electromobility with remote control in the mining industry can radically reduce air pollutants, improving workers' well-being.

4.2.2 Strategies hinders

On the negative side, a point presented in many articles was the lack of social readiness, as people do not always have access to new technologies, nor are they prepared to use them (Li et al., 2020). This was stated in the case of the involvement of elders (Jia et al., 2021; Tsunetomo et al., 2022) and in the case of workers, usually when talking about business structures (Li et al., 2020; Negash & Sarmiento, 2023; Watanabe et al., 2020). Negash & Samiento (2023) state that some patients and physicians may

become frustrated because they are not used to digital technologies. This affects strategies 1, 2, 3, and 4 as it segregates those with difficulties adapting to new technologies and who do not have access due to low income.

Despite the benefits presented by the articles being related to the exchange of large amounts of data, only four documents cited ethical concerns: Tsunetomo et al. (2022), Zheng et al. (2019), Cargiano (2017), and Menichinelli (2017). Each provided a different aspect. In developing an online platform for open design, Cargiano (2017) cites the importance of transparency and democratic processes, providing more inclusive opportunities and being especially relevant to strategies 3 and 4.

Only Tsunetomo et al. (2022) presented privacy and surveillance concerns. Nevertheless, sensors have been suggested in ten works, collecting data from the use of smart objects and services (e.g., Chiu et al., 2021; Jia et al., 2021; Lee & Kao, 2014; Li et al., 2020; Li & Found, 2017; Negash & Sarmiento, 2023; Tsunetomo et al., 2022; Watanabe et al., 2020; Yang et al., 2021; Zheng et al., 2020). In Tsunetomo et al. (2022), the authors presented a case of a monitoring service with a communication robot for elders. In a workshop with potential users, participants showed concern about the “incognito approach” function where the elderly could be watched at any time by their caretakers. Then the design was adapted to allow users to be not always observed. Furthermore, a function to enable communication between family members has been added in the interest of the value human relationships related to social cohesion (4).

Of the papers that brought the concept of data-driven value co-creation, only Zheng et al. (2019) stated concern about data collection. They mention that the design solution must follow legal restrictions such as the GDPR, ensuring awareness and consent of the collected data.

From a deeper perspective, Menichinelli (2017) goes further on the matter of data. While discussing social interaction mapping in a platform for open design, the author acknowledges the criticism of platform ecosystems regarding their influence on the social, political, and economic spheres. He cites that these interactions can affect the human relationship with knowledge, creating a preference for one type of information processing over another. The author warns that state-of-the-art technology does not necessarily mean democracy or the expression of collective intelligence. These statements can be connected to strategies 3 and 4.

5 Discussion

Although it is possible to position some of these negative impacts and relate them closer to a strategy, they may permeate and influence others, not just those associated with this paper. Furthermore, despite the positive evidence presented, many of them can be discussed from an ethical point of view. In the ten articles that presented the co-creation of value through user-generated data, this concept was seen as a promising manner to include users in the development of new solutions. Nonetheless, the use of data to develop products and services can be misleading due to bias replication presented in this data (Crawford, 2021). Moreover, it may not represent a real user will, leaving the issue of a forced desire without understanding conscious choices where the user can reflect on future actions and improve their own behaviour. Zuboff (2020) points out that one of the most significant contemporary problems is the use of excess personal data for behaviour modification and manipulation aimed at greater consumption.

In the case of the labour market, one of the biggest problems of current technology is the obsolescence of professions and professionals. Bertoni et al. (2022) and Li et al. (2017) cite the possibility of improving business structures through technology, eliminating the need for humans. Another fact is the case of the unpreparedness of users and workers, which may represent a denial of already oppressed groups who are excluded and marginalised through technology (Gonzatto & Amstel, 2022). At this point, designers may even reinforce the problem by developing products and services for idealised users, ignoring those with difficulty interacting or those without access to the web (Gonzatto & Amstel, 2022).

Lastly, in the case of Yang et al. (2021), using sensors to understand emotional and cognitive product preferences can be addressed by a more recent discussion on cognitive privacy and neural surveillance (Corbyn, 2023). The evolution of wearable devices that can collect neural activity data raises concerns that it could worsen the existing surveillance problems of digital technology.

Due to the weight of these issues and the fact that technology is generating unprecedented socio-ethical changes, a gap is identified here to reformulate the S.PSS and DE design strategies to approach these factors. These strategies should address crucial concerns such as data concentration, privacy violations, surveillance, and the potential barriers to accessing information, products, and services that threaten democratic values. Furthermore, it is important to enhance these system models to ensure they continue to benefit the socio-ethical dimension. For example, Cargiano (2017) pointed out that transparency and a democratic process could lead to more inclusive opportunities, which aligns with open innovation supported by distributed control over the data, leading to collaborative development of products and services involving users in decisions.

As Tackara (2016, p.8) states, the design shall “deliver value to people—not deliver people to systems”. Ethics should not be seen only as a legislative obligation but as a guide to the future that society envisions, and design shall take part to collaborate for this sustainability. Therefore, there are many points where a greater understanding of the role of design and possible improvements is needed.

6 Conclusion

This article analysed the factors that influence the socio-ethical dimension of sustainability in S.PSS and DE models. The method applied was a systematic literature review that used six strategies for designing sustainable systems focused on the socio-ethical dimension as criteria. The results brought a diversity of articles in the sense of geographic locations and fields of research, showing the importance of the subject as global and transdisciplinary.

On evidence found, digital technologies have shown advantages in improving workers' conditions, providing safer environments, and offering better and optimised workplaces. In the case of equity, most of the evidence was in meeting the diversity of customer preferences. The co-creation of value through data included customers developing better services and products (Zheng et al., 2019; Li et al., 2020). Another point was that the offer of remote telemonitoring services could favour the inclusion of people with special needs. For social cohesion, the concept of Open Knowledge was presented by the authors intertwined with digital platforms to bring diverse people together and develop online communities (Cangiano et al., 2017; Zheng et al., 2020). The simple act of opening a new communication channel through a function available in a product by Tsunetomo et al. (2022) aided in

better social cohesion between different age parents and their adult children. Also, to enhance local resources, technology can provide better solutions locally (customised), such as the presence of a 3D printer in Beltagui et al. (2020) and Li & Found (2017). Alternatively, improve local service structures as the offer of digital payment is cited by Watanabe et al. (2020). Customisation can reflect on responsible consumption, providing information, choices, or limiting options based on personal data for sustainable behaviour (Li & Found, 2017; Li et al., 2023; Zheng et al., 2019; Zheng et al., 2020; Yang et al., 2021;).

On the negative side, problems were presented regarding inclusion related to access to new technologies and user preparation for them (Jia et al., 2021; Tsunetomo et al., 2022). Points associated with the surveillance of devices equipped with sensors were also raised (Tsunetomo et al., 2022). Zheng et al. (2019) cited the concern about complying with data protection legislation. Cargiano (2017) presented the importance of transparency and more democratic processes. Moreover, finally, Menichinelli (2017) brought the political and socio-ethical influences that technology can have. All the problems could hinder more than one strategy.

Digital technologies can potentially support different design strategies for socio-ethical sustainability in S.PSS and DE. However, due to the disruption its advancement causes in social development (positive or negative), it is necessary to maintain a dialogue and constant development on ethical parameters. In the case of S.PSS and DE design, the six strategies presented touch on ideas within these themes. Nevertheless, due to the significance of contemporary technology and its fast-paced evolution, this article suggests updating the strategies and models to consider crucial issues such as data concentration, violations of privacy and surveillance, and potential barriers to accessing information, products, and services. Raising issues and solutions beyond legal obligations, thus that the professional designer shall be equipped with a solid knowledge base and know-how for conscious and active participation, collaborating with the application of technology for a democratic, fair, and humane future. For future work, it is suggested to deepen the research and the understanding of the designer's role when dealing with the abovementioned ethical issues in the era of disruptive digital technology.

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