INTERIORS IN THE AGE OF UNCERTAINTY

Future-proofing design practices

Elena Elgani, Umberto Monchiero

D.I. FrancoAngeli
DESIGN INTERNATIONAL

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The book is written by the authors sharing the background of reference and articulation of content.
The chapters *Introduction. Approaching post-pandemic interiors*, 1. Sustainability (1.1 *A contemporary debate on sustainable development*; 1.2 *Towards Collective responses*; 1.3 *Sustainable processes applied to hospitality spaces*) and 2. Flexibility (2.1 *Re-defining Public and Private: new concepts and hybridizations* and 2.2 *Designing adaptable spaces, furniture and objects*) are written by Elena Elgani.
The chapter 3. Perception (3.1 *New languages of safety: the role of sensorial perception in re-inhabiting interiors* and 3.2 *Adaptive scenarios: virtual and physical responses to new challenges*) is written by Umberto Monchiero.
The chapter *Conclusions. Expanding future interior ecologies* is written by both.

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Special thanks to our families!

to my beloved mother and father, we never give up. Elena

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Foreword

*Francesco Scullica**

This book originates from an in-depth period of research, based on desk research, literature review and a series of lectures, interviews and participations at conferences held during the period of the Covid-19 pandemic, and in the immediately following period, concerning the evolution of design to respond to the new challenges posed by the contemporary uncertain period, especially focusing on spatial design.

The publication builds on this cultural substratum and then evolves to embrace a broader definition of the role of interiors in times of crisis, which can therefore tame common uncertainties and help people live and create a more sustainable future.

The contribution is therefore based on a solid methodological approach focused on references and case studies analysis, acquired through explorations on the themes of post-pandemic design with significant attention to sustainability, but also on equally consolidated knowledge on themes such as the design for hospitality, new hybridization and fertilization processes applied to spatial solutions, and design-related innovation gained through prior research and teaching experience on these themes. This work on both these areas of knowledge is a typical approach of the "Design System" of the Politecnico di Milano (which includes the School of Design, the Department of Design and the POLI.design Consortium).

A strong feature of this contribution is the different approach to design research and the different interests pursued by the two authors, Elena Elgani and Umberto Monchiero, which opens the publication to innova-

* Francesco Scullica is full professor in industrial design at Department of Design, Politecnico di Milano and Programme Board Coordinator for the Bachelor Degree in Design degli Interni and the Master Degree in Interior and Spatial Design at School of Design, Politecnico di Milano.

tive scenarios while rooting it in highly contemporary multidisciplinary approaches.

Elena Elgani, PhD in Interior Architecture and Exhibition Design is a fellow researcher (RTDA) at the Design Department of the Politecnico di Milano and she coordinated the research group for this publication. For many years her research interests have been in the field of interior design, with a focus on the evolution of design for hospitality. She has analysed the transformations of the hospitality sector in terms of new behaviours and spatial transformations, such as hybridisation processes. Recently, she has focused on the relationship between spatial design and environmental sustainability, taking into account customized solutions for equipping interiors (funded research project 2022-24).

Considering her structured methodological approaches, she has long proven the ability to carry out quality research both independently and within teams, but also to effectively coordinate research and teaching projects aimed at exploring theoretical and design fields that can support the regeneration of ecosystems through design.

Umberto Monchiero, on the other hand, explores themes in his research that play on crossing the boundaries between theory and practice, between time and space, and between art and design. His interests are focused on analysing and investigating the role of sound in space by adopting a historical, theoretical and analytical approach derived from his studies in the field of musicology, which may prove quite distinct from those adopted in architectural and interior design research. His growing experience allows him to be autonomous in exploring innovative areas of research that overcome the conventional division between contemporary design, visual and performing arts; he furthermore participated in the production of lectures and conferences on significant topics related to interior design, and he has tutored in institutional courses and workshops.

The result of the union of two such different perspectives and experiences is therefore an interesting mixture of new material and immaterial paradigms, of physical, practical but also poetic inputs, which allow the book to deal in an innovative way with themes that affect our everyday lives closely.

The outcomes of this publication therefore open up research prospects that go well beyond interiors, exploring design discipline but also encompass laterally related fields of research, in order to define innovative insights that may offer researchers, students and practioners new and more conscious ways of handling future periods of uncertainty through design.

Introduction
Approaching post-pandemic interiors

> *We're living in a 1:1 scale world, and we are always inside a huge interior: it is there, I can see it, it is not a map, it is a physical reality.*
>
> (Rota, 2018)

The early years of the second decade of the 21st century marked a profound change in humanity's living and interacting experiences. This era is defined by some scholars as the Anthropocene (Crutzen & Stoermer, 2000), due to the massive influence that human activities are having in relation to the surrounding environment, in particular with fundamental biogeochemical cycles (McNeill & Engelke, 2014), and by others as the Capitalocene (Klein, 2014; Boehnert, 2018) to emphasise the «common but differentiated responsibilities» of individuals participating in the capitalistic economic system that is bringing on irreversible transformations on the environment. Indeed, in recent years there have been numerous changes in the way people experience dwelling, as understood according to Heidegger's phenomenological interpretation of *Daisen*, "being" (Heidegger, 1954).

Since 1945, it is possible to witness what scholars of environmental history refer to as the Great Acceleration (McNeill & Engelke, 2014), as all human activities that lead to the accumulation of carbon dioxide have increased (Steffen et al., 2015): the rise of inhabitants on Earth, the spread of motor vehicles, the worldwide production of plastics and fertilisers used for agriculture. While some of these activities are slowly decreasing, the capacity of humans to disrupt ecosystems does not seem to be diminishing. This generates significant environmental disruptions that can result in the spread of unfavourable conditions to people's lives. These include the destruction of natural habitats and the loss of biodiversity caused by growing anthropisation processes.

This scenario includes the emergency generated by the global health crisis brought about by the pandemic caused by the SARS-CoV-2 virus, which affected the Earth from the end of 2019 until mid-2023. This virus, originating from an animal source, was transmitted from the animal

kingdom to the human population. The interconnectivity of mobility networks, particularly through air travel, and the dense urbanisation of cities have facilitated a global transmission, resulting in a worldwide outbreak of the disease (Brownell, 2022).

During the pandemic, at certain times, it became necessary to suspend the traditional activities of daily life in cities, to empty out collective venues, and to confine people within their homes, or other shared domestic places, to reduce the chances of virus transmission, to protect as many people as possible, and to limit the hazards of spreading the virus. Reducing proximity, especially in urban contexts, has been the most widely adopted strategy to contain the effects of this highly dangerous human infection, which has caused about 7 million recorded deaths worldwide (WHO, 2023) although it is postulated that the actual number of deaths could be far higher.

This has profoundly influenced people's lifestyles and affected the relationship of individuals with urban spaces and built environments (Brownell, 2022; Valenti, 2022; Bassanelli, 2020; Bassoli, 2020), stimulating debate in the design world (Sparke et al., 2023; Antonelli & Rawsthorn, 2022; Scullica & Monchiero, 2022). The communal spaces – both private and public, both indoor and outdoor – of cities have long been vacant, while people have intensively inhabited private spaces, mainly their homes, interrupting the continuity of relationships and activities in the urban landscape. Business, professional, and cultural activities have slowed down significantly, and citizens have been working, studying, entertaining themselves, connecting with relatives and friends from home, using online platforms for video calls and virtual meetings. All but strictly necessary travelling has been cancelled and "mobile lifestyles" (Urry & Elliott, 2010) have been heavily reduced, forcing people to become temporarily settled.

New behaviours of social distancing, protection and care of one's individual health, nullification of physical proximity to safeguard collective wellbeing have been implemented, overturning the principles of proxemics, and prompting people to explore new ways of carrying out their daily lives, strongly projected into the virtual world. Purchases of all kinds have been transferred to digital platforms, while shops have been left deserted.

The psychophysical well-being of individuals and the relationships between people have been heavily impacted by the pandemic. On the one hand, there has been a generalised diffidence of proximity with others out of fear of contamination and, on the other hand, a desire to explore new forms of relationships, albeit at a distance.

The new behaviours have had immediate repercussions on lifestyles but have also accelerated ongoing processes that will naturally deter-

mine long-term repercussions. The inadequacies of some living space were immediately apparent (Bernardi et al., 2021). The absence of a supportive social context that is mindful of caring for those living in our proximity (Manzini, 2021), and the lack of adequate services to deal with such an emergency, were registered.

Despite individuals' different ways of introjecting the experience of the pandemic and coping psychologically with the consequent restrictions on movement and relationships, it can be said that for everyone the pandemic has imposed a new way of thinking, since what had before seemed unrealistic has now materialised. A microscopic virus and its variants, to all intents and purposes invisible to the human eye, have imposed tangible and material upheavals on the way of living. Above all, the pandemic has challenged the way people understand our own being as part of a multispecies community that inhabits different ecosystems, the way we materialise our dwelling through the design of spaces and equipment that make people feel comfortable and safe, and the way we think about the future (Balducci, 2023). In the aftermath of the pandemic, there is a widespread greater awareness of the global dimension of relationships and exchanges, and therefore of the impact that transformations can have on society as a whole, including the way we define living and the system of relationships around an object system. In addition, there has been a widespread realisation that there is a need to define new approaches and specific strategies for designing spaces, especially interiors, that improve the quality of people's living (Brownell, 2022), as the functionalist axiom of modern thinking has demonstrated its fragility, considering well-being and health.

At the same time, the perceived fragility has allowed new possible paths to be explored and investigated: themes such as ecological transition, care, and the enhancement of social communities are opportunities to imagine a different future development that supports the increase of a shared well-being.

In this context of temporary deprivation of collective common spaces and intensification in the use of private spaces, design has rediscovered the value of space.

Spatial design has identified new areas of experimentation, or rather, has strengthened existing research paths aimed at prefiguring scenarios, exploring fields adjacent to the reflection on spaces-products-services, investigating design solutions aimed at a continuous improvement of people's living conditions on Earth. The pandemic was an opportunity to re-examine the value of spaces, both domestic and collective, the importance of the technical-functional quality, not only for finished spaces, and even the value of the processes that allow a space to be defined and

equipped, as well as the perceptive, narrative, and aesthetic value of the places we inhabit.

However, the health crisis was immediately followed by a new dimension of "polycrisis" (Lawrence et al., 2022). In effect, in the post-pandemic period, uncertainty – first dictated by the pandemic, and then by the memory of a traumatic collective experience – has been joined by other situations that are currently increasing the definition of a condition of collective uncertainty. Global geo-political instabilities cause significant daily fluctuations in global markets, that contribute to worldwide economic instability. The increase in migration from countries with poorer economies towards economic powers, as well as the numerous conflicts and situations of political instability are emblematic of a "permacrisis" condition (Turnbull, 2022) based on instability and insecurity.

These conditions are coupled with climate variability brought about by the intensification of increasingly unpredictable extreme weather phenomena derived from the climate change, considered as «the long-term shifts in temperatures and weather patterns that in the long run will completely alter the ecosystems that support life on the planet» (UN Climate Change, 2022). Climate change, air pollution and biodiversity loss are considered the elements of triple planetary crisis of an environmental nature (Ibid.).

The result is a snapshot of the present day in which it seems that the new normal coincides with a condition of uncertainty in every sphere, as the only certainty that can be detected. Indeed, in different disciplines and study fields, this historical moment is defined as the Age of Uncertainty (Müller, 2023; Poloz, 2022; Murphy-Greene, 2022; Krasniqi & McPherson, 2022; Chaney & Jones, 2022; Obeng-Odoom, 2020). The concomitance of the pandemic, climate change, and social inequalities put at risk many communities often unprepared to respond effectively to these challenges (Murphy-Greene, 2022, p. 1), while the economic downturns of recent decades underline «that the future may never be as certain as it had seemed in the past» (Poloz, 2022, p. 16).

Uncertainty is accompanied by the continuous acceleration of mutations, not only of viruses, but of all innovation processes in every sector, technological evolutions, digitalisation of services, as well as climatic upheavals, political and economic drift, poverty and social disruption. Contemporary time is organised in an increasingly instantaneous present, contracted by the increase of single actions or experiences per unit of time (Rosa, 2010). All this implies a blurring of the once sharp boundaries of the private, domestic sphere with the public, collective one, disruption between what is natural and what is artificial, between the physical and the virtual, among sustainable and unsustainable.

Understanding these changes is crucial for designers to adapt design approaches and experiment with practices, which are never unambiguous, with respect to the evolving needs of contemporary inhabitants.

This scenario, which is unlikely to return to "normality" – understood as the pre-pandemic state of things –, poses numerous questions for spatial design, a discipline that supports the relationships between the individual and the spaces they inhabit, whether permanent or temporary, open or enclosed, and the system of objects that furnish spaces and contribute to their meaning, as well as the relationship with increasingly articulated systems of services (Crespi, 2023; Bosoni, Rebaglio & Scullica, 2012).

These queries mainly concern the need to:

1. Questioning the way of approaching design of spaces. Reconsidering the priorities, as well as strategies and methodologies, that allow us to define and shape spaces. In this discussion, it becomes fundamental to acquire an ecological thinking that allows to innovate design processes for a tangible and positive transition towards sustainable models of living.
2. Exploring how to re-define the relationship between private and public, personal and shared, considering the adaptation of the existing built heritage, which is frequently defined as obsolete, in complex ecosystems. At the same time, questioning the need for new interiors and the characteristics that these space-product-service systems should have for significantly reduce their environmental impact. Besides, rethinking the system of products that every day fill the existences of people both in terms of their use values and in terms of the way they are produced and set up.
3. Redefining the way of designing flexible spaces by considering the time of use in relation to the increasingly sudden change in behaviour, integrating the virtual dimension that is now omnipresent through social networks, online platforms for work collaboration and new devices. Moreover, refocusing the relationship with the conceptual design of the perception of an interior space, understanding "soft", immaterial experiences and relationships with non-design elements as indispensable expedients for achieving the user's well-being in a space.

All this requires the construction of a new "toolbox" for designers, who can become a sort of "*bricoleur*", as described by Lévi-Strauss in *La Pensèe Sauvage*, and a "practioner" (Lokko, 2023) to underline the request of an interdisciplinary approach, capable to deal with socio-technical complex systems, connecting cultural research and practical exploration in order to meet future challenges.

The aim of this publication is to investigate how spatial design, and in particular interior design, has reacted and continues to respond to the ever-changing transformations of the contemporary scenario, considering both the conceptual-designing dimension of defining spaces and the operational-executive dimension, which cannot be separated from the completion of a design process.

Oscillating between two polarities, which sometimes struggle to find common ground for dialogue, the second objective is to identify relevant themes that can influence future design practices. These themes find correspondence in the guidelines of the National Recovery and Resilience Plan (PNRR, 2021), the Italian programme to support the nation's economic and social recovery after the pandemic period. The plan aims to foster the resilience, understood as the ability to react to what happened during the pandemic period, of all the stakeholders involved (institutions, businesses and citizens) focusing on strategic topics, such as ecological transition, for the country's future development.

In addition, the outlined reflections explored, and the practice-based projects presented, particularly in chapters 1 and 2, are related to an ongoing financed research project at Design Department, Politecnico di Milano (Research Project: DOI_Design, Hospitality and Innovation: the contract sector for the definition of a new hospitality between design, production, realisation and fruition, financed by PON Research and Innovation – REACT EU, 2022-24. Scientific coordinator: prof. Francesco Scullica. Researcher: Elena Elgani).

In particular, the specific point of view of interior design is adopted because «interiors can assemble meanings and give value and consequences to a situation» (Brooker & Stone, 2010). Indeed, interior design is «an interdisciplinary practice that is concerned with the creation of a range of interior environments that articulate identity and atmosphere through the manipulation of spatial volume, placement of specific elements and furniture, and treatment of surfaces» (Ivi, p. 12). These considerations have led to present three macro-themes, with the intention of focusing on the potential expressed by the uncertainty of the times in which we live. As affirmed by Ciravegna, Giardina & Pletto «a crisis, as such, is not necessarily negative and, if approached appropriately, can become an important opportunity for positive change, even when addressed by Design (Scherling & DeRosa, 2020)» (2023).

For these macro-themes the aim is to contribute to a reflection on contemporary and future design practices, transversally and critically analysing inhabited spaces through certain emerging variants, with the aim of analysing, understanding and sometimes predicting the paradigmatic transformations that will characterise future uncertain times.

The first topic addressed is that of sustainability, since the pandemic has underlined how the well-being of individuals is closely connected to the ongoing disruption of natural ecosystems. Only a radical transformation of the ways of understanding and developing projects in the field of design and architecture will make it possible to reduce the environmental impact that the production and consumption model has on the Planet and improve people's living conditions. In this section, the aim is trying to identify initial guidelines on the development of sustainable approach to interior design, in the knowledge that the course of transition is constantly changing, and many other possible paths will open up.

The second theme addressed is that of flexibility. This is certainly not a new field of exploration for design, however, here too the pandemic has had an important impact by intensifying certain transformations that were already taking place. If before the pandemic the phenomenon of the hybridisation of activities carried out in collective spaces, for example between hospitality spaces and workspaces (Scullica & Elgani, 2019) was gradually consolidating, during the global health crisis the process of hybridisation and contamination between spaces, functional activities and behaviours became more pronounced. On the one hand, there was the permeation and contamination between the domestic and working spheres (Bassanelli, 2022), and later, there was the increase of hybridisation processes in sociocultural spaces that offer cultural moments of aggregation, innovation and social inclusion (Inti & Mastropirro, 2020) to create and incentivise proximity relations, collaborative welfare services and a solidary economy (Cacciari, 2016).

Therefore, it is essential to examine the solutions that the design is exploring in terms of adaptability and flexibility concerning sustainable transition issues for spaces, furniture, and objects.

Finally, it was decided to address the theme of perception, a term understood in its complexity as the multisensory experience of an interior space, but also as a true "design tool"; reflecting deeply on components classically considered as merely decorative in the design of a space can in fact help us calm insecurities in inhabiting interiors, normalising and redefining new experiences of contact (and absence) with the people around us.

In a first section, an analysis was undertaken of how sensory elements such as colour, materiality and the acoustics of a space can help us redefine the qualities of an interior environment, while a second section dealt with the growing role of the virtual component in our interpersonal relationships in a space, also understanding this component as an immaterial revolution of the artistic-narrative experience of an interior.

In the initial phase, the research focused on a reconnaissance of the transformations in spaces that occurred during the pandemic period and continue afterwards.

The multilevel approach made it possible to analyse the transformations of behaviour, that determines the new inputs for designing spaces as well as for relating with the system of elements equipping the space. Subsequently, an attempt has made to identify the guidelines corresponding to the three main macro themes that could guide interior design in the future.

The methodology applied is based on desk research and literature review that offers a conceptual framework for studying design-oriented processes. This analysis has complemented by the investigation of relevant case studies. The research has also focused on practiced regenerative development paradigms applied to spaces for hospitality that permit to define innovative trajectories.

The final aim of the book is not to resolve the design uncertainty that characterises the present and most likely the future, but rather to learn how to navigate these times, developing a resilient and adaptive approach capable of «living with difficulties» as suggested by the activist Donna Haraway (Haraway, 2016) and proposing new pathways of exploration.

Design is a discipline that not only wants to read the present, but due to its own nature is projected into the future to support and stimulate the relationship between individuals and other species, the connection with a system of spaces-products-services, the interaction with technologies, communication and transmission of knowledge. In this sense, design makes it possible to nourish the hope of a development that can improve the human (and "more-than-human") way of being on Earth, their way of dwelling in the most intimate and profound sense explored since the Heideggerian approach, even if it has to do with a complexity that seems to overwhelm the individual's capacity to understand.

Likewise, design can promote the way to live together, the dwelling is the way in which human beings are in the world, the place in which we inhabit and therefore in which we are alive. Indeed, according to the reflection of the philosopher Emanuele Coccia on the home and the sense of dwelling «every home is a purely moral reality: we build houses to accommodate in a form of intimacy the portion of the world – made up of things, people, animals, plants, atmospheres, events, images and memories – that make our own happiness possible»[1] (Coccia, 2021). In

1. Translation from orig.: «Ogni casa è una realtà puramente morale: costruiamo case per accogliere in una forma di intimità la porzione di mondo – fatta di cose, persone, animali, piante, atmosfere, eventi, immagini e ricordi – che rendono possibile la nostra stessa felicità» (Coccia, 2021).

this sense, relationship is inevitable, it is the way we are in the world with others, and with a system of spaces and objects, and should be aimed at achieving happiness for all.

It is then perhaps a matter of exploring new horizons, through enhanced strategies, and jointly returning to discover sensibilities, including design sensibilities, that in part belong to the "culture of the project" already from its initial definition, for a tangible transition: thinking about spaces, connected to systems of products and services, that know how to take care of people, and other species, and inspire people to take care of the common good.

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1. Sustainability

1.1 A contemporary debate on sustainable development

Sustainability is driven by design

In the uncertain times we are living through, sustainability is an increasingly raised, discussed, and researched topic. In April 2020, during worldwide lock-down in response of Covid-19, Google Trends reported a 4,500% increase in searches on how to live a sustainable lifestyle. The urgency of living a healthy lifestyle had only been amplified due to the pandemic (Bituin Eriksson, 2021).

The global health crisis has shed a light on the unbreakable connection between climate change, the failure to preserve the natural environment and collective wellbeing. This has led to the spread of awareness regarding role and responsibility of everyone in shaping a sustainable future.

As individuals changed their everyday routine and behaviours during lockdown for Covid-19 pandemic, there was a significant reduction in greenhouse gasses, and other air, water, and land-polluting outputs (Rume, 2020). The non-interference of human activities on lives of natural creatures during lockdown period has determined the behavioural changes of wild animals, birds, butterfly, pets, and street animals. Scientists analysed that there was a certain correlation between atmospheric change with the behavioural changes of natural creature during lockdown period (Bar, 2021). Though global economic growth declined due to nationwide lock-down, there are certain positive impacts on environment. This demonstrates that everyone might have a positive impact on natural environment by changing habits and attitudes towards all-encompassing global wellness and developing innovative approaches (Spathonis et al., 2020). However, in recent years there has been an increasing anthropogenic impact, which

refers to the changes caused directly or indirectly on ecosystems and natural resources by human production and consumption activities. Human activities that cause damage to the environment on a global scale include population growth, overuse of non-renewable resources, overexploitation of natural resources such as water and soil, overconsumption of goods and services, the spread of toxic chemicals, land and water pollution, and deforestation (National Geographic, 2024).

The impact of human activity has resulted in severe consequences, such as global warming, environmental degradation (e.g. ocean acidification), mass extinction of animals and plants, loss of biodiversity, eutrophication, alteration of freshwater flows, and ecological collapse (Vezzoli, 2018). Human development has resulted in large-scale side-effects that now threaten to destroy our life-support systems (Schultz, 2009) and represent catastrophic risks to the survival of the human species. Human beings have exceeded the resilience of the biosphere and geosphere, which is the capacity to persist, adapt, or transform in the face of change in such a way that the basic identity of a system is maintained (Ibid.), and have also compromised socio-ecological resilience, which is related to enabling the long-term survival and well-being of humans as part of the biosphere. The *Earth Overshoot Day*, which marks the date when human society has depleted all the biological resources that the Earth can regenerate in a year, is reached earlier every year[1].

The equilibrium between human productivity and the environment has been compromised. This emphasizes the need to investigate methods, strategies, and potential solutions in response to the multiple crises we are experiencing, to ensure the survival of humanity, as extensively explored in the exhibition *Broken Nature: Design Takes on Human Survival* (XXII International Exhibition, Milan, 2019).

Therefore, the design world must also necessarily address sustainability issues, even if today the word "sustainability" is overused, misunderstood, abused in all areas of human endeavour and thus also in design, within which green storytelling permeates every sphere. As affirmed by Corbellini «there are terms that, instead of framing a precise definition, tend to absorb meanings. Sustainability is certainly one of these. Those who pronounce it can understand extremely different things, and even greater is the variety of interpretations possible for those who listen to this word, inevitably projecting their beliefs and expectations on it» (Corbellini, 2020, p. 128).

1. Overshoot occurs when humanity's demand on nature exceeds Earth's biocapacity, to verify Earth Overshoot Day for each year: https://overshoot.footprintnetwork.org.

Certainly, sustainability is a very complex subject that is laden with multiple meanings that oscillate between wanting to trace everything back, with positivist confidence, to a verification of data and performance of products, spaces and processes that confirm the reduction of their impact on the planet, and the integration of an ethical-moral approach will provide solutions that improve the quality of human living. Convinced that both the approaches are important in helping to achieve better living conditions for all and respectful behaviours in all the ecosystems, it is important to consider the reflection on sustainability not only in relation to the present but also to the future, as it primarily concerns the projection of human activities towards the future.

Sustainable development is in fact «the development that meets the needs of the present without compromising the ability of future generations to meet their own needs», as stated in the Brundtland Report[2].

Designing for sustainable development therefore means tackling the complexity and extension of very distant, but inevitably related and interconnected spheres that intercept every aspect of life for all species on this planet: from the relationship with nature and other species, the care and wellbeing of individuals, to production and supply systems for all types of products, to economic flows, mobility, to technological development, as well as culture and education. Sustainability considerations pervade every field of knowledge and require a planning process capable of taking into account the three dimensions of sustainability, which must be considered as closely connected and must be investigated in their correlations (Vezzoli, 2018).

According to Vezzoli's research in *Design for Environmental Sustainability: Life Cycle Design of Products* (2018) and within the LeNS network activities[3] the three dimensions of sustainability are:

- Environmental sustainability. The environmental dimension is focused on assessing and reducing the impact of each process on natural ecosystems in terms of the depletion of resources extracted from the environment (input) and emissions into the environment (output), which determine all the environmental impacts (global warming, depletion

2. The report *Our Common Future* was promoted in 1987 by the World Commission on Environment and Development (WCED) and supported by United Nations (UN). Today the sustainable development is globally supported by the Sustainable Development Goals which represent global priorities in the 2030 Agenda for Sustainable Development: https://sdgs.un.org/2030agenda.

3. www.lenslab.polimi.it.

of the ozone layer, smog, acidification, eutrophication) causing climate change. Alongside these is the increasing production of waste. Three scenarios of goods production and consumption systems can be used to increase environmental sustainability: biocompatibility, non-interference with natural ecosystems and dematerialisation of products.

- Social-ethical sustainability. The social dimension is closely linked to the principle of equity, as defined internationally: «every person, in a fair distribution of resources, has a right to the same environmental space, i.e. to the same availability of global natural resources» by numerous meetings and decrees (New York, 2015; Rio+20, 2012; Johannesburg, 2002; UN Summit, Rio1992). It is also defined by the principles that enable the formation of a cohesive society such as social inclusion, equal rights, accessibility to spaces, goods and services, and the fight against poverty. Indeed, it has been described «as a positive condition within communities, and a process within communities that can achieve that condition» (Morelli, 2011, p. 3).
- Economical sustainability. The economic dimension is determined by the principle of prosperity, such as the promotion of inclusive and sustainable economic growth, employment and decent work for all, according to the SDG8 (Sachs et al., 2017). Strategically, it could be determined proper attribution of the costs to resources, in term of "internalisation" of the direct and indirect environmental resources' costs to apply through economic leverage the minimisation of environmental impacts. At the same time, the second strategy to be applied may be to steer major transitions towards interconnected systems. And finally, the enhancing promising (of niche) economic models, e.g. *Sustainable Product-Service System* (SPSS) and *Distributed Economies* (DE) (Vezzoli et al., 2022; Vezzoli et al., 2021). As affirmed by Vezzoli, «an environmentally and socio-ethically sustainable production and consumption model must also be economically viable».

These three universally recognised dimensions of sustainability can be combined with a specific point of view that also emphasises the cultural approach in order to deepen sustainability-related issues and disseminate knowledge and awareness, developing a comprehensive definition of sustainability.

Sustainability considerations directly encounter both design practices and design-driven research precisely because they require thinking within the discipline, as well as reconsidering the boundaries of design as a discipline, and even exploring connection between disciplines that are seem-

ingly distant from each other, in order to identify new paths addressed at improving the living conditions of all species on Earth.

The Ellen MacArthur Foundation[4], one of the most recognised and active realities in the promotion of a sustainable approach, identifies in design the discipline capable of supporting the transition from a linear consumption model (take-make-dispose) to a circular one that will allow for improved manufacturing, containing the loss of raw materials and the production of waste, reducing the impact of production on the environment and re-introducing into circulation what is discarded. The foundation's thinking originates in the sustainable economic model based on the idea that to limit the waste of resources, it was necessary to extend the life cycle of buildings and other goods, as theorised by Walter R. Stahel in 1976 and in the theories of the British economist Kate Raworth, in her economic essay *The Doughnut Economics. Seven Ways to Think Like a 21st-Century Economist* (2017).

The trans-disciplinary systemic approach promoted by Ellen MacArthur, combined with a very accessible communication of complex processes, has allowed design to lead this transition in all areas of the discipline, exploring even previously distant fields with an experimental and investigative approach.

In fact, sustainability issues have been a subject of reflection for design for many years already. Starting in the 1960s with exploration in artistic and design fields, such as Enzo Mari's projects, to critics and books from Tomás Maldonado (1970), Victor Papanek (1971) and Ezio Manzini in the 1990s, to cite only few masters, the explorative attitude of design (Rawsthorn, 2018) taken always on uncharted territories to question the socio-ethical dimension of design, limits of an economic development related to certain production systems involving consumption of resources and energy, as well as to reconsider the role of the designer[5].

For many years now (Vezzoli et al., 2022; Lotti et al., 2022; Vezzoli, 2014; Vezzoli & Manzini, 2007; Manzini & Jégou, 2003; McDonough & Braungart, 2002; Manzini, 1990), the theme of sustainability has been intertwining with the world of design. From a focus on the use of resources and on design and production models aimed at reducing the environmental impact of products, the research has arrived at a systemic approach that intends to explore not only the production dimension, but also the social

4. Circular design: turning ambition into action: www.ellenmacarthurfoundation.org/topics/circular-design/overview.

5. Tamborrini P. & Tartaro G., definition of "design sostenibile" in *Treccani*, 2010. www.treccani.it/enciclopedia/design-sostenibile_(XXI-Secolo).

context and ways to innovate it. According to Ceschin & Gaziulusoy (2016), the areas of interest and exploration for design can be organised into four macro categories: product innovation, product-service system innovation, social context innovation, and socio-technical system innovation.

As far as product design is concerned, considering both Cradle to Cradle method (McDonough & Braungart, 2002) and Biomimicry (Benyus, 1997), there is much research focused on the design or rethinking, through new methodologies, strategic approaches, sometimes bioinspired, of individual products as well as entire production chains.

Over the years, guidelines for design for sustainability have been formulated, that allow the consolidation of significant expertise in sustainable product design and product-service systems (Egenhoefer, 2018; Ceschin & Gaziulusoy, 2020; Vezzoli, 2018; Vezzoli et al., 2022b) and in the implementation of circular production processes.

The development of knowledge as well as the study of new models of design development, prototyping, realisation and impact assessment are constantly evolving and expanding and progressively include more and more areas of interest, also intercepting the interior design sphere with an innovative focus on environmental sustainability for furniture design (Vezzoli & Yang, 2022).

In very recent years, Italian companies have been among the first in Europe to apply specific circularity strategies to implement sustainable approach to production, as demonstrated by FederlegnoArredo Plus project and analysed in the Design Economy Reports (2024 and 2023), which envisage a new focus on: the rethinking of the entire product supply-chain through research on the materials used, the reduction of energy consumption in the production phase, the dis-assemblability and recyclability of product components, the reduction of packaging, and the re-introduction of materials into new product cycles at the end of the object's life.

However, although many processes have been implemented, there are still many application areas to be explored by design. Furthermore, it is very important overcoming systemic, cultural, economic and regulatory barriers that constitute inhibiting factors to the diffusion of a sustainable approach.

A significant example is hospitality design in the hotel sector that is the research subject for ongoing research[6] which included a direct confrontation with the production realities operating in this sector.

6. Research Project: DOI_Design, Hospitality and Innovation: the contract sector for the definition of a new hospitality between design, production, realization and fruition, financed by PON Research and Innovation – REACT EU (2022-2024). Scientific coordinator: prof. Francesco Scullica. Researcher: Elena Elgani.

In Italy, the contract manufacturing, understood as the bespoke production of fixed systems to equip space or furniture, custom-made and mass-produced to furnish it which, starting from a local context, which tends to be based on Made in Italy, has to deal with a global market. The Italian contract supply chain is developed for stocking very distant contexts and markets with different regulations, but also certification and assessment protocols, and it struggles to absorb all the strategies codified by design for sustainability, precisely because of the significant level of customization and adaptability to different requests and the complexity of regulations.

At the same time, the logic of new business models that interpret the *product-as-a-service* that can be accessed without owning it are not yet that widespread, albeit virtuous. In fact, sometimes there are difficulties from manufacturers in the transformation of their productive, management and product marketing models, which shows how theoretical considerations are often able to anticipate development models that take time to be absorbed by the majority of the market.

Therefore, design can guide the transition towards sustainable production and consumption models by acting on several fronts (Ceschin & Gaziulusoy, 2020), in particular in this contribution we intend to explore the reflection on environmental sustainability in relation to spatial design.

How sustainability will impact interior design

Considering that in urban conurbations people spend approximately 80/90% of their time indoors (Klepeis, 2001), it can be argued that the built environment, particularly interiors, play a fundamental role in people's lives.

However, the pandemic has shown that these places no longer coincide for everyone with the expression of psychophysical well-being, as it is precisely indoor environments that have stimulated the spread of the Sars-CoV-2 virus (Brownell, 2022). Places of domestic, private or shared living, workplaces where people spend most of their day, places of relaxation and recreation have suddenly become sites of potential infection, therefore unsafe contexts within which to wear masks, observe distance, disinfect hands several times. All this has profoundly undermined the individual's relationship of trust with the indoors, which has been perceived instead as a space of personal intimacy, since the earliest primitive expressions of the "enclosure" as explored in the first issue of *Rassegna* (Gregotti et al., 1979).

Research shows that environmental pollutants can cause critical health problems, impacting on the physical well-being of individuals (Manisalidis

et al., 2020; OECD, 2001). Interiors therefore play a fundamental role in people's quality of life; nowadays, most interior environments are controlled through HVAC (Heating, Ventilation and Air Conditioning) and artificial light systems (Rashdan, 2015). However, the highest concentration of Volatile Organic Compounds (VOCs) in the air can be found right inside buildings (Šenitková, 2016, p. 3), determining the "sick buildings syndrome", in terms of a situation in which the occupants of a building experience acute health, or comfort-related, effects that seem to be linked directly to the time spent in the building (Joshi, 2008). Indeed, the modern construction techniques have completely isolated the interior from the exterior (Rahm, 2023), eliminating even those exchanges that can support the well-being of individuals.

At the same time, according to EU, the construction system, which includes all building processes, and thus also the realisation of interiors and the furnishing of spaces, is responsible for generating approximately one third of the world's total carbon dioxide emissions (European Commission, 2020).

Therefore, it can be said that sustainability research is an urgent issue in the field of design and architecture, especially spatial design, due to worsening environmental problems, and even social inequalities. Indeed, it is necessary to understand how contemporary thinking on spaces must necessarily be considered by evaluating two polarities, on the one hand the analysis of the meaning we attribute to spaces, how we perceive and interpret them (Perolini, 2011). On the other, it is important to include in design research the environmental factors that impact on the built environment and thus on people's psychophysical well-being (Brownell, 2022).

Circular Interior Life-Cycle

If we broaden our perspective and consider entire systems of collective spaces, from offices, retail spaces, hotels to large housing complexes, we notice that in recent years tangible actions to implement sustainable design are mainly focused on the building through architectural design, innovation of building components, development of construction methods (Lavagna, 2008; Lavagna, 2022) and materials research (Paoletti, 2021).

There is a significant evolution in the study of technological solutions to be adopted and the publication of regulations promoting the construction of NZEB, *near-zero energy buildings*, with the forecast and target of reducing carbon dioxide emissions by at least 90-95% by 2050 in Europe, according to Breakthroughs report from UN campaign Race to Zero, 2021.

Technological innovations and the updating of standards that guide processes are aspects that allow for the improvement of the performance of

the building itself, particularly regarding new constructions. The focus is on the implementation of energy efficiency, the containment of consumption and the reduced use of resources such as water, up to the use of intelligent information technologies to reduce the environmental impact of the architectural artefact and to boost electric mobility by integrating recharging infrastructures in buildings (Silvestrini, 2022).

The construction of these buildings is associated with methods of environmental assessment of buildings. These are tools that make it possible to assess the expected performance of the building and can provide valuable reference criteria for design, which over time also allow for the refinement of the solutions adopted. In addition, the definition of protocols for assessing the entire life cycle of buildings, referred to as life-cycle assessment (LCA) protocols for building envelopes, allow for significant reflections on design strategies and construction processes (Lavagna, 2022). Within these methods, the environmental assessment is verified by means of indicators to which a score is associated to verify compliance with the eco-compatibility criteria described by the assessment methods (Lavagna, 2008). Some of the indicators allow a discussion of indoor environmental quality in terms of thermal comfort, ventilation, the relationship with natural light and the selection of low-emissivity materials that reduce the presence of indoor pollutants (Moxon, 2012).

In this scenario, however, interiors seem to be, from a functionalist perspective, the result of architectural and engineering design and construction processes that, although important, circumscribe interiors in relation to the selection of materials and finishes, the elements that characterise and equip the space and the furnishings.

Interiors have their own specific environmental impact, but above all «the design of interior spaces constitutes an activity with autonomous cultural foundations»[7], as affirmed by Andrea Branzi.

For this reason, it is necessary to identify a tailor-made path in the achievement of sustainability goals for interiors that certainly on one side explore the cultural complexity of sustainability trying to challenge established views of the habitat. On the other side, the research for a specific interior approach to sustainability addresses the key issues related to the reduction in the use of resources, in particular energy and water, and in the choice of materials, which can be assessed through the assessment processes (Moxon, 2012). Therefore, it is necessary to explore the 10R model (Fig. 1), proposed

7. Translation from orig.: «La progettazione degli spazi interni costituisce un'attività con fon-damenti culturali autonomi» (Andrea Branzi, definition of "Interni" in Enciclopedia Treccani, 2010).

by Jacqueline Cramer (2022), elaborating on the principle of *reduce, reuse, recycle* from the 1970s with contemporary reflections by Ellen MacArthur Foundation (2013) and Ad Lansink (2017), with the specific approach of spatial design. As can be seen in the diagram, the 10R model summarises the principles of the circular economy (CE) to support changemakers around the world in their efforts. This will make it possible to reconsider the active role of designers and to re-configure obsolete or environmentally negative manufacturing and production processes.

Thus, it will be possible to achieve internationally the goals shared in the Circular Economy Action Plan, launched as part of the European Green Deal in the EU in 2020.

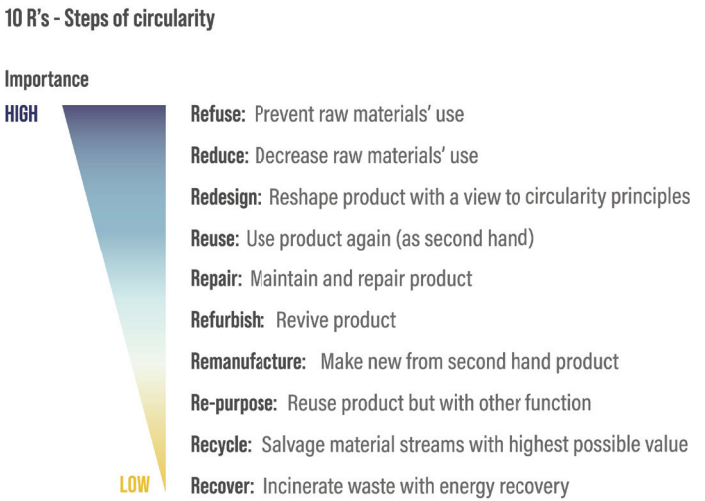


Fig. 1 - The10R Model, based on the principle of reduce, reuse, recycle*, by J. Cramer, 2022 (Author's elaboration)*

Hence the importance of also considering interiors from a life-cycle perspective. This entails rethinking the entire design chain in a manner that is concretely circular: from concept ideation and development to the sourcing of materials, the realisation of spaces, maintenance during the periods of use, and the subsequent decommissioning.

In this sense it is necessary to acquire a *life-cycle thinking approach* to investigate the relationship of interiors with the system in which they participate and the context in which they are inserted in a certain period of time.

In an interior design project, the circular life-cycle thinking approach must be combined with a systemic perspective capable of evaluating all components and, specially, capable of incorporating circularity processes for defining interiors from the first stage of the project development. All this is being intensively explored in the Netherlands (Van den Heuvel, 2023), which is among the first European country with the goal of becoming circular by 2050 in all sectors, including construction and interiors[8].

Clearly, interiors are closely connected to the architectural envelopes that accommodate and define them because they allow the space to be equipped and furnished, and sometimes they integrate with the space itself, as historically investigated by Gianni Ottolini and Vera Di Prizio in *La Casa Attrezzata* (2005). However, interiors unlike other parts of buildings are more frequently subject to transformation for recurrent replacements and refurbishments, as shown by Stewart Brand in his book *How Buildings Learn. What happens after they're built* (1994) (Fig. 2). For this reason, it is important to consider the different life-spans for each layer composing the building to implement circular approach.

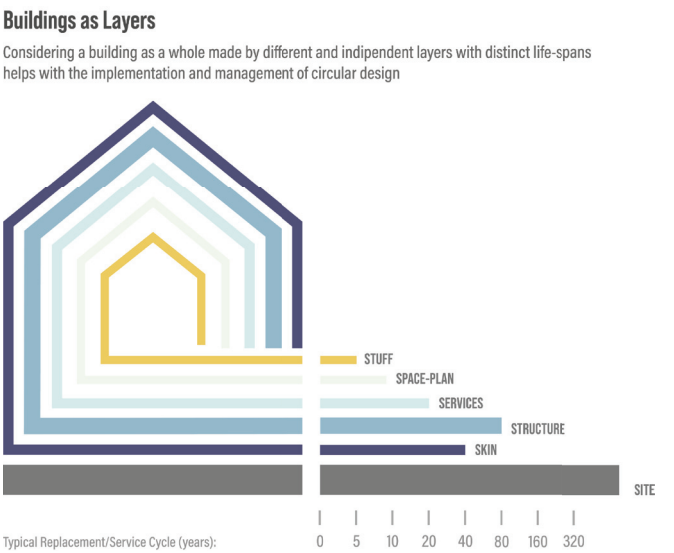


Fig. 2 - Shearing layers of change in a building from S. Brand, How Buildings Learn*, Viking, New York, 1994 (Author's elaboration)*

8. Dutch National Circular Economy Programme 2023-2030.

For example, in the hotel field the frequent use of spaces results in significant wear and tear of surfaces and consumption of furniture. At the same time, these spaces quickly become obsolete in terms of aesthetic language and shared appreciation. This leads to processes of partial or complete refurbishment, with soft or hard interventions, depending on the type of action on the building envelope and the FF&E, furnishing, finishes and equipment system. Refurbishments are frequently scheduled at short intervals, every 5-7 years, and for food & beverage spaces even more frequently (Perkins & Will, 2021). If these processes are analysed in relation to the normal day-to-day activities housed in a hotel and the technologies used, aimed at defining the best comfort experience, a substantial consumption of resources, such as water (Mendoza et al., 2022) increasing a relevant environmental impact, can be identified. The system of hospitality based on traditionally conceived hotels is unsustainable: according to the United Nations World Tourism Organization's 2008 Responding to Global Challenges report, the hotel sector is responsible for around 1% of the carbon emissions in the environment. Therefore, the sector needs to reduce carbon emissions by at least 66% by 2030 and up to 90% per room by year-end 2050, according to the Sustainable Hospitality Alliance's Global Hotel Decarbonization Report.

Interior design by its very nature looks at the small scale, at the relationship between individuals, spaces and systems of objects, at the *devices* (Ottolini, 1996) that can activate these relationships, adapting more rapidly to evolving behaviour, at technological advancements to redefine their boundaries. Moreover, «interior designers have a moral and ethical responsibility to protect consumers and occupants through the design of code-compliant, accessible, and inclusive interior environments that address well-being, while considering the complex physical, mental, and emotional needs of people» (Council for Interior Design Qualification, 2019).

The sustainable and circular technical issues must therefore complement an ethical and responsible approach to design. Additionally, there is a relational dimension, a sense of belonging and identity, that overcome the functional requirements, that the attitudinal dimension of design can investigate and support. Particularly in terms of sustainability, design can encourage responsible and virtuous behaviour in all the people who frequent a space. This can take place both through the design of interiors, understood as systems of spaces-products-services, during the entire life-cycle: from the design, realisation and disposal phases.

Virtuous behaviour can also be encouraged through experience design. Experience is nowadays an integral part of the relationship with space, objects and services, and can stimulate ways of reading contexts

and using space, interacting with the system of objects, as well as attributing meanings, both in the private and collective sphere, using different modalities.

1.2 Towards Collective responses

In the post-pandemic context, the condition of environmental, geopolitical (Latour, 2018), social and economic multi-crisis continues to present the urgency to rethink both the way of understanding spaces in general, and space-product-service systems, in particular, and even the entire design process to define or adapt them to changes. More specifically, the reflection on the environmental impact of space-product-service systems and on the social impact of certain design-supported processes involving the relationship with spaces, as well as the multi-species relationship and equity in the distribution of resources, are topics of great interest for the contemporary design debate with particular reference to sustainable interior design.

This reflection requires us to consider specific approaches that make it possible to outline some necessary transformations in the way of understanding the social and cultural role of the designers, their design processes and their relationships with the construction-execution dimensions.

1.2.1 A radical change for circularity in interiors

Eco-systemic approach

The achievement of sustainability goals requires a progressive path of gaining awareness by the whole society, also considering the possibility of interpreting some global phenomena in an unconventional way, with respect to the ordinary interpretation, and the importance of defining alternative scenarios that are possible and actually practicable for most people. It is necessary to apply an ethical and ecological approach to design, considering the entire life-cycle of space-product-service systems. On the one hand, it is important to implement "good" design practices developed starting from the acquisition of technical-scientific skills on design for sustainability and circularity strategies[9] by designers, students

9. For a comprehensive and open-source collection of systemic design strategies to accelerate the circular economy, see the map www.circulardesign.it.

and all those involved in the chain of realisation and commercialisation of space-product-service systems. On the other hand, the adoption of virtuous behaviours by end users is essential. People should acquire basic sustainability skills and become aware of the importance of certain daily choices and behaviours regarding the impact of private and collective furnishing systems. In this sense, trends forecasting proves that future consumer profiles, Gen Z and probably Alpha, as future generation, will have an even greater focus on sustainability issues (WGSN Future Consumer 2024 & 2025). Some consumers have devalued their material purchases over time, and they have a positive approach to frugality, encompassing the shift towards conscious consumerism and concrete sustainability. Lifestyles and consumption patterns can direct production markets, so reducing environmental impacts and improving certain social realities are closely linked to the economic sustainability of processes.

However, narrative strategies, such as storytelling for sustainability, are needed to engage consumers and to develop the audience, to explain complex phenomena and to enable more and more people to carry out sustainable activities. In this area design can activate a communicative-narrative dimension that can offer some keys to interpreting highly articulated themes and simplify the narrative of complex phenomena. In this way it will be possible to overcome cultural, economic, regulatory, and technological resistances that feed the sustainability gap (Elgani, 2024 forthcoming), which limit the diffusion of good practices among people.

Evolutions in one or another direction require transition times to achieve the goals. A radical and sudden sustainable transition cannot be assumed, but a time for training and acquiring skills is necessary. The development of new skills through design-driven research and the training of a new generation of designers, as well as the interior designers and the interior architects, was the subject of the panel *Design New Spaces/ New Interiors: Research and Didactic for New Sustainable Futures*[10]. According to the main subject of the conference, presentations that

10. The panel *Design New Spaces/New Interiors: Research and Didactic for New Sustainable Futures. From Cumulus Antwerp 2023 to IASDR2023* is organised by Francesco Scullica, Elena Elgani and Chiara Lecce with the support of Anne Schoonbrodt (Politecnico di Milano), during the IASDR 2023 international conference at the Politecnico di Milano, 13th October 2023. The panel included the participation of international speakers: Inge Somers (University of Antwerp), Liene Jākobsone (Art Academy of Latvia), Louie T. Navarro (University of Santo Tomas, College of Fine Arts and Design, Manila); and colleagues from Dept. of Design, Politecnico di Milano: James Postell, Valentina Rognoli, Paola Cordera, Luca Guerrini, Anna Anzani, Barbara Di Prete, Emilio Lonardo, Alessandro Colombo, Francesco Vergani, Annalinda De Rosa, Davide Fassi, Laura Galluzzo, Luca Vivanti.

included the participation of numerous scholars, tried to explore the life-changing design topic to deepen the theme of the sustainable spaces: exploring new frontiers for interior design education approaches.

Furthermore, the transition cannot happen by the will of a single component of a design and implementation process using design skills alone. Priorities must be re-established. The economic and social growth objectives pursued to date have led to major environmental, social, and economic imbalances that must necessarily be reviewed in the light of new requirements.

In order to achieve sustainability goals, a systemic approach to the entire design process is required to support environmental responsibility (Bistagnino, 2011; Battistoni et al., 2019; Aulisio et al., 2023). The systemic approach is not limited to design competences, but can connect topic, knowledge, and competences, contributing to the definition of ecosystems, transversally. The relationship of distant disciplines and skills promote the dialogue between designers and end users. If in the in previous years design was focused on functions and product with defined shapes to fulfil specific needs, today in uncertain times the shift from product to process is registered (Findeli & Bousbaci, 2005). Considering the process means thinking of a system that can be constantly redefined and renewed, and in which many actors and stakeholders are involved.

This leads to an increase in the complexity of projects where there are numerous factors to be considered, which is why it is deemed necessary to proceed with an approach that integrates methods and tools to be applied in the field of sustainability.

In this sense, the approach should be multi-scalar, in terms of capability of connecting the different scales of the project; multi-level, in terms of connecting different aspects considering the entire system and not stand-alone elements. The approach should be also based on inter-disciplinarity, favouring processes of collaboration between disciplines, but also of contamination, learning, cross-fertilisation between different knowledges (Scullica & Elgani, 2015). And finally, the design approach should stimulate a resilient approach that support the evolution instead of stasis.

Strategic and processual approach

The complexity of socio-technical systems require design to reflect on its approaches and methodologies to become more strategic (Verganti, 2016; Zurlo, 2004). The theoretical-experimental dimension in which spaces, furnishing systems and services are imagined, processes are conceived and the relations between subjects are foreshadowed, is closely

connected to an executive dimension anchored to construction logistics, timeframes for engineering production processes, execution, building sites, setting up and assembly that are frequently contained in order to respond to economic and management requirements that are not always aligned with those of design.

An approach that concretely wants to achieve sustainability objectives requires rethinking the parameters of the project to date with a new focus on the entire process of defining a space-product-service system. The focus on process has become preponderant and should aim to identify models for a transition from a linear model to a circular system of design and realisation of all the components that equip the space involving the entire supply chain.

Each phase must be rethought from the new parameters of analysis and understanding of the context and those who will be the recipients of the project. The Ellen MacArthur Foundation argues that «a circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models» (MacArthur Foundation, 2013).

As far as the design process is concerned, it is necessary to define new design methodologies and strategies, whether low-tech or high-tech, that affect all phases: from concept definition, design, sourcing of materials to be used in production, to the production and marketing of individual components or furniture systems, as well as interior design. In this sense, the extensive research conducted by Marieke Van den Heuvel in *The not-so-easy guide to circular interior design* (Volume 63, 2023) following and mapping interior circular design projects, mainly in the Netherlands, tried to outline how to approach this transition practically. The spatial designer pointed out that in the near future it will be possible to «reverse the current process and approach concept designing with existing materials in mind. Instead of creating a concept first and then find out what is available» (Ivi, p. 90).

Certainly, this reversal will bring initial complications, however «circular design demands heightened creativity from designers, as it necessitates flexibility right from outset» (Ibid.). This means thinking to the process in a strategic and systemic way, trying to consider not only the project, as an isolated event, but a series of actions related to the project during a longer period of time (Ibid.). This approach proposes a real methodological revolution that can be outlined through different paths, in this case the one already experimented in northern Europe is reported.

Focusing on starting a project, the first aspect involves defining project objectives and strategies, looking for ways to eliminate waste and pollution, as well as to verify the effective circulation of products and materials at their maximum value and to connect the project with the ecosystem.

In the case of an intervention on the existing, for the definition of the concept the designer can start from the connection with the local context and from what is on the project site, in terms of components, materials, and furniture to imagine how to reuse it, activate it, or simply decommission it. Even in the case of a new construction, the objective is to reuse existing materials, furniture and components, which will have to be founded elsewhere.

Next, it will be necessary to understand how to practically integrate the components available without losing sight of the original aim into the design process. Considering different purposes regarding components already present, components to be recovered, and raw materials to be procured will be strategic. This aspect is complex because it requires actions and management chains, for components, furniture and materials that are not yet so widespread. Considering in advance the construction and implementation phase, it is important to design timing and execution methods that differ from the traditional approach. Additionally, the dismantled phase after the use must also be included in the design phase.

This design process, which still needs experimentation and fine-tuning, will allow the entire interior design to be approached conceptually in a different way exploring: design, use and decommissioning timeframes, the relationship with the components, the choice of finishes and materials, the functional and even aesthetic dimension, the interaction with the furnishings and their use in the project, paving the way for projects that not only reduce their impact on the environment but are also able to regenerate it.

Exploring circular materials

This new design model is integrated with the implementation of materials research, again reshaping the approach. Materials are the first component of any project, but the logic by which they must be chosen for a project has changed.

The selection criteria are no longer based only on availability, but more on sustainability, so contemporary research focuses on circular building materials for architecture and interiors. Today, more and more designers are not just choosing materials, but becoming designers of the materials and experimenters they want to use in their projects, thus «the designer took the opportunity to acquire control of the entire design process by

developing material artefacts autonomously» (Rognoli, Ayala Garcia, Pollini, 2021).

As far as interiors are concerned, there is significant research on bio-based materials, since produced with organic renewable materials, such as natural elements and organic waste, applying organic processes, as shown in the Materials Design for Transitions Lab at Politecnico di Milano[11] that have a reduced impact both in the production and disposal phase. Important advances have been made in research on fibres, mycelium, the vegetative part of fungi, and the use of corn crops, rice straw, hemp, and coffee to create high-end materials for interiors. As demonstrated by the Italian brand Mogu, which markets acoustic panels and wallcovering panels as well as floor coverings made by biobased materials, such as mycelium and agro-industrial residues[12] (Fig. 3).

At the same time, the use of circular materials obtained from upcycle processes is becoming increasingly important. Thus, it becomes necessary to update the production chains through the redefinition of business models up to the redefinition of all production, executive and production processes, up to those involving the disassembly and reuse phases of the project's useful components.

This research, however, calls for a rethinking of all the components of the project, in terms of materials, forms, colours, and surfaces, and aesthetic languages as regards both the fixed equipment, which is composed of horizontal and vertical planes, and the furniture systems and all the components that equip the space. Exploring what already exist, reuse materials or introduce new biomaterials will involve an aesthetic exploration that will overcome the axiom of "the new" as necessarily more beautiful or better.

For instance, the experiments conducted by Atelier Luma through bioregional design practices on natural materials (Atelier LUMA, 2023) have found application in the renovation project of *Le Magasin Électrique*, the workspace of circular-design lab in the Parc des Ateliers, a former industrial site, where the French LUMA Arles Arts Centre is located (Figs. 4-5). The laboratory is self-designed with studios Assemble and BC Architects & Studies[13]. The space is a prototype of a low-impact

11. MaDe/Trans www.materialsxtransition.com.

12. Mogu https://mogu.bio.

13. For more information on the project: Le Magasin Électrique www.luma.org/fr/arles/nous-connaitre/parc-des-ateliers/le-magasin-electrique.html, Video *Rénovation du Magasin Électrique par Atelier LUMA en collaboration avec BC architects & studies et Assemble.* Retrieved 29th March 2024: www.luma.org/fr/live/watch/projet-lot-8-8d8e8096-0b84-4e9a-88bf-38b7b37eca8e.html.

bioregional approach to design and included twenty materials classified as waste products, bio-products or under-valued materials. For example, the materials used included bioplastic plug sockets and wall and acoustic panels made from agricultural waste including sunflower fibres. Door handles are made from salt crystals, bathroom tiles are made from algae and mended earth walls and external earth plaster are made with demolition waste.

Another example focuses on colours extracted from natural local flora, like red cabbage and berries to create plant-based pigments, which can be used to colour certain surfaces and objects, as in the experiments of Studio Loop Loop[14].

The role of assessment

The renewal of the design process, including selection of materials, considers the evaluation of environmental, economic and social impacts through specific methodologies offered by the assessment and certification schemes. Indeed, «assessment and certification schemes offer a way for designers to formalize a sustainable approach to design. The whole design is assessed, using calculation and measurement, to give a scientific, objective evaluation of its likely environment impact» (Moxon, 2012, p. 53).

Considering spatial design, the design assessment schemes should be a tool for evaluating the project, mainly the intervention on the building, during the design stage, with some post-completion checking, and not the end of the design process, as is unfortunately happening due to the proliferation of increasingly articulated and complex certifications to achieve. The whole design assessment schemes are available locally as is the case in Europe for Klima Haus, or worldwide. The tools differ from each other in objectives, categories, standard, rating and scoring systems and what stage they are applied. Recently «a number of interior – and refurbishment – specific standard assessments have emerged, and this trend looks likely to continue as the certification schemes develop» (Ibid.). To name the most widespread: LEED (Leadership in Energy and Environmental Design) from US Green Building Council, BREEAM (Building Research Establishment Environmental Assessment Method), WELL, developed by the International WELL Building Institute, helps organizations demonstrate their commitment to well-being by earning the highest pinnacle of health achievement for their buildings.

14. www.studiolooploop.nl.

In addition to these protocols, there are sustainability certifications of individual products that comply with UNI ISO standards. Alongside these are special certifications such as Ecolabel. The EU Ecolabel is the European Union's ecological quality mark that distinguishes products and services that, while guaranteeing high performance standards, are characterised by a reduced environmental impact during their entire life cycle. And finally, one can consider ESG criteria, focused on indicators that allow one to analyse the activity of a company considering environment, social, governance, introduced in the real estate world.

Despite the improper attribution of value that sometimes occurs, certifications can be very useful tools for the achievement of sustainability goals because they can guide the designer and constitute a way of objectively evaluating the processes applied, allowing comparisons of the results achieved. In this perspective, certifications contribute to the diffusion of knowledge and virtuous protocols, because focusing on just one aspect cannot guarantee the effectiveness of the result.

Of course, methods and tools to guide the design of environmentally sustainable solutions and to assess the environmental impact of products and systems including spaces are of great importance, with particular emphasis on LCA (Life Cycle Assessment). Assessments are complemented by specific methodologies that can «complement and support a product design process for the development of environmentally sustainable solutions» (Vezzoli, 2018, p. 208), such as the MPDS (Method for Product Design for Environmental Sustainability) method and tools, developed by prof. Vezzoli in LENS Polimi.

Accepting social challenges

The emergence of new processes is therefore subordinated to the spread of new ecological thoughts, which find in frugality the will to reduce the constant desire for novelty, on which some sectors are based in order to rediscover the value of the essential, as investigated in the Studio Albori approach. Also moving in this direction are all the other approaches that intend to work on the existing and which we will see in the section on reuse. In this context new ideals can guide the design approach of new generations such as *build less, but better* or, as affirmed by Heisel, Hebel & Webster «build better, less, different» (2022).

In addition to research into the technical aspects of construction, new models of thought and methodologies are integrated with the study of new models of interaction that make it possible to involve users in the decision-

making phase by developing a project that is more responsive to the needs of those who will inhabit it.

Design is able to trigger relationships between those who are connected to the processes, through forms of participatory approach, in terms of information for the general public, and educational or professional training, for the new generations of students and designers, but also co-design and co-creation with end users. In this sense, processes that reduce environmental impact are complemented by design approaches capable of listening to and involving the users of spaces, both in decision-making and design processes, while respecting their different competences.

In this, design can play the role of a bridging discipline between the scientific and anthropological spheres by intervening in what is considered an intangible but very important dimension.

In this sense, the aim of the process is care, inclusion, and the establishment of an egalitarian dimension of both environmental contexts and communities.

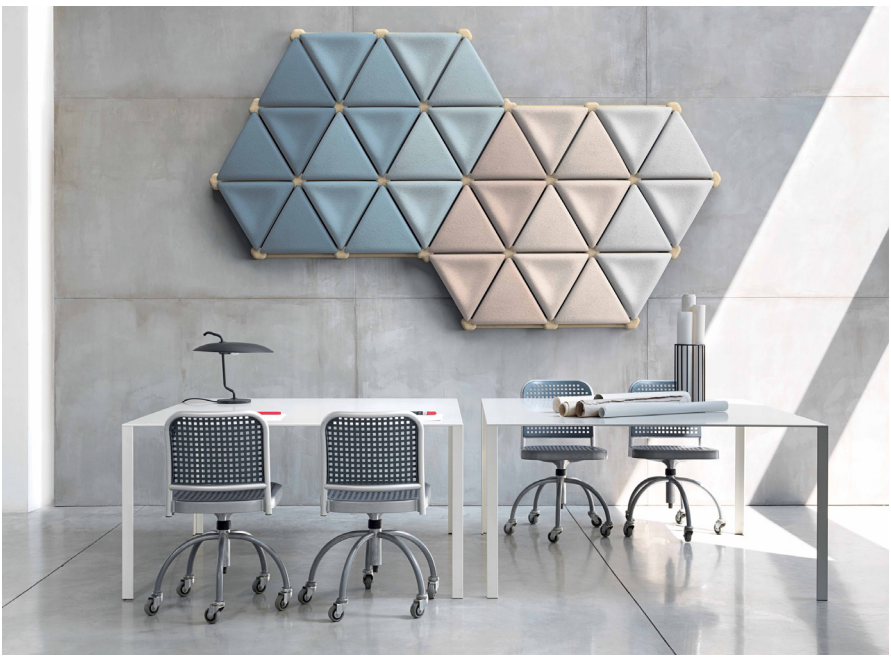


Fig. 3 - Mogu's Acoustic panels for interiors are 100% circular, because panels are made of fungal mycelium and of upcycled textile residues (Image courtesy of © MOGU)

Fig. 4 - 1:50 model showing the complete architectural project of the renovation project for the Le Magasin Électrique*, LUMA Arles, France (Image courtesy of © LUMA Arles, ph. Credit © Victor&Simon – Joana Luz)*

Fig. 5 - Detail of the floor construction with recycled roof tiles at the building site of Le Magasin Électrique*, LUMA Arles, France (Image courtesy of © LUMA Arles, ph. Credit © Adrian Deweerdt)*

1.2.2 Design future possibilities for interiors

Practicing awareness and responsibility

Research shows that in Italy after the pandemic there is a gradually growing awareness of the need to adapt the building heritage in order to achieve the environmental sustainability goals promoted by the European Union (Mannheimer, 2023).

In this sense, each individual must be aware of the political system in which he or she participates, feeling responsible for the collective choices made on sustainability issues, and understanding that some decisions if replicated on a large scale can have drastic environmental impacts.

The African continent is home to 17% of the world's population but is responsible for only 4% of global greenhouse gas emissions, yet African populations are among the first to suffer the climate effects of global emissions in terms of thermal warming and natural disasters (U.N. African Union Report, 2023)[15]. According to Oxfam and Stockholm Environment Institute Report in 2019, the richest 1%, in terms of income, of the world's population was responsible for as much CO2 emissions as 5 billion people, or 66% of the global population, two-thirds of humanity (Oxfam Report, 2023). Therefore, there is now a profound inequality both in social terms and in terms of environmental impact in different areas of the world, which means that certain behaviours and choices in some parts of the world cause major transformations on the environment and local economies in areas of the world that do not share the same behaviours and live with increasingly limited resources.

The multi-crisis condition people live in makes it necessary to understand the increasingly stringent cause-effect relationship in different contexts.

The sustainable approach should be for everyone, this is the only way to prevent experiences such as the pandemic from slipping by without leaving a positive legacy in terms of collective awareness, but also in terms of shared action on how to approach the design of spaces.

As part of the design project, each figure intercepting the project, designers, professionals as well as operators and users of spaces should become increasingly responsible for their impact on the environment and communities. In belonging to a social community, the designer can first of all acquire a new mindset, in terms of a way of looking at design that has

15. U.N. African Union Report, 2023 is based on World Carbon Atlas and World Meteorological Organization Report (2022), State of the Climate in Africa.

within it the ability to connect local dimensions with an understanding of complex global phenomena (Thackara, 2005), trying to define a different development path (Thackara, 2017). Indeed, «all the great transformations or creations have been unthinkable until they actually came to pass […] the fact that a belief system is deeply rooted does not mean it cannot change» (Morin, 1999).

This was demonstrated by the exhibition *The Laboratory of the Future*, at the *18th Biennale di Architettura Exhibition* in Venice (2023), which illustrated how until now an exclusive vision of architectural design, based on the methodological approach of western culture, has not been able to represent and interpret the complexity in terms of the variety of approaches to the design and realisation of living spaces that characterises the entire world. For the first time in the history of the exhibition, the curator, Leslie Lokko, wanted to represent the African approach, and that of the African diaspora, to architecture by bringing a point of view that has been rarely explored in Europe, reflecting on cultural identity, the plurality and variety of cultural, methodological and technical approaches of individual designers in relation to a global system capable of generating heterogeneous results (Lokko, 2023).

Undertaking a transformation of the design mindset means acquiring an ecological way of thinking, which in some way must be confronted with an ethical component, which allows us to broaden the horizons of the project, to consider the context and those who inhabit this context with a new approach.

What does it mean to acquire ecological thinking for interior design?

In the design field, acquiring ecological thinking means trying to question defined and consolidated processes of thought around the project, of project development and realisation, accentuating the need to follow counter-trend paths that require confrontation with regulatory systems that are not always open to experimentation.

According to research it means also embracing criteria of responsible innovation, focusing on responsible innovation processes that cross sectors and fields explored considering different perspectives, related to ethic, political, economic and governance issues (Gianni et al., 2019; Jakobsen et al., 2019).

There is therefore an urgent need to equip designers with interpretative conceptual keys that provide an incentive to follow new paths, overcoming a superficial vision of sustainability. New theoretical approaches can thus

be applied to innovative design processes. The exploration of some significant themes in approaching in design processes with a focus on interior design is attempted below.

More-than-human

As far as design is concerned, having an ecological mindset means overcoming an anthropocentric design approach in favour of a biocentric approach derived from *post-human thinking* and designing (Forlano, 2017; Braidotti, 2013). In fact, it is likely that the human-centred thinking that has guided the processes in design has been part of the problems humans face environmentally, socially, and economically and not the solution as it has long been understood (Wakkary, 2021).

Putting the biosphere at the centre means embracing a *multi-species vision*, where not necessarily humans are at the centre, but the relationships between species within a habitat of reference are strictly central and related to a set of physical factors, that are formed as a relationship between these parts of the ecosystem (Caffo, 2022). Ecology is in fact a discipline that belongs to the biological sciences; however, it can help us describe a «system of possible worlds towards which to orient the future» (Ivi, p. 46).

The future of the project can be actualised by acquiring a *more-than-human* perspective (Jaque et al., 2020; Davidová & Zavoleas, 2020) which investigates the relationship, and especially the interdependence and symbiotic relationship between species within a context (Camocini & Vergani, 2021). As environmental activist Donna Haraway states «the earth of the ongoing Chthulucene [her designation for the Anthropocene] is sympoietic, not autopoietic», attributing to sympoietic this definition from M. Beth Dempster's Master of Environmental Studies thesis written in 1998: «collectively producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change». By contrast, autopoietic systems are «self-producing» autonomous units «with self-defined spatial or temporal boundaries that tend to be centrally controlled, homeostatic, and predictable» (Haraway, 2016, p. 33).

In this sense, not only the human species, but also plants and animals are recognised as living entities, which have the right to a sustainable life (Galimberti, 2023). Indeed, studies by botanist Stefano Mancuso show that plants participate in highly complex systems and possess «a plant intelligence – an evolutionary intelligence whose main characteristic is the non-

belong to a single nervous system but to what can be defined as a "diffuse brain"» (Comoglio, 2023).

This openness determines an evolution in design thinking, because «post-humanism shifts the focus away from the power of self-reflexive human reasoning to situated, partial and multiple ways of knowing» (Wakkary, 2021), allowing us to frame an important paradigm shift in design (Caffo, 2022), because we can «rethink design from a present understanding of differentiated humans entangled in an equal fate with all that is not human and material» (Wakkary, 2021).

In the post-pandemic period, the reflection on the more-than-human approach is progressively spreading among designers, artists and creatives, as Leveratto reconstructs chronologically, even reaching the European institutional sphere: «adopt a more-than-human […] culture» (NEB High-Level Round Table, 2021), without yet having an unambiguous definition (Leveratto, 2023). Indeed, Anab Jain affirm: «In a more-than-human-centred approach to design we consider ourselves as deeply entangled in relationships with other species, both human and non-human» Thomas Wright offers: «More-than-human design is a conceptual articulation that stimulates action by designing for impact beyond humans» (NEB High-Level Round Table, 2021).

In relation to spatial design, this reflection pushes us to reconsider the concept of *habitat* as a context within which design can support coexistence and collaboration between species that generates common benefits. This collaboration, which translates into forms of symbiotic cohabitation, aims not only to reduce the impact on the environment, which remains fundamental, but to explore this relationship so that it can generate positive impacts and even regenerate the ecosystems of reference by actually defining *hospitable habitats*.

The exploration of the possibility of synergic sharing between different subjects broadens the scope of the designer who can become a facilitator of these processes. The radical change is in the redefinition of priorities and the search for new strategies as it pushes to rethink the project in terms of exchange, sharing and collaboration. The focus is on the use of resources that we already have and not on consumption of ones we don't have on reduction instead of construction, on adaptability instead of disruption, on prosperity instead of growth.

This open approach to exchange and the proliferation of interactions and indeterminacies has recently been consolidating in the design field as Studio Ossidiana's theoretical and design reflections demonstrate. The Rotterdam based studio, created by Giovanni Bellotti and Alessandra Covini, answered to the question "How will we live together?" provoca-

tively launched by Hashim Sarkis, curator of *17th Biennale di Architettura Exhibition* in Venice (2021). Looking towards a post-Anthropocene future, Studio Ossidiana designed the *Platform for Humans and Birds* (Fig. 6), where the relation with birds as a form of play can be explored, proposing «a cast surface-landscape where to negotiate boundaries, territories, resources and affordances between humans and another specie. As relations evolve, so does the platform, as boundaries are drawn, shaped, negotiated, and territories appear and dissolve upon it» (Kuitert, 2023).

Similar attitudes are demonstrated by other designers such as Formafantasma studio, who presenting the exhibition *Oltre Terra – Why Wool Matters* (Fig. 7), at National Museum of Oslo (2023) has affirmed: «cohabitation and proximity between species have created important forms of co-existence and co-dependence. This is a key issue because we are talking about an animal that needs to live with humans to survive, and humans have to take care of it. This issue raises ethical questions because if an animal or another species relies on us so much that it is dependent on humans, it is obvious that intensive farming is an abomination» (Valenti, Trimarchi & Farresin, 2023).

These theoretical and critic approaches, intently investigated by the speculative design (Dunne & Raby, 2013), show that a real turning point in the world in which design is imagined has been achieved. Natural dimension, which was previously too often considered to be only background to human's work, can be include in multidisciplinary explorations, based on sharing and collaborations.

According to the anthropologist Anna Lowenthaup Tsing «collaboration means working across differences, which leads to contamination. Without collaborations we all die» (2015)[16]. In this context, the designer, through his and her work, can contribute to the shifting form the individual dimension to the collective one. Adopting ethical approach and investigating relational methods in the multispecies interactions' designers can define new scenarios, focused on unexpected forms of community and hospitality (Haraway, 2016). Exploring a local, living and non-living, dimension and adapting strategies to specific contexts while understanding more complex phenomena, designer can explore a design approach directed towards «a cosmic hospitality open to biodiversity» (Renna, 2018), as suggested in *Grand Paris* project by Andrea Branzi and Stefano Boeri (2008).

16. Anna Lowenhaupt Tsing is author of the book: *The Mushroom at the End of the World* (2015), that is considered a classic of ecology and a major contribution to the definition of the more-than-human theory.

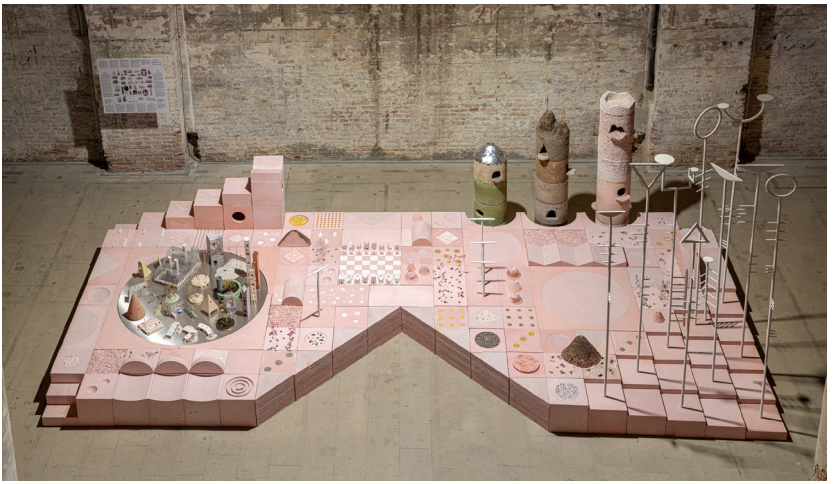


Fig. 6 - Platform for Humans and Birds*, designed by Studio Ossidiana 17th Biennale di Architettura Exhibition in Venice, 2021 (Image courtesy of © Riccardo De Vecchi)*

Fig. 7 - Oltre Terra *is an ongoing investigation conducted by Formafantasma focused on the history, ecology, and global dynamics of the extraction and production of wool in relation to the biological evolution of sheep. Exhibition at the National Museum of Oslo, 26 May-1 October 2023 (Image courtesy of © Formafantasma, ph.Gregorio Gonella)*

Climatic perspectives

Ecological thinking approaches the "climatic" dimension of design in order to address contemporary challenges of sustainable development.

In this sense, for many years now, the sustainable design of buildings has brought back to the centre of the debate the need to design spaces that stop ignoring the changing seasons, the evolution of climatic conditions, the transitions between day and night, and that require a great use of resources to maintain internal environmental conditions. It is a matter of recovering an approach that was already inherent in the making of architecture from its origins, aimed at producing architecture that creates comfort, as can be seen in architect Mario Cucinella's personal recollections of architectural journeys in his book *The Future is a Journey to the Past. Ten Stories About Architecture* (2022). Historically, climatic conditions have been the traditional generator of functions in dwelling spaces. This theme has also interested some architects of the modern era, as investigated by Daniel A. Barber in *Modern Architecture and Climate: Design before Air Conditioning* (2020) where, in the chapter entitled *The Planetary Interior*, he states the possibility for designers to re-evaluate the work of past architects to identify approaches that can support the contemporary practice of climate-sensitive architecture.

However, increasing global warming and sudden atmospheric changes impose the design of heated and cooled interiors, which are increasingly paradoxically isolated, controlled and they consume a considerable amount of energy to maintain optimal indoor comfort. These practices permit to realise sustainable spaces increasing the division between indoor and outdoor environments, reducing of all exchanges. It is now appropriate to pose the question of whether reintroducing nature into the interior, making the interior of a building more natural than the exterior.

An interesting approach that brings the interior back into the centre of the debate has been developed by Philippe Rahm, which was probably inspired by Cedric Price's reflections on the climate impact on architecture. In his consideration, which explores design at all scales, Rahm argues that «form and function follow climatic conditions» (Clement, Rahm & Borasi, 2007, p. 152). Rahm theorises the importance of returning to consider the relationship between interiors and the environment, as «modern heating and cooling systems, which contribute significantly to global warming, can no longer suffice in our Anthropocene era as the only way to heat or cool our buildings» (Ibid.).

Focusing on the central role of interiors, the Swiss architect proposes to overcome the fracture between architecture and decoration caused by minimalism in the last century in order to:

> redraw the lines, patterns and geometry of walls, ceilings floors, woodwork, mouldings according to the optical behaviour of the solar rays to multiply natural sunlight to reduce conduction of excessive heat accumulated on the ceiling to increase coefficient of thermal insulation of walls and impede cold bridges. Rethinking the intelligence of materials to choose the material basing specifical physical behaviour such as optical, thermal, acoustic absorption or reflection, porosity or proofing to water vapor, air their factor of conductivity or diffusivity. Rethinking materials in terms of its colours, textured with physical value, choosing innovative and non-toxic materials as interior materials, to reflect, infrared, absorb the other wavelengths, let them go elsewhere, while at the same time they reflect the shorter wavelengths of white light or absorb to enjoy even their heat (Rahm, 2017).

Rahm's research proposes rediscovering the old decorative techniques not for their aesthetic function but for their main function: «we need to harness thermal insulation, vapor barriers, double-flow ventilation, and other techniques, whose consequences include the invention of a new decorative language inside our homes and workplaces that will supersede the Modernist minimalism of the 20th century» (Ibid.).

In this sense, the system for equipping space becomes a tool to «reduce energy consumption, improve the thermal envelope and air tightness, water vapor management and condensation problems, room ventilation to reach the sustainable development at the fight against global warming» (Rahm, 2018). And, the system of product and objects to equip and furnish a space has become the «response to thermal and environmental requirements» (Ibid.) of buildings.

Philippe Rahms' studio has explored this theme in numerous projects, including Anthropocene Style, a furniture system for the *25th Biennale Interieur Exhibition*, in Kortrijk (2017). The furniture «are intended to improve interior comfort in a cool climate by harnessing the precise physical properties of the materials from which they are made» (Ibid.). As stated by the architect explaining some products designed for the exhibition:

- Low-thermal-effusivity rug is made from materials with the lowest thermal effusivity in order not to absorb heat from the human body on contact with it (see Fig. 8).
- The low-emissivity curtain is made from a material with the lowest thermal emissivity to prevent the radiant coldness of windows from issuing inwards.

- The high-reflective mirror reflects not only the visible spectrum but also the infrared, returning the radiant heat emitted by the human body back on itself.
- Low-thermal-conductivity tapestry, made from the highest-performance thermal-insulation materials, prevents the conduction of coldness from the exterior walls to indoor air.
- The convective dampening screen is made from the most air-impermeable materials available today: placed in front of external doors, it minimizes air currents.

Philippe Rahms' approach therefore suggests a new design exploration for the future, focus on climate-responsive interior projects, which is progressively being expanded through the design and speculative explorations of other designers.

Biophilic approach

Reflection on multi-species attention and climatic dimension of interiors are complemented by biophilic approach to design, which attributes a regenerative role to the direct connection with nature and to presence of natural elements in indoor spaces for the individuals who inhabit those spaces.

Starting from the first definition of *biophilia* (Fromm, 1964), later explored by Edward Osborne Wilson (1984), environmental psychology has demonstrated that direct and empathic connection with the natural world is essential for individual and collective wellbeing, for cognitive and emotional growth, for giving meaning and satisfaction to existence (Pazzaglia & Tizi, 2022).

In 2008 Kellert pointed to biophilia as «the inherent human inclination to affiliate with natural systems and processes, most particularly life and life-like (e.g. ecosystems) features of the nonhuman environment» (Kellert et al., 2008, p. 462). He connected research on biophilia and design practices in the book *Biophilic Design: The Theory Science and practice of bringing building to life*, defining five biophilic principles to support design. These principles were later extended by Terrapin Bright Green, who through a multidisciplinary approach came up with fourteen biophilic patterns[17] to apply in design processes.

17. The Patterns defined by Terrapin Bright Green are organized in three areas: 1) Nature in the Space: visual connection with nature; non-visual connection with nature; non-rhythmic sensory stimuli; thermal & airflow variability; presence of water; dynamic

Natural elements have always directly and unconsciously inspired designers and architects. They are used in various ways within projects, but recently there has been an increase in research interested in assessing how and with what impact green elements have a positive effect on people's well-being and the rest of ecosystems. «Some elements (e.g. air, daylight, plants, and landscape) present opportunities to develop design strategies with multiple benefits, especially for enhancing health and well-being, productivity, biodiversity, circularity, and resilience» (Zhong, 2022).

For these reasons, biophilic spaces are claimed to contribute to sustainability, overcoming the lack of contact with nature and effectively managing natural resources. Biophilic design could contribute effectively to the goals of sustainable spaces, although the topic is very complex and more articulated than it may seem, because connect different areas, from biological sciences to psychology and perception studies trough technological investigations, and of, course, studies on comfort, affordance and proximity in spaces.

According to Zhong «biophilic design is more complex and richer than the mere application of vegetation in buildings; it broadens the variety through encompassing different types of nature from physical, sensory, metaphorical, morphological, material to spiritual. Moreover, knowledge gaps are identified to motivate future research and critical reflections on biophilic design practices» (Ibid.).

Indeed, in Italy the research on biophilic design and nature-based solutions is intensifying. PNAT, a think-tank of designers and plant scientists founded by Stefano Mancuso, professor at the University of Florence and director of the International Laboratory of Plant Neurobiology, promotes plant-based solutions for cities and indoor spaces because it believes that, from an eco-systemic approach, nature can provide «integrated, smart, low-cost solutions to many challenges that society must and will face» (PNAT, 2022, p. 23).

The positive impact of green elements and plants on people's physical well-being and health can be estimated and evaluated. The Millennium Ecosystem Assessment try exploring the benefits that the Earth's ecosystems offer individuals (Ibid.). Considering this contribution's focus on interiors, the attention is only on indoor air quality, although the benefits that can be explored through this approach are greater[18]. Focusing on

& diffuse light; connection with natural systems; 2) Natural Analogues: biomorphic forms & patterns; material connection with nature; complexity & order; 3) Nature of the Space: prospect; refuge; mystery; risk/peril. www.terrapinbrightgreen.com/reports/14-patterns/.

18. For in-depth study: PNAT, *Linee guida alla progettazione di plant based solutions alla scala dell'edificio e delle sue pertinenze per interventi di urban jungle*. EU European Union, Città di Prato, 2022. www.pnat.net.

indoor air, PNAT assessed how plants «capture air pollutant and incorporate them into their biomass. Their leaves and roots work as highly efficient filters, with an indefinite duration. Based on the results of laboratory experiments, PNAT uses plant technologies to innovate ventilation system, promoting an approach based on air recycling and botanical filtration, and ongoing monitoring of environmental pollutant concentrations» (PNAT, 2024).

In fact, based on these considerations, the think tank designed in 2019 *Fabbrica dell'Aria* (Air Factory), a patented indoor air filtration and purification system that uses plants as a botanical filter. The system purifies the air of air pollutants, fine dust, VOCs (Volatile organic compounds).

Additionally, the cohabitation between plants and people introduces another relevant topic for design. According to PNAT in the forthcoming period it will indeed be important to explore potentialities of including more plants in all the urban spaces such as gardens, streets, common spaces as well as in indoor spaces, such as health care systems, learning structures, to enhance urban prosperity. This will require a more in-depth study of the plant world and the interactions between species. It will also require

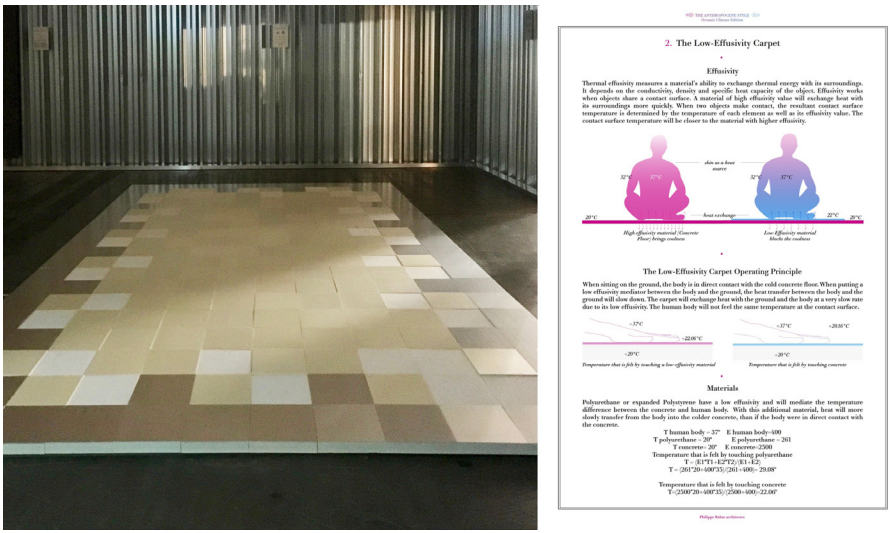


Fig. 8 - The Low-Effusivity Carpet designed by Philippe Rahm architects for The Anthropocene Style Exhibition. New Decorative Style for the Age of global warming *at* 25th Biennale Interieur Exhibition*, in Kortrijk (2017) (Image courtesy of © Philippe Rahm architects)*

exploring new processes of reforestation (self-)production processes, and regeneration.

As will be seen below, the subject of regeneration is of direct interest to design, as the discipline allows for the connection of such distant fields as biological sciences and tourism activities to initiate regenerative processes in natural ecosystems.

Frugality

Ecological thinking can bring designers closer to active and innovative practices, that are never unambiguous of reducing consumption, waste, abundance and accumulation. It approaches moderation, which should not, however, be understood as deprivation or renunciation, but as a conscious choice, focused on wellbeing, since the most consolidated design processes, production and consumption models applied up to now have determined a condition of unsustainability.

In this sense, the approach of Studio Albori, born from the collaboration between architects Emanuele Almagioni, Giacomo Borella and Francesca Riva, is of great interest. For many years now, the studio has been pursuing a design approach that disrupts certain consolidated conceptions of how a project should be conceived and subsequently realised with a view to the continuous consumption of resources and adaptation to standardised construction canons that are as polluting as they are.

To cite just one example, consider the recent project *Social Friendship: Meeting in the Garden*. Studio Albori was invited to intervene in the garden spaces of the Benedictine Abbey of San Giorgio Maggiore in Venice, for the project of the Pavilion for the Holy See, curated by Roberto Cremascoli at *18th Biennale di Architettura Exhibition*, in Venice (2023) (Fig. 9).

The designers rethought the conformation and use of the garden to make these spaces suitable for welcoming the exhibition audience and the following guests. Inspired and supported by Pope Francis' reflections on the ecological approach also needed in architecture and presented in the encyclicals "Laudato si'" (2015), and "Fratelli tutti" (2020) (Cremascoli, 2023) the studio introduced a design process based on an experimental building attitude and an approach rooted in «*fare con poco, quello che serve*», that may be translated as «doing with little, what is needed». The process has been broken down into different phases that have involved the constant active participation of the architects, even in the construction phase. The first step was to collaborate with the About cultural association to bring order to the garden, integrating the existing essences with the

Fig. 9 - Self-built installations by Studio Albori for Social Friendship: Meeting in the Garden*, the project of the Pavilion for the Holy See, in the spaces of the Benedictine Abbey of San Giorgio Maggiore in Venice, for the* 18th Biennale di Architettura Exhibition *(2023) (Image courtesy of © Studio Albori)*

new plantings of the vegetable garden, in order to breathe new life into this open space. Secondly, operations were defined to favour the use of the space, walking among the vegetable gardens, and finally, through the re-use of material from the dismantling of a house in Cortina d'Ampezzo, a kiosk with a pergola, a sunshade with seats, a seed store and shelter for tools, a greenhouse and a henhouse were built, also through self-construction, temporary artefacts that make it possible to stop in the garden, shelter, meet people, and shelter the chickens.

The decision to use almost exclusively waste materials in the construction phase is inspired by a radical critique of the use of materials defined as sustainable, but which in fact feed an incessant chain of consumption. This *modus operandi* does not renounce the aesthetic dimension of the project, but poetically explores it through new frugal and essential languages.

Studio Albori's project is thus the result of a process of knowledge of the place and exploration of the opportunities given by the context at a given time, which has allowed the designers to prefigure unexpected scenarios, which find their expression in environmentally and community-sensitive practices. In this project, as in others by Studio Albori, emerges «the intention to recover the sense of necessity expressed by objects and spaces» (Corbellini, 2016, pp. 58-75), that can be considered a significant goal for these uncertain times.

Stimulating behavioural changes

The ecological thinking stimulates the explorative attitude of design and induces the designer to explore new uncharted territories and narrative paths (Valenti, Trimarchi & Farresin, 2023).

The paradigm shift is not only in the way the project is developed, but also in the capacity that design can have to narrate the project (Petroni, 2022) and involve different stakeholders. In the light of this reflection, one does not just design for a living entity, but by involving it. The communities for whom one designs and with whom one designs belong to different species that share a habitat and cohabit it (Leveratto, 2023).

In this sense the designer can, and should, stimulate behavioural change and social innovation among the humans inhabiting these spaces. Promoting the definition of contexts of active participation based on inclusive practices such as co-design, as explored in Polimi Desis Lab (Selloni, Meroni & Corubolo, 2023; Fassi & Manzini, 2022) and multi-species inclusion (Camocini & Vergani, 2021) design can improve sustainable behaviours in every moment of daily life (Manzini & Jégou, 2003).

This will allow the attribution of new meanings to spaces, as well as the exploration of new behaviours, languages and aesthetics (De Rosa & Galluzzo, 2024) that are not necessarily based on continuous renewal.

The final goal is to promote well-being for all while preserving the planet, to support the coexistence of animals, plants, and people in which there are no inequalities, so that individuals can co-evolve with nature, promoting an interspecies approach to design, to discover «the way to live together as a space of possibilities» (Kuitert, 2023).

1.3 Sustainable processes applied to hospitality spaces

The field of tourism, with particular focus on hospitality sector, is an area of interest for design (Scullica, 2008), which is a discipline capable of promoting research and innovation through innovative methodological approaches, processes and established practices (Dominioni & Scullica, 2022; Camocini & Dominioni, 2022), that can connect scientific fields and social sciences (Collina, 2005).

Design makes it possible to investigate the concept of hospitality from the urban scale, with the definition of the *hospitable city* (Crespi in Bosoni, Rebaglio & Scullica, 2012; Fassi & Scullica, 2008), to the systems of hospitality spaces-products-services, including the relationship with tourism activities. Additionally, focusing on interiors, it is possible to deepen the study of the evolution of hospitality spaces, with attention to the development of the concept of hospitality and welcoming. Analyzing new formats for hospitality, such as hostels and coliving, transformations of functions and spatial layouts are explored to understand changes in hospitable interiors (Scullica & Elgani, 2020; Scullica & Elgani, 2019; Scullica & Elgani, 2015; Scullica, 2008).

After the halt imposed by the pandemic, design has put particular interest in focusing on how to support, through specific strategies, the increase of a sustainable approach in all sectors. In the hospitality sector, this approach is of great importance and urgency, as the hospitality industry has a major impact on the environment, as evidenced by reports from the Sustainable Hospitality Alliance[19]. At the same time, according to research by Skift, the 53% of travellers are willing to pay more for products, including space and services, that demonstrate environmental responsibility (Sheivachman, 2019). Recently a growing number of hotels

19. For more data and details: https://sustainablehospitalityalliance.org/only-one-earth/.

brands are embracing a *zero-waste philosophy*, primarily concentrating on food waste, reduction of consumption and waste of resources, and attention to packaging and mono-use amenities (Thiemann, 2023). However, there is still much to be done as expressed by Kevin Jacobs, Chief Financial Officer & President, Global Development for Hilton, during a meeting with finalists at the Sustainable Hospitality Challenge during the Future Hospitality Summit – Abu Dhabi, September 2023: «Too few designers are involved at an early stage in the development and design processes of hospitality spaces. In the future we hope to involve more designers in the conception and development of our hotels».

Current reflections and debates on sustainability are progressively defining a responsible approach to tourism (Goodwin, 2011), and spaces related to tourism activities, that can bring a positive impact on the territories and communities that host tourism activities. It is therefore becoming increasingly important design of responsible tourism experiences based on a system of sustainable spaces for both environments and communities that welcome them, and for contemporary travellers.

Since 2022, desk research has been conducted at Dept. of Design – Politecnico di Milano with the aim to discover how the application of sustainability principles to the design and development processes of interiors for hospitality, with particular reference to bespoke interiors, derived from contract design and production processes, could innovate the hospitality industry[20]. During the years the research has been integrated with a design practice-based approach interested in the application of circularity processes to hospitality interiors with the aim of reducing the impact of spaces on the environment. Some of the research activities conducted involved educational activities, which made it possible to implement awareness of certain issues and sustainability skills for future young professionals in interiors. The conceptual framework defined made it possible to hypothesise new processes for integrating sustainable design-oriented processes into the development of future hospitality spaces for the tourism sector, certainly to reduce the impact of these spaces, but above all to initiate processes of environmental and social regeneration in specific local contexts.

These reflections found reference within the broader research on regenerative tourism that «departs from the sustainable development paradigm

20. Research Project: DOI_Design, Hospitality and Innovation: the contract sector for the definition of a new hospitality between design, production, realisation and fruition, financed by PON Research and Innovation – REACT EU. Scientific coordinator: prof. Francesco Scullica. Researcher: Elena Elgani.

by positioning tourism activities as interventions that develop the capacities of places, communities and their guests to operate in harmony with interconnected social-ecological systems» (Bellato et al., 2022).

Two experiences of research (presented below) have focused on practice-led regenerative development paradigm (Mang & Reed, 2011; Mang & Haggard, 2016) (Fig. 10), applied to hospitality spaces in two different contexts, which in the first case, allow to define an innovative regenerative floating space for aquatic hospitality, and in the second, to improve the regenerative approach in a socio-cultural context, where is not so explored.

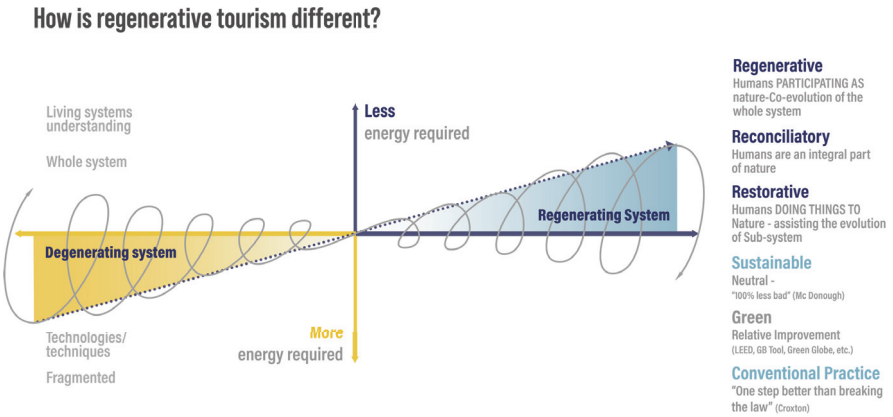


Fig. 10 - Trajectory of environmentally responsible design: shifting from sustainability to regeneration, described by Bill Reed, 2007 (Author's elaboration)

This made it possible to define that the regenerative spaces for hospitality are sustainable space-product-service systems to support responsible tourism experiences that can reconnect welcoming spaces, natural environments as well as cultural aspects and social communities in defined ecosystems.

In one case, it was decided to apply the identified design strategies to a significant natural context to develop a pilot case study, which could become a practical case study for stakeholders working towards regenerative futures in hospitality industry. In the second case, the experience gained in a specific cultural context was subsequently applied in a different geographical context by trying to build links between two distant realities.

Design has the competence to connect distant technical and scientific fields to create immersive and transformative experiences for users that can have a positive impact on people's mindsets. Recently, there is a shift from creating memorable experiences designed for many, towards experiences that are potentially self-transcending and life-changing for one (Neuhofer, 2020).

Thus, stimulating a progressive behavioural change that will enable the achievement of sustainability goals. This approach is fundamental in the design of hospitality spaces for the future generations because these spaces are too often focused on consuming experiences and activities with negative impacts on the environment.

This research project is focused on sustainable tourism with the aim to design a product-service-system for hospitality able to regenerate aquatic ecosystems. The aim is to realize a design project, focusing on how design can facilitate the reconnection between humans and nature through the cross-fertilization of disciplines to achieve impactful solutions.

The specific focus has been on aquatic ecosystems because water pollution, particularly of the oceans and seas (Elgani et al., 2024), threatens both aquatic ecosystems (Jol & Füssel, 2017) and the lives of many communities around the world (Jones et al., 2023). The abundance of plastics, but above all microplastics, which are fragments of plastic with sizes less than 5 mm, in coastal areas as well as in remote oceanic zones, where collection is more difficult, determines the continuing destruction of marine ecosystems, with a particular focus on coral bleaching. At the same time, the coral reef is one of the natural attractions that supports marine tourism for a specific target group: diving and snorkelling enthusiasts. Water-based tourism is very important because «can enhance local communities' quality of life due to the mobility of economic activities. It also offers opportunities for the sustainability of ecosystems, particularly for water supply, and will become an alternative energy source for recreation innovation and climate protection in the future» (Rahmat et al., 2023).

The explorative research conducted on spaces for hospitality in extra-ordinary nature based aquatic ecosystems like resorts, and villages, is completed with the development of a pilot case study. The project was developed with a team of students to participate in the Sustainable Hospitality Challenge and won the 2023 edition of the

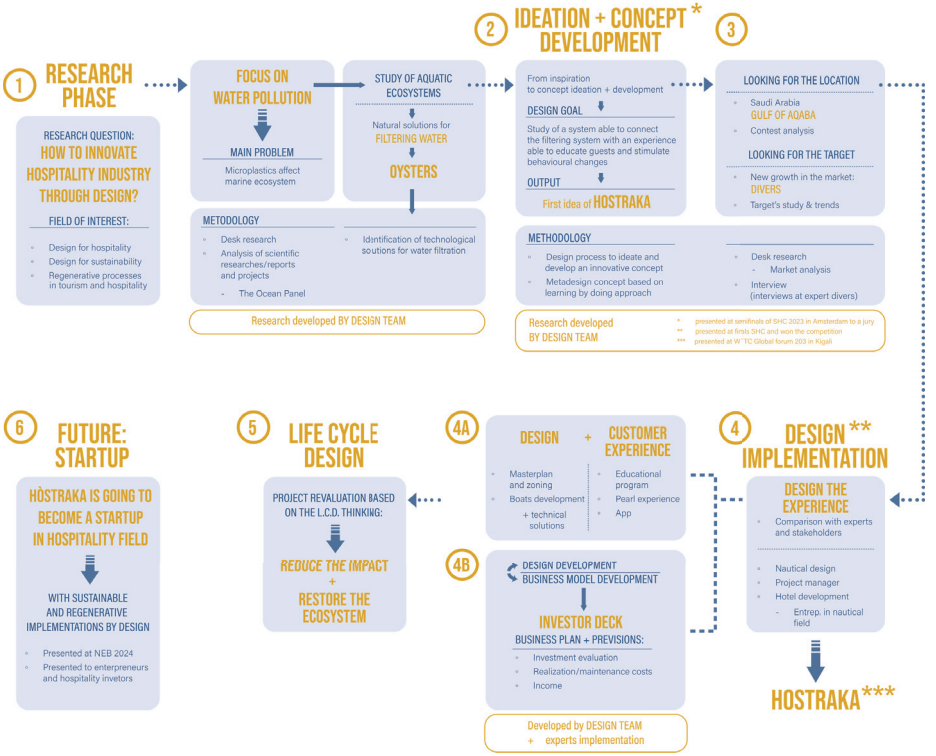
competition. The Sustainable Hospitality Challenge is the largest international contest for young professionals created by Hotel School The Hague, to support the green transition and innovation of the entire hospitality industry.

The team, composed by young designers Rosanna Caldarella, Giulia Ettori, Davide Grasso and Elisa Schembri, from the School of Design of Politecnico di Milano, involving Elena Elgani, as research fellow from Department of Design of Politecnico di Milano, designed *Hòstraka*, a sustainable floating resort for diving lovers.

The idea is to improve responsive behaviours trough a system of spaces for hospitality that can collect microplastics from waters, supporting the regeneration of marine ecosystem. A design practice-based approach is adopted. Through a meta-design process (Collina, 2005), based on "learning by doing" methodology, an innovative hospitality concept is developed. The aim was to design a system of spaces for hospitality concretely sustainable in environmental, social, and economic terms.

Hòstraka is designed applying strategies from design for sustainability and circular design in space for hospitality. It takes its inspiration from the ocean, looking at oysters' natural cleaning and the filtering water activity. Clams can turn captured impurities into pearls, transforming something bad into a new and unexpected product with remarkable qualities. From this idea is driven the inspiration to design a system of spaces anchored to the seabed represented by the common areas mixed with floating private spaces. The structure is completed by little boats as floating suites and ecological transportation for the guests, who can discover in total autonomy the natural environment where the resort is located.

The guest journey is a fundamental aspect of the project, because guests can be part of the sustainable transition to a cleaner world. Guest journey enables customers to raise their awareness of pollution and to take an active role in collecting microplastics from the water. In fact, guests can collect the microplastics by navigating, while interacting with the aquatic environment in which they find themselves. In common spaces guest can be involved in educational activities in a fully equipped laboratory to understand the process of re-use of collected microplastics. Indeed, the private movable suites, called *Stràka*, can collect microplastics, through a special engine. The development of the small boats and applied technologies, including the special engine, was studied with Professors Andrea Ratti and Arianna Bionda (Design. Dept – Politecnico di Milano) with the support of yacht designer Matteo Costa (costadesign.it).



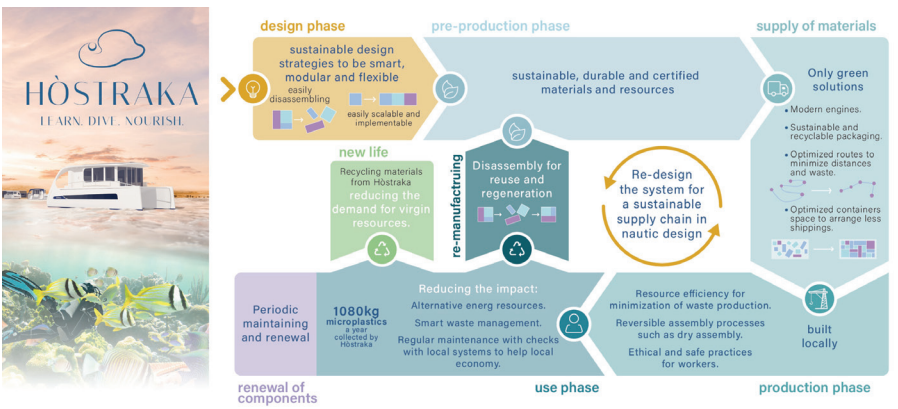


Fig. 11 - The first diagram summarises the entire Hòstraka's design process. The second diagram is focused on Hòstraka's life-cycle design developed including design strategies for sustainability (Image courtesy of © Hòstraka Team)

The *Hòstraka* project intends to include guests in a new dimension of hospitality based on empowerment through educational experiences. Particular attention is also given to proper interaction with the local community. Local inhabitants are invited to actively participate in the educational programme and contribute to the design of the experiences. Temporary guests can participate in community based environmental efforts. In addition, *Hòstraka* has an important aspect in its design development incorporating principles from design for sustainability (Fig. 11) which aims to introduce eco-efficient design in the hospitality industry, considering the environmental, economic and social impact during the entire life-cycle design (LCD).

Design can outline a possible innovative path for hospitality industry and facilitate this by incorporating a regenerative approach that combines environmental and negative social impact reduction with ecosystem regeneration. This can be achieved by integrating skills and knowledge from various disciplines to experiment with new design processes and considering the life-cycle design of the entire process. This will allow the design of hospitality spaces that unite technical and social dimensions, as demonstrated by the development of *Hòstraka*.

Connecting cultures to enhance sustainability in hospitality spaces: "From Rimini to Habana", MODE's suite

The second research project is defined through two interconnected research-actions supported by an international cooperation activity. The first activity took place in Cuba for the Italian Design Day 2023, involving young Cuban professionals in a training activity[21].

During the workshop, the first step focused on identifying significant themes of La Habana's cultural heritage and involved participants in brainstorming sessions in small groups. This initial process was followed by a study of potential new tourist destinations, considering the travel behaviour of new generations. Urban areas or existing buildings of interest were then selected, taking into account their location, links with the city and architectural features. Workshop participants rethought these spaces, trying to

21. The training activity is part of the programme *Hogar Dulce Hogar* organised for the Italian Design Day 2023 by Dr. Simona Autuori, ICE La Habana, with the support of the Italian Embassy in Cuba, the Oficina Nacional de Diseño (ONDi), Oficina del Historiador at the ReDi centre (La Habana). The programme included a competition for young Cuban designers, and an intensive masterclass with the workshop *Del enfoque sostenible al proyecto de la hospitalidad (muebles textiles/interiors)*, held by Prof. Giovanni Conti and Elena Elgani in La Habana, Cuba (15-19 May 2023).

apply strategies from design for sustainability to host tourist experiences that would overcome a stereotypical view of the city.

The shared process made it possible to:

- analyse the socio-cultural context of La Habana (considering also the entire context of Cuba) through the lens of the local design community;
- share different approaches and methodologies related to design processes and tourism development;
- foster the circulation of strategies for sustainable approaches to design and tourism in the Carribean context, with a peer-to-peer approach between researchers and young professionals;
- stimulate reflections on social innovation within the local design community.

The second activity was developed through a collaboration between ICE (office of Italian Institute for Foreign Trade based in La Habana), the Italian Embassy in Cuba, and the School of Design, Politecnico di Milano. Three young Cuban professionals were invited to participate in a workshop developed in Milano with Teamwork Hospitality, an Italian company specialized in marketing and concept development projects for the hospitality industry.

The company is currently designing and building a sustainable hotel pilot project, called MODE[22]. The project is focused on obtaining LEED certification, based on Green Building Council rating system (USA), to certify the reduction of the hotel environmental impact on the local urban context. Additional aim is the guest engagement, developed to promote and spread responsible behaviours. The long-term objective is the realization of a sustainable process that can be a reference for hospitality operators and developers in Italy, in terms of design, hotel management, provision of services that are guided by sustainability principles.

The hotel is located in Rimini, a city with a long history as a tourist location, having been one of the first Italian destinations for mass tourism in the 1960s, thanks to Italy's economic boom.

22. The MODE Project is developed by Mauro Santinato, president of Teamwork Hospitality, with the coordination of arch. Laura Verdi and the consultancy of: Studio Cavazzoni Associati, Studio ASP – Loris Rinaldi, Hospitality Project, Comfort Hub – Chiara Tabellini and Ing. Stefano Ferri for all the technical issues and LEED Certifications. The professional firms involved are: OTTO Studio (Paola Navone e Gian Paolo Venier), Eclettico Design – Lombardini22, the ne[s]t, NOA, ovre.design, GLA Genius Loci Architettura, Alessia Galimberti Studio, Rizoma Architetture, Laura Verdi Studio, Roberta Studio, Dipartimento di Design del Politecnico di Milano.

The adaptive reuse of an existing hotel building, close to an area of local historical importance, has been started in 2023. The hotel is limited in dimension and in the functional layout, but it is representative of the recurring family-managed hotel typology in Italy.

The development of MODE is related to a previous project DEMO with the same design development process, both stems from ROOMS, the format devised by Teamwork Hospitality and realised at the Rimini trade fair during the SIA Exhibition 2018 and 2019, which involved in the design of hotel rooms and suites a significant architecture and interior firms called upon to interpret their idea of hospitality.

This approach differs significantly from the established design process in the hotel field, but it is similar to a design approach developed in 2004 during the construction of the Puerta America hotel in Madrid by Silkens Group. The most famous design brands of the period were involved in the Puerta America development: Foster and Partners, Zaha Hadid, David Chipperfield, Jean Nouvel, Arata Isozaki, Ron Arad, and John Pawson are invited to design public areas and very different private rooms.

This approach of hotel project development has its conceptual origin in the *Grand Hotel Salone Exhibition* at the *Milan Furniture Fair* in 2002, where different mock-up rooms were realized to explore the potentiality of the interior design in interpreting different ways to experience travels. The exhibition showed also the ability of the Italian contract system to develop bespoke solutions for large welcoming spaces, demonstrating great technical skills and care in the execution of detailing.

In MODE are involved eleven design studios, that are exploring sustainability approach to the hospitality design, for nine suites and indoor and outdoor common spaces. At the same time Italian furniture brands as well as firms for finishings and materials are involved in the construction and in the fit out of the interiors.

Organised in collaboration with Teamwork Hospitality, the workshop aimed to define meta-design concepts for hospitality spaces, capable of translating a sense of place and inspiring guests to a sustainable approach to the tourism experience. Young professionals from Cuba and third-year students of the Interior Design Degree course at the School of Design participated in the workshop. As a result, different scenarios were obtained, expressing different sensitivities, from which concepts were developed.

Subsequently, Teamwork Hospitality decided to further research and executive design the *From Rimini to Habana* concept, developed by a team of young professionals and students, from interior architecture and design, both Italian and Cuban: Elisa Cattaneo, Rolando Antonio Escobar Hidalgo, Benedetta Franci, Elisa Panizza and Erika Spanu.

The executive development phase of the project was entrusted to the Design Department of the Politecnico di Milano. The research team is composed by Francesco Scullica, Elena Elgani, Cinzia Pagni, Claudia Borgonovo and Federico Salmaso. The executive development allowed for further research into the sustainable approach to interior design, delving into the initial ideas through to the realisation of the room. During the research phase, in particular were deepened the details of the supplies for FFF&E (furniture, fixture, finishes & equipment design). In particular, research focused on the identification and selection of sustainable materials, that are selected to ensure durability performance, confirmed by product certifications, for use in the hotel sector and to achieve LEED certification. In addition, materials were selected considering their possible future reuse, or even their recyclability. Sustainable technologies that could be integrated into the interior design were explored with the design studio coordinating the entire project.

Finally, it was decided to explore processes of furniture re-use, discovered in second-hand marketplaces, and re-manufacturing (Talamo, 2022) of existing furniture, which will furnish the room. This aspect is one of the most complex to apply, because it requires an intense period of research to identify suitable furniture for the project. In Italy, the application of this *modus operandi* is more complex than in other European countries, because marketplaces for second-hand goods, although widespread, do not yet participate in a structured supply chain to respond rapidly to the needs of designers and the technical time required to realise a project. The research made it possible to compare the Italian context with other realities, identifying in this segment a possible further field of development and experimentation.

The multilevel approach has allowed to innovate the selection criteria for hotel interiors facilities. The final output to be obtained from the MODE project is a collection of prototypes of a sustainable space able to explain innovative design process to apply strategies from design for sustainability to a hospitality spaces, innovating both the design process and the relationship of the guest with the reception spaces.

2. Flexibility

2.1 Re-defining Public and Private: new concepts and hybridizations

The pandemic accelerated the transformation of lifestyles, relational behaviour and organisational models that were already undergoing profound transformations before the spread of the virus. From the perspective of spaces, it can be noted that «one of the most noticeable effects of Covid-19 on interiors, especially those located within the home, was the erosion of what had, prior to 2020, been a set of relatively stable binaries, among them those of public/private, work/leisure, individual/collective and urban/domestic» (Sparke et al., 2023).

In fact, activities that traditionally took place in public or semi-public places were relegated to the home (Ivi, p. 82), such as work and schooling, which moved entirely online for a certain period of time. While spaces traditionally intended for these functions, such as workplaces, schools, hotels and other collective spaces, were left empty and waiting for redesign or, at least, repurposing.

Among the main influencing factors were the digitisation of many work activities and the spread of forms of social interaction through social networks, virtual collaboration platforms, which supported the relocation of individuals from spaces with well-established roles; the temporary redefinition of the boundaries between public and private was not only physical, but also behavioural and relational: working and studying from home one could see how a traditionally private place stimulates private behaviours (Ivi, p. 31) in contexts where they would otherwise be considered inappropriate (lying in bed with the laptop open while listening to the lecture, eating breakfast or getting changed while attending a work meeting, etc.).

This redefinition, however, has not simply taken place in the realm of the virtual, but has also had tangible repercussions in the physical realm: in fact, «the intrusion of public activities into the domestic space, be they working or leisure activities, calls for reconsidering both the traditional articulation of rooms in individual bedrooms and common living zones, and the nondescript extension of open spaces» (Spanedda & Fusaro, 2022).

The lack in contemporary times of internal partitions in living spaces (and not only), which from being a necessity due to lack of space in urban places has now become a standard, has in fact led during the pandemic to the coexistence of both public and private functions, often not overlapping, in the same space with the result of reduced privacy (Ibid.) which may be detrimental to the well-being of the users. At the same time, the instantaneousness of virtual interactions has, however, promoted the reduction of relationship times and consequently of the use of spaces. While in some ways these have increased the efficiency of certain processes and the reduction of some forms of over-mobility, with a positive impact on the environment, significant spatial repercussions have emerged.

Spatial transformations were accelerated during the pandemic period with significant repercussions in the post-pandemic phase and are now the object of debate because they intercept experiments on sustainable transition and modify individuals' perceptions of space. In the post-pandemic period, we see the overcoming of fixed and predefined infrastructures and spaces-product-services systems.

There is a proliferation of different spatial solutions regarding many work and study locations, true "environmental systems" made up of space, services, communication, and technology (Gerosa & Manciaracina, 2023). Different organisational solutions, from the private office to co-working, to the open space realised in accordance with the principles of biophilic design often coexist in places designed to be more and more welcoming in order to foster a sense of belonging, well-being and participation in the corporate mission, and consequently productivity. Workspaces and study spaces are transformed because of the evolution of employees and student behaviours as well as updated working tasks, learning models and teaching practices.

Hospitality spaces tend to be increasingly out of the ordinary in order to surprise and engage guests in immersive experience focused on well-being, *bleisure* and leisure personalized experiences and discovering of places. At the same time, hospitality spaces have acquired new functions and services for guest and citizens. Indeed, the places of travel and leisure suffered a terrible pause for pandemic, which emptied them of their activities for long periods, compromising the economic stability of some activi-

ties that necessarily reinvented themselves. One example is the hotels that have changed the layout of some rooms to offer temporary offices for individual professionals and meeting rooms for a few colleagues while guaranteeing the hygiene and catering services usually offered to leisure customers. For example, during the pandemic, NH Hotels designed Smart Spaces, a programme designed to recreate temporary offices or locations in which to organise small meetings or working groups, and Hybrid Meetings, a format designed especially for global companies that allows hybrid events to be organised in which teams and clients from various destinations and located in various hotels are connected in a single space: physical presence and virtual participation in a single connective hub, which are systems of integrated spaces and services remained active even after the pandemic ended (Assumma & Bonini, 2020).

For some individuals, the transformations imposed by the pandemic, initially temporary, in the way spaces are used have been radical and permanent as they have permanently changed some personal balances, for example in relation to work-life balance.

During the pandemic, some knowledge workers were forced to work remotely from their homes, and at the end of the health emergency they maintained a remote work activity, erroneously defined as "smart-working", which required them to locate a small area in their home, sometimes disputed with other inhabitants, to be used as a workstation, at least, for a few hours a day. At the same time, this new working dimension has required a different organisation of one's lifestyle, one's movements and rhythms, as well as a new relationship with other individuals with whom one shares both work activities and the domestic dimension. This process has reduced the need for a workstation in an office, in fact contributing to the dematerialisation of workplaces already undertaken with the digitisation of activities, with significant impacts on work processes and even on the relational sphere and involvement of workers.

In addition, some relationships with specific domestic spheres also changed during this period, especially during lockdowns. Everyone has come to terms with his or her living space. In case of infection with the virus, it was necessary to isolate oneself in a few rooms, organising the use of shared spaces necessarily according to well-defined shifts and sanitisation processes. The greatest difficulties were encountered by those living in homes where basic facilities such as toilets had to be shared.

In some cases, conflictual situations were defined, as certain spaces or furnishings were contested by several inhabitants of the same domestic space, sometimes demonstrating the inadequacy of certain interior living solutions, thresholds, spaces of mediation between indoor/outdoor, such

as balconies and terrace, or previously unexpressed needs and desires (Bassanelli, 2020). In others, forced cohabitation has allowed for new attention to be paid to the system of furnishings and objects that equip one's home, stimulating decluttering processes (Sandlin et al., 2022) or the renewal of certain furnishing systems to better respond to changing needs.

The domestic dimension has been the focus of much reflection during the pandemic and has now undergone profound transformations, more in its interpretations (Sparke et al., 2023; Bassanelli, 2022) and uses than in its conformation, as it increasingly has to accommodate home working, study, leisure and social activities.

As the acute phase of the health emergency came to an end, there was a significant search for open spaces, in which to meet again, albeit at a distance, spend time outdoors and reconnect, where possible, with nature. In addition, there has been an increase in the search for new housing solutions that would allow greater access to primary services and/or a better connection with natural elements (Finizio, 2022) and sustainable lifestyles, both within large cities and by moving to more peripheral, less densely inhabited areas, as suggested by architect Stefano Boeri, who has encouraged a return to inhabiting abandoned villages in Italy (Giovara, 2020).

For other people, on the other hand, the pandemic was a temporary interlude that imposed a limited disruption of their routine, which was followed by a desired return to their well-known place of work and lifestyle, with leisure and socialising activities mainly carried out outside the home.

Today, in what we can define as the post-pandemic everyday life, the different space models, as well as physical and virtual dimensions, co-exist in a plurality and complexity of solutions and combinations that try to meet the most diverse needs. From the desire for relationship, encounter, sharing and exchange, to the need for privacy, reflection and isolation, to the insecurity, fear and fatigue of a return to meeting in collective spaces, and to the desire for and awareness of the need for more sustainable lifestyles, with reduced environmental impact, there is a multiplication of behaviours to which it is possible to associate different systems of spaces equipped to accommodate and welcome individuals that are related with systems of products and services.

The reflection initiated during the pandemic and the desire to follow transitional paths that support responsible and sustainable forms of living is supported by some relevant themes of reflection related to space and spaces-product-services systems. It will try to briefly explore them hereinafter with the understanding that they are themes with blurred and

often overlapping boundaries, originating in the pre-pandemic period, in a certain way of approaching the project. However, it is believed that they may codify sustainable approaches to interior design for the future.

Maximizing the use of the space

In the aftermath of Covid-19 pandemic, the return to the community has stimulated a demand for meaningful collective spaces, that are physical spaces for human connections and where to return to emotions.

However, it is no longer sustainable to assign only one function to a space and equipping it for just few activities during the day, because for many hours these spaces are not inhabited, but are still heated, cooled and lit, increasing their environmental impact.

This mainly affects collective spaces: offices, where people no longer go every day for smart and remote working, consumption spaces, because the use of e-commerce and delivery services has intensified, hotels may remain unoccupied in the absence of bookings, schools that are open to on/off-line learning activities. Therefore, for future there is the importance of an intensification in the use of existing spaces through processes of space re-programming and/or re-signification, working on the small scale of interiors and possible micro-interventions. It means a multi-layered approach based on the combination of different spatial solutions and equipment systems that support the definition of multiple use as well as the definition of private spheres in shared spaces, such as in working spaces or in public spaces, like libraries, to support the increase or decrease in occupancy and density in relation to different time slots.

Working on collective spaces means also to think how different generational target can interact. Considering values and amenities that can bring different groups together could reactivate intergenerational interaction to reduce loneliness and improve sense of care (Anzani & Scullica, 2023) in uncertain times.

Maximizing the use of the space can be also considered a strategy to achieve zero carbon emission, because is a strategy to implement the use of existing spaces.

In post-pandemic society retail spaces are re-designed as interactive spaces for socialization, creation, exploration, trying to answer to a question: in an era where online shopping is the norm, why would anyone visit a physical store?

The fashion brand Marni, which has previously employed a cross-fertilisation approach between fashion, art and design, a strategy that has been employed by other brands in the past and which is still being intensively

explored in the contemporary world, has incorporated an artist studio into its flagship store in Milan. Blurring the line between creative lab, art exhibition and storefront, the brand increase the use of the store during the day and the evening. The project by Brinkworth and The Wilson Brothers was born out of a desire to offer something more to a consumer experience. The goal is to stimulate «a creative interaction, as opposed to a mere retail transaction» explains the design team Brinkworth (Yellowtrace, 2022). Indeed, they wanted to bring creativity and culture into the heart of the store. The design team defined a space that could be occupied by rotating artists-in-residence, who would take over each studio and make it their own. This was done in accordance with the design principle of the "box in the box" for the interior set-up. Each artist is invited to adapt the exterior of this "box" in a manner that reflects their own aesthetic sensibilities, thereby creating a unique structure that collectively represents the evolution of Marni's brand. Over time, this initiative aims to reflect Marni's passion for storytelling through craft and the power of cross-pollinating ideas.

At the same time, hyper-specialisation is not necessary to intensify the use of space, indeed «in an age of uncertainty, being intentionally vague about the use of spaces and objects may be the most future-proof design strategy» affirmed Robert Thiemann (Thiemann, 2023, p. 59).

According to the sociologist Tracy Brower (2021) the embracement of ambiguity can support making sense of the future. It means imaging spaces that are more open to personal interpretation trough spatial fluidity and able to adapt to different frameworks and needs of individuals and groups. This also promotes inclusiveness, as more people will find the spaces and equipment to meet their needs. Freedom of use as well as indeterminacy can be explored with hybridization and sharing to improve flexibility and sustainability in interiors.

Hybridization and sharing

One of the most worrisome aspects that emerged during the pandemic due to "social distancing" strategies was the sense of bewilderment and loneliness of individuals who felt isolated from established social relationships, and in some cases unable to access some basic services (Lo Coco et al., 2023). This perception was among the most ingrained and among the most difficult to overcome (Brooks, 2023).

As affirmed in the Togetherness Economy Report the sense of belonging of a community and the relationships among members within the community itself is decreasing due to the continuing geo-political

crisis and because there are fewer cultural, economic and social experiences that people share across different generations than there used to be (FleishmanHillard, 2022).

In the post-pandemic condition, the sharing of spaces, products and services can still be a way to recover and reinforce social relationships, as well as a solution to sustainably inhabit increasingly densely populated urban contexts. Indeed, forecasts, such as 2018 Revision of World Urbanization Prospects (UN, 2018) predicting that by 2050 the majority of the population will inhabit urban contexts are still relevant.

The design of shared, multigenerational or target-focused housing solutions, such as co-living, co-housing, social housing, facilitates social interactions and enables relationships and promote a sense of community. Even if coliving offers short-term living accommodations, where people most of the time don't personally manage the services and guest are not allowed to fully customise private spaces, while co-housing projects are focus on the engagement of a selective community for the early stage of the project design (Scullica et al., 2022).

Furthermore, sociocultural spaces that offer cultural moments of aggregation, innovation and social inclusion (Inti & Mastropirro, 2020) are particularly relevant during times of crisis, such as the current period of uncertainty, because they become incubators for new adaptive strategies for urban living. Indeed, as transcribed by Inti and Mastropirro quoting the experience *Il Tavolo Milano* (2020) of *Lo stato dei luoghi*, the Italian network of activators of culturally based regenerated places and spaces, sociocultural spaces «are alternative production spaces of a solidarity-based economy, part of a generative welfare, which proposes new management models attempting to combine innovation and social inclusion»[1] (Inti & Mastropirro, 2020).

In this way, collective spaces can become platforms going beyond the traditional understanding of functions and activities of city spaces.

This type of approach is focused on *togetherness*, in terms of connectedness, relationship with people and solidarity among groups in society (FleishmanHillard, 2022), considering all those activities and processes that support social cohesion. In this case, the designer should question itself about the meaning of dwelling, not only in terms of the design of adequately equipped spaces and services, but in particular in terms of proximity, exchange and sociability, accessibility and support that these spaces can offer.

1. For more information: www.lostatodeiluoghi.com.

From a spatial point of view, it therefore means re-negotiating the private and public spheres, reasoning about systems of spaces that can stimulate a way to live linked to an idea of community. Already in 2017, the exhibition *Together! The New Architecture of the Collective* at the Vitra Design Museum explored, through the analysis of paradigmatic case studies, the collaborative dimension of living (Ruby et al., 2017).

The interventions aimed at defining a mix of functions, principally in collective spaces, can be initiated in newly constructed buildings, as well as in processes of adaptive reuse, studying and designing the necessary system of spaces and services with the inhabitants.

In this context, special importance must be given to co-design processes, which include in the design process a meaningful relationship with those who will be able to use and inhabit the spaces, democratic decision-making processes, engagement and vision-making, in relation to the type of project with the aim of designing spaces that adapt to the community that inhabits them. Designers can define spatial schemes and layouts able to become more open to different activities and behaviours, but the use programmes should be tailored to and with those who inhabit these spaces. The design team can involve processes of co-design, participation by the community of inhabitants, meaningful dialogues and open processes that allow people to actively engaged in decision-making. This makes it possible to develop a sense of ownership, pride and belonging as a part of a long-term or temporary community, spread around the world, as in case of networked co-living. In this sense, functional layouts, fixed equipment and mobile furniture must be designed to allow flexibility of use at different times during the day or considering different periods of the year.

At the same time, these spaces should be designed considering the adaptability of the use of the space during space or building life cycle. Indeed, architectural alterations as well as interiors refurbishment are resource-consuming, economical expensive, and often unnecessary. Spaces can be designed considering multi-function and possible re-arrangement, scheduling the replacement of some soft components of the space or the needed upgrading of some equipment subject to greater wear and tear over time.

There are different design approaches that focus on: movable elements, constructed elements that can be modified by disassembling or dragging and/or hanging them, interchanged modular fixtures, hanging systems that allow for agile movement, as well as soft and lightweight elements such as curtains and fabrics.

Designers can explore and invent many solutions that make spaces not only open to multiple uses but also inclusive and accessible to everyone.

This also allows to extend the use of space beyond the traditional paradigms personal vs shared, private vs public, interior vs exterior.

This theme is also very interesting to explore with regard to the training of young designers. In recent years, an intense research and teaching activity has been developed, also through the relationship with the international CO-LIV network[2], in order to experiment how the design of spatial solutions allow to inhabit urban and extra-urban contexts. Since, during the didactical activities in Laboratorio di Metaprogetto, sez. I2, course in Interior Design, School of Design – Politecnico di Milano, proff. Francesco Scullica and Elgani Elgani with, during the years, Marco De Allegri, Alberto Zanetta, Geo Carignani, Umberto Monchiero, Alessandra Sironi, the design of hospitable spaces such as coliving has been intensively explored.

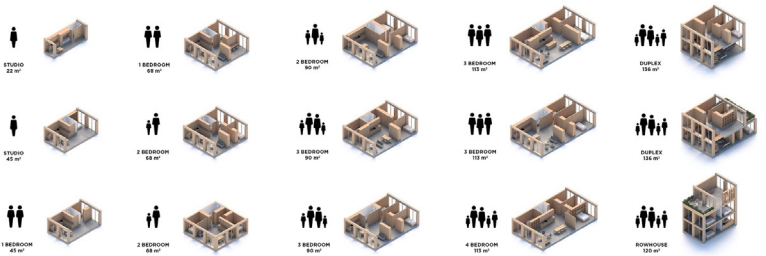
Particular attention has been paid to living in urban contexts as well as outside the city. In recent years, the focus has been on Alpine contexts (San Martino di Castrozza – Dolomiti bellunesi, and Sondrio – Valtellina), also in relation to the future Winter Olympic Games (Milano-Cortina 2026), in order to implement the attractiveness of these places, which are often less frequented at certain times of the year. The study of possible targets of inhabitants for the short, medium to long-term stay permits to explore ways to return to inhabit the Alps or to experience sustainable expressions of tourism. In 2023-24 the design experience, supported by the winery Mamete Prevostini, has demonstrated how combining leisure experiences, work tasks and activities related to physical and mental wellbeing can support the development of innovative living models for a correct work-life balance. As evidenced by the OLOS project, designed by students Sara Bedini, Elisa Caridi, Sofia Morselli, and Anna Tom for the San Lorenzo Convent in Sondrio (Fig. 12).

Explore contamination and hybridizations means thinking about systems of spaces-products-services that can evolve with the communities that inhabit them and adapt nimbly. Thus, according to the conceptual housing project Biome[3], that is an interior housing system that promote alterations, adaptations and update over the time in Copenhagen (Fig. 13). Developed in 2021 by EFFEKT Architects, who explore construction practices to define new sustainable models for living, and CREE Buildings,

2. CO-LIV, www.co-liv.org/. We thank the Italian CO-LIV team for their collaboration: Virginia Scapinelli, Cate Maiolini, Laura Sundin, Laura Vanazzi, Alex Morelli.

3. Biome is a new housing system combining CREE Buildings' proven modular timber-hybrid system with EFFEKT Architects' customized design solutions to new adaptable spaces for living www.biomehousing.com.

Fig. 12 - The design project OLOS is developed by students Sara Bedini, Elisa Caridi, Sofia Morselli, and Anna Tom in the Laboratorio di Metaprogetto, sez. I2, course in Interior Design, School of Design – Politecnico di Milano, proff. F. Scullica and E. Elgani with M. De Allegri, A. Zanetta, G. Carignani, U. Monchiero, a.y. 2023-24 (Image courtesy of © OLOS design team)



Biome unlocks a wide range of apartment typologies.

Biome homes grows with people and adapts to changing life patterns.

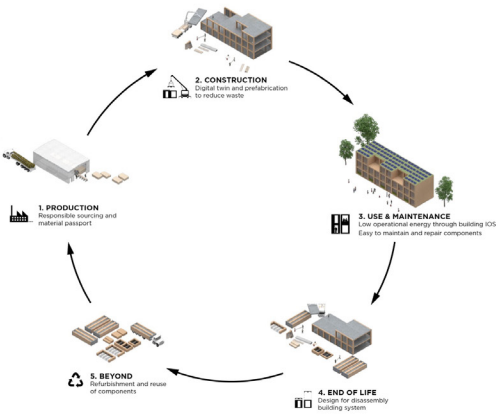


Fig. 13 - The diagrams show the flexibility and adaptability of the housing system Biome developed by EFFEKT Architects and CREE Buildings (Image courtesy of © EFFEKT Architects)

who provides modular timber-hybrid building systems, the project proves that «buildings are never static, they constantly learn, evolve and adapt once they are used, so spatial design should set a framework that allows change over the time» (Ingram, 2023, p. 36). Biome's modular and standardized yet highly customizable building system, reducing risk, cost and construction time, introducing circularity processes in the building system that will progressively reduce the impact of buildings on the environment and accommodate changes in people's lifestyles.

Adaptive Reuse

Working with existing heritage has been a long-standing practice in interiors history. However, in the future, it will be necessary to approach this practice with a renewed spirit that considers sustainable objectives for both the environment and society. Indeed, adaptive reuse processes of existing buildings, may still have a use value, can be considered one of the sustainable ways to design cities. The history of interiors is characterised by processes of reuse of spaces, which have accompanied some buildings to the present day or new constructions from disused buildings, because these interventions allow the existing space to be adapted to the new needs of its inhabitants.

However, interventions in existing spaces require specific processes of adaptation of entire space or parts thereof (Brooker, 2016; Plevoets & Van Cleempoel, 2019) and above all they require re-signification of the place as well as attribution of new meanings to meet contemporary and future needs. According to Graeme Brooker design strategies are used to enable an articulated design idea. In his book *Adaptation. Strategies for Interior Architecture and Design* he described eight strategies: reprogramming, intervention, superuse, artifice, installation, narrative, on/off site, insertion. These "re-editing" strategies are explored to concretely explain how the of reuse existing spaces can be developed, emphasizing the occupancy, the process of recycle, or the relation with an artifice, or the intervention to stabilize some ruins, as well as the narration to demonstrate that the «approach to creating interior space that is not defined by function, but instead is based on response to the existing building» (Brooker, 2016, pp. 9-10).

The analysis of the multiple ways and times of using spaces by users and communities according to new behaviours will allow design to be directed towards adaptable and flexible systems of spaces and products, capable of evolving and adapting to rapidly changing user needs.

The approach of Luciano Crespi and a team of researchers at Politecnico di Milano (Crespi, 2023; 2021; 2017), on the other hand, specif-

ically explores the dimension of the unfinished, focusing on leftovers, buildings abandoned for different reasons that involve a redefinition of space starting from its reading.

This relationship with the space requires a transdisciplinary intervention of a high cultural level that can be defined as *design of the unfinished* and has as its perspective «the attribution to the environments to be regenerated of a hospitable character and at the same time representative of the conditions of temporariness, precariousness, transculturality, characteristic of contemporaneity, whatever their function». It is an approach that promotes taking care of the existing heritage «with widespread interventions, to obtain a new environmental system made up of numerous micro diversities, each characterised by a high aesthetic and symbolic quality» (Crespi, 2023).

In the distinctiveness of their approaches, these new design perspectives propose to imagine new aesthetic languages, sometimes based on "rough-and-ready" aesthetic, sometimes based on reuse or upcycling processes of existing components, such as furniture, sometimes aware of exploring the materiality, even raw tactility, of the components of the project. Additionally, the aesthetic exploration is aimed at exploring the sense of imperfection, as well as essentiality and reduction rather than abundance, for example through interventions that minimise design intervention, because they focus on what is really needed rather than what's always been done. Likewise, there are interventions that favour a single material to differentiate themselves from existing contexts. Summarizing all these aesthetics are based on a "principle of necessity" to reduce, to implement, to explore new directions for better opportunities.

Moreover, it means practising the principle of adjustability, careful to limit additions in order to make a place usable again. Additionally, in reuse processes designers can study spatial schemes able to become more open to different activities and behaviours, but the space and the use programmes should be rethanked with those who will inhabit these spaces.

So, reuse processes can be integrated with processes of co-design, involving active participation by the community of inhabitants. In this sense, again, functional layouts, fixed equipment and mobile furniture should be designed to allow flexibility of use at different times during the day or considering different periods of the year.

At the same time, these spaces should be designed considering the adaptability of the use of the space during space or building life cycle. These themes can be integrated and overlapped with interventions focused on maximizing the use of spaces, hybridization and sharing. All these approaches to the design of spaces can affect the design of all living spaces, with a particular emphasis on collective spaces.

Spaces for hospitality, like hotels, have the potential to become strategic places for human intersections, as after the pandemic are the places that welcome people with mobile lifestyles, but also all those who need an additional temporary space in the city.

Hospitality spaces can also be places of interesting experimentation where different strategies and sensibilities can be combined and tested and then exported to other spheres, such as the home or the workplace.

In 2019, the exhibition *Hôtel Métropole – depuis 1818*, at Pavillon de l'Arsenal, in Paris (2019-2020) investigated the historical role of hotels in Paris, but above all questioned the role these buildings will play in relation to both the 2024 Olympic Games and the environmental challenges also affecting major European metropolises.

While collective spaces in hotels, like lobby and bar, have already become hybrid places of work, leisure, culture since some years before the pandemic (Scullica & Elgani, 2019), the private spaces of hotel rooms can be an opportunity for rethinking the use and the equipment. In this sense, the reflections on the layout of room spaces as well as fixed and mobile equipment to increase their use throughout the day are significant. This is demonstrated by the explorative and speculative project *A room for imagination, zero carbon hotel room concept*, developed by Lina Ghotmeh Architecture, for the exhibition *Hôtel Métropole – depuis 1818* (Sabbah, 2019). The design team explored the potential for new uses of an existing standard hotel room, with a surface area of 24 sqm (Fig. 14). By modifying the position of fixed equipment and reflecting on movable furnishings, the room can be adapted as a workspace, meeting room, fitness space or a temporary family space. The essential functions are ensured and organized in a wall equipped to accommodate a bed, walk-in wardrobe, storage space for tables and chairs, shower and toilet. In this way, the space is adapted to the different activities accommodated during the hotel stay, which tends to vary, becoming longer or shorter depending on requirements. The hotel room is interpreted as a space capable of multiplying its uses and minimizing its environmental impact because it allows multiple uses without losing its vocation for hospitality.

In this sense there is a possible re-use of spaces that can be adapted to the hospitable functions, as well as an intensification of the use of existing hospitality spaces to fulfil new functions and to allow the exploration of new meanings. There are no superfluous decorations, and all the panels are realized in wood panels. The design of its space creates its own decoration, and the lighting is integrated into the walls. The wall coverings are made of recycled materials for the bathroom and natural materials for the

bed area. The integration between a conceptual strategy in the definition of the layout and technical solutions for materials selection and constructive processes permit to improve the sustainability of the interior and to intensify the use of the space.

Fig. 14 - Image and visualization from the design A room for imagination – Zero carbon hôtel Paris, France*, for the* Hôtel Métropole – depuis 1818 *exhibition, at Pavillon de l'Arsenal, in Paris (2019-2020) (Image courtesy of © Lina Ghotmeh – Architecture, 2019)*

2.2 Designing adaptable spaces, furniture and objects

Component-oriented approach

In the post-pandemic era, different generations present increasingly articulated and different ways of understanding and using spaces (Cushman & Wakefield, 2020), of accessing services, as well as of interacting with different types of products, often influenced by fast and superficial patterns of use or determined by specific psycho-physical conditions resulting from the pandemic period.

The pandemic has once again drawn attention to the need to develop home, work, study, leisure and care spaces that are less rigid and adaptable to changing behaviours. Indeed, there is a need for spaces capable of responding to the changing needs of those who inhabit these places, either temporarily or for longer intervals of time.

The diversification of users' behaviour and of the experiences proposed must be matched by a different way of understanding, designing and realising the spaces that welcome people. Observing the users means witnessing the affirmation of multiple expectations and needs, often antithetical to each other, to be satisfied in collective spaces, which stimulate the hybridisation of different functions and spatial environments, supporting a more fluid way of living. Thus, a demand emerges for easily reconfigurable layouts as well as flexible space equipment systems.

At the same time the contemporary condition and new sustainable feelings support the affirmation of new sensibilities in approaching space, more attentive to the components that equip it for flexibility and to the sustainable life-cycle thinking. This way of understanding and reading complex systems based on spaces, products and services is oriented towards a *component-oriented approach* which ideally allows the space to be "constructed and deconstructed" as well as "assembly and disassembly" from its components, understood as the spatial elements that define it and the fixed or mobile furniture systems that equip it, during a defined period of time, considering the project life-cycle.

This conceptual operation has a significant example in the cultural and emotional components-oriented approach explored by Flores & Prats. In project for the Beckett Hall, realised in 2015 in Barcelona, the architects were commissioned to transform a former 1920s factory into a cultural centre dedicated to theatre, artistic experimentation, and theatre education. Applying a process of adaptive reuse, the designers respectfully intervened on the existing structure, a ruin, by studying its environmental characteristics and identifying the components that made up the space. The space was

dismantled in parts. From the original building, all the significant elements were recovered and preserved: the doors, the window and doorframes, the polychrome tiles, the rosettes, the stratifications present between masonry and plaster. All the components were reinserted into the project, where they could be used again with new function and aesthetical output. In this way, the intervention on the ruin made it possible to rework it and transform it into a space responding to the needs of the new use, so that it could be part of the future.

The component-oriented approach also investigates all components that support adaptable layouts as well as reconfigurable equipment systems, and can be considered fundamental to the strategic, systemic and process-oriented approach of rethinking the interior design that was outlined above.

Flexibility and reconfigurability are themes that find numerous design references in the history of design as a result of important experiments that began in the 1960s and continue to the present day[4]. However, as far as the home is concerned, design solutions involving transformability of furniture components or mobility of entire furnishing systems have not found significant application on a large scale over the years (Collina, 2015), while workspaces have embraced the need for greater flexibility in advance (Forino, 2011).

Today, as a consequence of the pandemic, dwellings and collective spaces are invested by new uses, so the demand for flexible and adaptable solutions has become important again (Quaglio et al., 2021). Considering data from Housing in Europe – 2023 interactive publication (EU, 2023), changes in uses are also associated with a reduction in the space available for a single person and the desire to pursue sustainability goals. The increasing number of inhabitants in urban contexts and the rising costs of private housing will probably determine a constant decrease in the dimension of houses.

"All-in-one" housing models are spreading, where the traditional division between living and sleeping areas is surpassed because the space becomes a single, multi-functional one (Canepa, 2023). In workplaces,

4. Reflections on "adaptable spaces and artifacts" are pillars in the Design Program proposed by Emilio Ambasz, the curator of the exhibition *Italy, the New Domestic Landscape* at MoMa in 1972 to Italian designers involved in the development of prototypical solutions for domestic dwelling. In the "Design as Postulation" section at, the curator collected radicals dwelling experiments and micro units designed by Ettore Sottsass, Joe Colombo, Gae Aulenti, Marco Zanuso and Richard Sapper, Alberto Rosselli and Mario Bellini. In the same exhibition there was also a section of "protesters furniture", where are collected relevant flexible furniture. In 2002, the exhibition Living in Motion at Vitra Design Museum returned to explore flexibility and mobility in domestic life.

workstations are often not personal, but shared in highly accessorised open spaces. The digitalisation of many activities makes it possible to work, relax, eat in other spaces besides the defined ones. Even in the world of systems that equip and furnish space, that continuity between form and function, celebrated in the history of design, has been transformed. The goal for future is *design and plan to change.*

It is therefore important to encourage the research on the design of flexible, modular, adaptable, but also circular and economically accessible furnishing systems, capable of equipping spaces and generating spatiality useful to accommodate the activities of each inhabitant within a specified period of time, and to adapt or undergo transformation for different users in subsequent periods. Indeed, in contemporary times, the issues of adaptability and flexibility should be closely linked to the achievement of sustainability goals. On the one hand, it therefore becomes essential the reconfigurability of environments in relationship to sustainable goals that these systems should support, such as intensification of use, and reduction in resources consumption, so that environments are modifiable with respect to evolving modes of use.

On the other hand, it is important to apply the design for sustainability strategies derived from the world of product design, such as reduction in material consumption, reparability and upgradeability, to the world of interiors as well in all the phases of the interior life-cycle.

This makes it possible to read the architectural space from a design perspective and imagine that interior systems of spaces-products-services can be considered from their components and thus be easily repaired when necessary or it is possible to reuse or recycle only some elements of the whole system. Indeed, the desire to pursue sustainability goals requires a reflection on circularity applied to the entire complex design process for interiors. In order to govern this complexity, it is necessary to structure and apply design processes and implementation protocols capable of responding to different needs, timeframes and budgets that involve numerous players throughout the design process and the implementation chain.

In the context of an interior design project, it is of paramount importance to consider the life cycle of all components that comprise the project in order to verify its sustainability at all stages. This encompasses the sourcing of materials and their subsequent finishing, as well as the dry-assembly or dry layering processing of materials to obtain the components that can be used. Furthermore, it extends to the dry-assembly of all the elements on site, as well as maintenance and disassembly at the end of the project's lifespan. This means that the designer should focus on all components of the project, whether fixed or mobile, simple or articulated, because

if the space is to be flexible and adaptable over time, components must be designed to be individually disassembled, repaired or replaced. Anything that can be mobile must be easily repositionable.

In order to create adaptable and flexible spaces that can reconfigure to accommodate different experiences, it is necessary to further explore the elements with which the space is composed and equipped, while being aware that it is in the relationship between the elements that the usable space is achieved.

In this case, the standardisation and modularity of systems and components can be supported by the industrial production of the elements, such as prefabrication, or standardization processes, and the exploration di circular economy construction technologies.

This makes it possible to conceive entire buildings as architectural systems that can disassembled into parts, as demonstrated by the design of social housing Circle House, entirely built from circular principles by RUM Architects, with the support in first phase of Vandkunsten Architects, Lisbjerg, Århus, 2017-2020 (Fig. 15). According to the design team «the building is designed for reversibility – to be disassembled, and it is the goal that 90% of used materials can be reused without losing value»[5].

This approach of building differently is gradually spreading (Heisel et al., 2022), considering interior construction elements, a significant example is XFrame[6] from Australia, a modular demountable spatial system for interiors, that make possible to easily change buildings layout without creating waste. The system is based on a prefabricated, lightweight engineered wall, floor and roof framing system that enables end-of-life recovery and reuse (Fig. 16). XFrame belongs to the category of engineered wood products that involve the use of bio-based adhesives and preservation technologies that are derived from renewable sources: lignin-based adhesives and thermal modification for wood perseveration. Linings and claddings are connected to the frame using easily reversible fixing methods. Reversible wall linings allow changes to be easily made, minimising the mess and waste normally created when change interior layouts is required.

For future the design culture needs to further research also on how components are produced, for example with smart fabrication techniques, and how they are managed (e.g. dry assembly and disassembly, retrieval etc.) as well as the exploration on circular interiors finishing and building materials.

5. For more information: https://vandkunsten.com/en/projects/circle-house.

6. For more information: https://xframe.com.au/documents/xframe-interior-design-guide-for-architects-(v01.03.23---web).pdf and https://xframe.com.au/documents/XFrame-Interior-Systems-Overview-vJan2022.pdf.

In terms of equipment, integrated fixed and mobile partition systems, permit to "assembly and dis-assembly" from its components, allowing spaces to be reconfigured in a more flexible way, also to adapt to new ways of working and living, in relation to smart-working but also digital activities. This field of research offers the opportunity to explore even further the dimension of temporariness of projects supported by the possibility of assembly and disassembly of components.

Considering sustainable fixed elements to equip spaces, a significant example of the component-oriented approach applied in contemporary project is SAM – Smart Adaptable Model by Bao Living[7]. The Belgian company has gathered research and design experience on modularity to create a system of modules to equip interior spaces, from house to office, and standardized models that offer a wide range of living solutions. The system consists of prefabricated storage modules that contain a specific function for the kitchen, bathroom, stuff storage, bed, tv, partitions and doors which can be aggregated to obtain different configurations (Fig. 17). All the modular components are collected in a catalogue and can be aggregate autonomously using a configurator-software.

The individual functional elements can be organised and aggregated to make up integrated systems for equipping dwellings. This system also includes in special modules the technical equipment to connect to electricity, domestic water, air conditioning, and heating, which make it possible to equip a space, even an existing one with basic equipment, to accommodate people.

The system has been developed to equip living spaces with a dry system, which allows easy connections to installations that guarantee basic functions. Considering sustainability, the modularity of the individual elements makes it possible to reduce assembly time, contain the consumption of materials for the connection between the individual units, and possibly assemble, dis-assemble and re-assemble the single modules with a different configuration in another location. Aware that construction and demolition waste management is a crucial part towards the development of a sustainable construction industry, the designers are verifying through an LCA assessment of the modules how to modify the production process, already strongly defined through the principles of design for sustainability, to further reduce the environmental impact.

Considering that spaces can be assembled and disassembled by parts also means thinking about the possible reuse of individual components in their current state or after undergoing re-manufacturing processes. The

7. For more information: https://en.baoliving.com.

project *ReNetTa – Re-manufacturing Networks for Tertiary Architecture*[8] at Politecnico di Milano (Talamo, 2022) explored the re-manufacturing in the construction field, but it can be explored also from a product-service system point of view, as investigated by Vezzoli et al. with the aim to define a «set of guidelines that can facilitate product re-manufacturing processes toward more circular and sustainable organizational models in specific contexts, with particular attention on the tertiary sector» (Vezzoli et al., 2022a, pp. 155-166). All this entails design with circular processes in mind, by applying circular practices on production and construction sites.

In fact, strategies for re-manufacturing, reuse, for facilitating upgrading and adaptability, for facilitating maintenance, and also to facilitate repair, assembly and disassembly, are being explored. Among the addressed strategies, these are the most difficult to apply for different reasons: the difficulty in application of the «organizational models to maintain over time the value of the environmental and economic resources integrated into manufactured products, once they have been removed from buildings» (Talamo, 2022); the difficulty in transforming production processes considering dry assembly and disassembly technologies; the space and logistic needed for storage of components that affect the entire production and construction chain as well as numerous actors. Additionally, with regard to the reuse of components, there is a cultural resistance linked to two factors: the habit of associating beauty with everything that is new and mistrust regarding the performance of what comes from reuse processes.

Certainly, the component-oriented approach can reach its maximum expression when combined with reuse logics applied to the entire space-product-service system. As far as the reuse of components is concerned, the FCRBE Interreg Project North-West Europe[9] is among the most articulated at European level. Developed by Rotor and Bellastock, two design organisations that have been active for many years in imagining strategies for the reuse of building components, the project involves numerous partners and stakeholders in different European states (Belgium, France, United Kingdom, Luxembourg, Netherlands). The research is focused on reuse of all the building elements, from structural and material components to interiors components, furniture and equipment. The aim is to demonstrate that reuse can be applied today in numerous projects, including large-scale projects and within contexts considered.

8. For more information: www.remanufacturingforaec.polimi.it.

9. For more information about research and outputs: https://vb.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe/#tab-3.

All the actors involved have worked on the entire reuse chain of the individual components, experimenting both a new way of thinking about the project and of realising it. On the one hand, the design concept can be determined from the available components, in terms of materials, such as horizontal and vertical cladding, but also products, considering fixed components to equip interiors like fixtures, sanitary fittings and faucets and radiators. On the other hand, the process of disassembly and reassembly allows the designer to explore new narratives. A platform[10] has been set up that collects the most significant design experiences, but also offers a collection of all components and materials that can be purchased to be reused.

A significant example of this new *modus operandi* is the project for the cafeteria/canteen of the Realco company that Rotor developed with Atelier MAAT for the interior design project[11] (Fig. 18). The design brief called for a small refreshment area dedicated to employees. Starting from a contextual approach, the designers analysed what they had available and what was missing to design a bright and user-friendly space. The most important objective, however, was to use materials and furniture with a limited environmental impact. For this reason, the designers decided to use reused materials from the site itself or from specialist retailers. The materials chosen for the new cafeteria include ceramic tiles and terrazzo, reclaimed lighting fixtures, laminated wood tops and Corten steel cubes from Rotor DC for the finishes and fixed elements. At the same time, research for second-hand furniture was started: armchairs and chairs are selected from Office meubles. The elements of the existing kitchen were reused directly on site, but they were renovated. The only new materials used were melamine panels for the kitchen, wooden planks for the windowsills and Heraklith panels for sound insulation. At the same time, thought was given to the maintenance and repair of the elements during the entire life cycle of the project, as the space is subject to frequent use. At the end of the design and construction process the initial ambitions were largely achieved: more than 80% (in terms of mass) of the elements integrated in the project were reused. This represents an excellent outcome when viewed in the context of current construction practices. It is a method that is currently employed by only a small proportion of the construction market; however, it is likely that it will be implemented more widely in the future in order to achieve sustainability goals.

10. For more information about the web-platform to facilitate the reuse of reclaimed building materials: https://opalis.eu/en.

11. For more information about the interior design project: https://rotordb.org/en/projects/realco-cafeteria.

Fig. 15 - RUM Architects, with the support in first phase of Vandkunsten Architects, designed the social housing project social housing Circle House, Lisbjerg, Århus, 2017-2020, using circular principle like design for disassembly (Image courtesy of © RUMArchitects)

Fig. 16 - XFrame™ is a reconfigurable structural timber framing system that has been developed in response to the need to design buildings for change (Image courtesy of © XFrame™)

Fig. 17 - Bao Living design and produce SAM Smart Adaptable, based on 35 different modules which can be aggregated to generate the composition that meets the needs of the inhabitants (Image courtesy of © Bao Living)

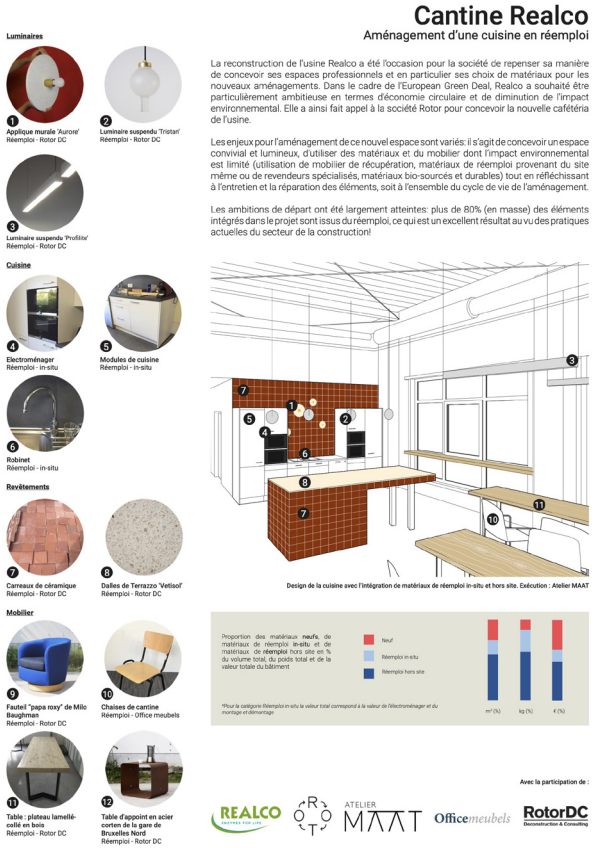


Fig. 18 - The project sheet presents the design process of reuse of components used in the refurbishment of the Realco canteen (Image courtesy of © Rotor)

Assembling furniture

Reflecting on the interior components with a circularity focused approach means considering interiors as a system of aggregation of individual elements that are very different from each other: the fixed elements and bio-based and/or recycled material finishes, the furniture and objects, the lighting elements and even intangible, but perceptible elements such as sounds and scents.

In this system each individual component has its own design value, which is amplified when considered in relation to the lifecycle of the space. This is why it is important that every single component is designed by applying the principles of design for sustainability, widely explored in the product design field.

Considering interior design what emerges is the need for furnishing that can be easily modified and furniture systems whose elements can be opened/closed, raised/lowered, moved. The reconfigurability of components allows the furniture to be used in many ways, but also ensures its adaptability to different contexts for working from at home or experiencing leisure in the office, meeting in the hotel and relaxing in the factory, exploring the relationship with *upgraded new species of spaces* than those described by Ida Faré and Silvia Piardi in 2003.

Furnishings and furniture, which are fundamental to the culture of Italian design, make it possible to organise, divide and equip available spaces, especially existing spaces, designed with a different functional purpose.

Furniture systems, such as reconfigurable desks and adaptable seating, can support the well-being of individuals and promote active lifestyles in the workplace as well as at home. In this way the space can be adapted to different behaviours and the same furniture system can be used several times for multiple function. A significant and pioneering example of this approach that is explored today is Hack, a table system designed by Konstantin Grcic for Vitra, in 2016.

The system is designed to meet the need for dynamic use of equipment in the office. Due to the modularity of the table system, various needs such as high flexibility and fast adaptability can be satisfied. Stripped down from any decorative elements, the desk is made simply from OSB wood to be robust and functional. The user has the option to adjust the tabletop to their desired height – whether standing or sitting – and in its lowest position can used as a sofa.

Additionally, Hack is produced considering design for sustainability. It has a manually operated mechanism and the production and use of Hack are ecologically sustainable. Furthermore, Hack is manufactured on site in an energy-efficient way with wooden parts which are locally produced and

assembled by Vitra. It can be folded up into a practical, flat "box" in just a few simple steps, making it easy to dismantle, transport and store.

This case study demonstrates how, before the pandemic, product design research was already moving towards exploring new production models because, according to European Commission (EU, 2020) around 80% of product environmental impacts are decided in the design stage, so designers can have a relevant impact in reducing the environmental impacts of furniture system. Currently, research is focusing on deepening the environmental impact during the five stages (pre-production, production, distribution, use, and disposal) of the products' life-cycle conducting researches on lifecycle assessment (LCA), as well as on Furniture Product-Service System (PSS) (Vezzoli & Yang, 2023).

It is interesting to highlight how life-cycle thinking approach and design for sustainability strategies, applied together to reduce the environmental impact of furniture, can respond to the need for flexible and reconfigurable furniture systems for transforming spaces. This would make it possible to overcome the obsolescence of certain furniture that is considered inadequate for functional and aesthetic reasons and is therefore discarded. Indeed, the replacement of furniture determine the increasing solid waste production, leading to more landfill space (Besch, 2005).

According to the research carried out in LENS Polimi, the following list presents what are considered as the main design strategies for sustainability to be taken into account in the design and realisation of furniture systems for future dwelling spaces, without going into detail on the sub-strategies required for each category of furniture[12].

Focus on materials:

Consideration of materials is fundamental to exploring the realisation of furniture systems with surplus stock, offcuts and recycled materials or bio-based materials. In particular context also the selection of easily accessible materials can be potential strategic. Significant attention must be paid to the application of innovative technologies that minimise material use.

Therefore, it is important to pay attention to:

- selection of materials;
- material life extension through material recycling or reuse;
- design for reduction in use of materials.

12. For a more in-depth study, please refer to LeNS Polimi network: www.lens-italia.polimi.it/.

These aspects relate to:

- resources renewability;
- reduction of energy consumption reduction.

Focus on furniture:

During design, reflection on the product allows different strategies to be applied, exploring not only its functional and environmental impact aspects but also its conceptual meaning.

The main processes are:

- assembly and dis-assembly: facilitating dis-assembly;
- furniture life extension and furniture use intensification: facilitating upgrading and adaptation;
- maintenance and reparability: facilitate furniture re-use and remanufacturing.

The overlapping and integration of strategies is fundamental, for example the selection of easily accessed materials combined with the use of standardized components permits to reduce production costs as well as to reduce time for the production, as well as improve future potential use and re-use. Additionally, simple solutions can solve problems and reduce cost for the investments. Strategies can also be analysed in relation to product-service systems, which will be explored in the next chapter.

A remarkable example in Italian design can be found in the customized productions for contract segment of the historic brand Tecno[13]. The brand is active in design and production of bespoke solutions to equip spaces, especially for work activities. The research and engineering of flexible furniture systems, such as Linea and Clavis, makes it possible to achieve sustainability goals, following the maxim of "doing more with less". The interchangeability of the elements that comprise these furniture systems provides numerous potentials uses and configurations, enabling them to be employed on a small or large scale in all collective spaces.

Linea is a micro-architectural system, designed by Zanon Architetti Associati with Tecno Centro Progetti in 2018 that offers the possibility

13. The firm Tecno is the selected technical partner in Research Project: *DOI_ Design, Hospitality and Innovation: the contract sector for the definition of a new hospitality between design, production, realisation and fruition*, financed by PON Research and Innovation – REACT EU, developed by Elena Elgani, for their expertise in customization processes.

to integrate different functions and accessories, such as panels, cabinets, drawers, doors, shelves, desks, boards, seats, electrical sockets, lights, lockers, in a wide range of materials and finishes (Fig. 17). The Linea[14] system's modularity and continuous reconfigurability permits to equip workstations, organize and reconfigure complex spaces, such as open workspaces and learning spaces. The simplicity of the assembly process, based on joints, tubular sections of components, and panels, permits to mix and match the components along each composition to obtain desks, worktops, seats, partitions and containers. This enables to achieve one of the main objectives of the contract sector to be fulfilled: namely the customization, in large scale, in terms of flexible configurations and multiple uses, dry assembly and dis-assembly, but also considering finishing, colours and coordination to specific aesthetic values of brands, which thus furniture systems become adaptable to very different contexts. A significant application example is the project for H-FARM Campus, an innovative hub for digital transformation in Treviso.

Another relevant product is Clavis, a desk system, based on a tool-free assembly, that can be used with Linea to equip interiors for different uses. The system designed by Centro Progetti and Daniele del Missier in 2016 can be reconfigured several times as a workstation or as a simple desk (Fig. 18). In this case, the product meets the criteria of sustainability because it is made with a reduced amount of material and basic elements: longitudinal elements, transverse features, single or shared legs and tops. It is extremely easy to assemble, dis-assemble and re-assemble over time, according to structural, dimensional, typological space requirements. Indeed, the system apply a patented joint, a tool-free coupling based on the simple 45° rotation of the longitudinal and transversal elements, while the tabletop is anchored with magnetic retainers. The wide range of component sizes, additional finishes and optional accessories, such as storage units, drawers, screens and modesty panels allow the configurations to be flexible and extensively customised. In 2018, Clavis was used in significant numbers, along with other Tecno products, to equip Moleskine offices in New York.

14. Tecno, Linea www.tecnospa.com/en-us/products/public/linea.

Fig. 19 - The micro-architectural system Linea by Tecno generates different configurations and layouts

Fig. 20 - Clavis by Tecno is a table system with versatile tool-free assembly (Image courtesy of © Tecno)

Furniture as a service

Sustainable principles of furniture design and production can also be associated with new business models. Some models are focused on principles of reuse, repairing re-selling, implementing second-hand markets, considering also selected vintage objects, trough web-platforms, that sometimes support social inclusion projects. Additionally, «the purchase of objects linked to the past – especially those that have become part of the collective imagination – is a concrete strategy to satisfy needs» (Giammetta, 2020) related to self-expression, identity and the need for belonging, increased with the pandemic.

Other approaches focus on circularity-oriented marketing strategies where the positive impact is not easily measurable. Among these, the initiatives promoted by IKEA can have a significant impact precisely because they are aimed at a wide audience, such as the "Bring Back and Sell" service: based on the repurchase and resale of used furniture by the brand itself.

In addition, IKEA opened a Circular Hub in different stores in Italy to promote sustainability learning experiences that teach how to renovate, repair and customise furniture to extend the life cycle of products. With the same aim, the sale of components, mainly spare parts for wardrobes, sofas, beds and chests of drawers, has been launched to extend the life of furniture.

IKEA is also experimenting with long-term rental formulas to extend the life cycle of products that can be rented and returned to be sold as second-hand.

Indeed, this innovative business model for furniture sector allow furniture to be conceived as a service, that are defined furniture-as-a-service[15] and can be considered in a Product-Service System.

Sustainable Product-Service Systems are indicated by the European Union as promising for the circular economy because «incentivising product-as-a-service or other models where producers keep the ownership of the product or the responsibility for its performance throughout its life-cycle» (EU, 2020)[16].

Considering this approach the increased focus on product performance stimulates the extension of the life cycle and the reduction of products environmental impact.

15. For a more in-depth study: Sustainable Product-Service Systems (Vezzoli & Yang, 2022).

16. A new Circular Economy Action Plan for a Cleaner and More Competitive Europe: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0098.

Significant attention is devoted to:

- reduction in material consumption;
- design to optimise, and, if it is possible, to extend the life of products;
- facilitate products maintenance, reparability, and upgradeability by parts;
- design for disassembly to encourage reuse in other contexts or recycling of the materials used.

Sustainable Product-Service Systems are models to promote environmental protection under the impetus of an economic benefit of those who produce/offer a given artefact, which have also proved promising for the accessibility of products and equipment, including office spaces and products that characterise them, because they lower the initial investment costs.

Considering interior design in European market, significant examples in this area focus on the supply, without ownership of furniture systems, such as kitchens in the home, or equipment for personal or shared workstations in offices, that permit to significantly reduce the waste of entire furniture systems or single elements and materials.

Two Amsterdam-based brands, Enginstill[17], a high-end brand with the spin-off Still, and the start-up Chainable[18], although belonging to different market segments promote a kitchen rental service.

The Still project promotes a modular kitchen system with standard modules, components, and some opportunities for customisation of finishes and appliances. The standardisation of the components guarantees good flexibility of solutions. The quality and durability of the materials is guaranteed by the selection made by Enginstill focusing on circular materials. The kitchens are distributed on a subscription basis. Through the payment of a five-year monthly fee, the customer can benefit from maintenance and repair services for the entire kitchen. If the customer wants to back out of the subscription, he/she can return the kitchen, which will be reused in a subsequent fit-out for a different customer.

A similar approach is promoted by the Dutch start-up Chainable, which makes modular and circular kitchens mainly for social housing projects with a focus on the most fragile targets. Chainable supplies 82% modular and circular kitchens to social housing operators who can rent the kitchen or buy it after a certain period with a buy-back contract. The

17. For more information please consult: www.eginstill.com/.
18. For more information please consult: www.chainable.nl/en/.

company remains the owner of the products in the first case or retains control of the materials in the second case. Maintenance and repair of the furniture system are always guaranteed. This aspect implements the research and development of furniture design, as the manufacturer pays more attention to the development and realisation of a long-lasting product (between 15 and 30 years), thus extending the life of the product compared to other companies.

In addition, the almost entirely local production allows control over the material supply chain. All kitchens have a steel structure to which the different modules are fixed. This allows for easier assembly and disassembly, as well as the possibility of expanding or reducing the system as required. The parts are made of wood and steel: the wood is 100 per cent recycled, while 25 per cent recycled steel is used. Household appliances are imported from foreign countries, but there is a move towards energy-efficient appliances, which reduce consumption and running costs.

This approach that explores the rental dimension rather than product ownership makes it possible to apply the principles of design for sustainability not only to the individual product, but potentially to the entire furnishing system, proposing a paradigmatic way of understanding and above all designing furniture.

Considering interior design, however, this approach also promotes a significant change in the way of initiating and developing the project, which focuses once again on criteria of modularity, standardization and reconfiguration, while also seeking to maintain consciousness about the design value and a good degree of customisation and that would be difficult to give up today.

3. Perception

3.1 New languages of safety: the role of sensorial perception in re-inhabiting interiors

In recent years, as previously mentioned, we have witnessed a pronounced change in the we live daily the constellation of interior spaces that surround us.

For instance, houses and private apartments in 2020 abruptly took on new functions that once were prerogative of workspaces due to the surge in teleworking practices that was intended as a way to ensure business continuity while complying with health emergency restrictions (Corso, 2020), often reconfiguring living spaces as home-workspaces; the home, during the Covid-19 pandemic, was abruptly asked to accommodate functions ranging from working to playing, from relaxing to taking care of one's own health (Bassanelli, 2020): this resulted in an extreme blurring of public and private spaces inside the home, and of the role of the home as a private retreat from working and other social activities; this paradigmatic shift is postulated to have long-term detrimental effects on health and well-being of many workers (Comella Darda et al., 2020).

This change in our ways of living, however, does not only simply limit itself to Covid-19: the rekindling of dormant conflicts has contributed to a general climate of unsafety (Bishara, 2023) far beyond the borders of the countries where these wars take place; furthermore the growing number of natural disasters and sky-rocketing temperatures world-wide (Comelli, 2024) force us to readjust the way we experience urban and non-urban public spaces, and open spaces in general.

In this time of change and precariousness, it is important to engage as participative citizens demanding effective action against these and other

growing problems, but it is equally important to understand how the individual human being has limited capacity for action on many of these factors. What can help to regain a feeling of security and comfort in our private and non-private lives is to reflect on our perception of a space, where the word perception is understood in this case as a design tool with the potential to activate new exemplar models of living and working and to enact meaningful changes towards a brighter future.

The meaning of perception

Before delving deeper into the effects of working on the perception of a space, it is worth understanding the actual meaning of the term.

The French philosopher Merleau-Ponty defines in his Phenomenology of Perception the existence of an "objective world" (Merleau-Ponty, 2002, p. 3) that actually and autonomously exists in a detached manner from the way we perceive it (Matthews, 2006); our experience of it occurs through a simple unit of measurement: a *sensation* (Merleau-Ponty, 2002, p. 3). The sensations we collect are not mere uncritical data, but instead provide complex data patterns that inform us of causal (but also casual) relations between one thing and another (Matthews, 2006, p. 434); through sensations we can also contemplate *impressions*, understood as an additional layer that adds meaning – not necessarily intrinsic – to any stimulus (Merleau-Ponty, 2002, p. 4).

Already from these early cues we can observe the emergence of some simple dichotomies; first, the existence of a real world and an abstract perception of it operated by our brains, and second, the existence of *sensations* as a direct scientific product of experience and *impressions* as a logical/emotional by-product of perception-related phenomena. Studying perception as a pure discipline is indeed a complex endeavour as we often still come across such polarizing splits in contemporary discussions, for instance how much of what we perceive objectively exists in reality and how much is a construct of our minds is still a widely debated issue not only in the philosophical world but also in the scientific one (Zigman, 2018, p. 1).

Merleau-Ponty's phenomenological approach, based on «the description of our direct, pre-reflective contact with the world around us in perception» (Matthews, 2006, p. 429), tries to find an answer to these differing understandings of the same issue:

> Perception, for him [Merleau-Ponty], is not what it is for "objective thinking": a kind of pure detached contemplation of things by a subject distinct from them.

Nor is it, as in intellectualism, an "absorption" of objects into our own subjectivity. The very meaning of the word "perception" (or "experience") implies […] a relation between subjects and objects, each of which has a degree of independence from the other. Subjectivity is not something purely inner, detached from its objects, but something that can exist only in so far as it is in communication with the world of objects. The phenomenological concept of the intentionality of consciousness, embodied in the slogan that "all consciousness is consciousness of something", encapsulates this idea. (Matthews, 2006, pp. 436-437)

It is thus apparent that the way in which individuals experience the world around them is a complex system of relationships with objects and spaces, and human beings become both leading actors and directors of such interactions:

Human beings are objects in a world that extends far beyond their experience of it; but they are not only objects, they are subjects, interacting purposively with that world. Because they interact purposively with it, meaning is given to the world, and so to their own existence as human beings. But these meanings are not a matter for absolutely free choice; they are constrained by what human beings already are, biologically and historically, and by the independence of the world. And because human existence is open to the future, the definition of the meaning of that existence is always incomplete and ambiguous. (Matthews, 2006, p. 466)

In this last passage, another key element is revealed: perception of the world around us contributes meaning to it and to our being in this world and informs the definition of our future. Thus, we can see the crucial importance that perception can assume in ensuring a good quality lifestyle for us, including from a psychological point of view: this topic is addressed by Inghilleri (2021) where he highlights, in the midst of the Covid-19 pandemic, the relationships between the spaces we experience and an emotional-perceptual dimension of them; he emphasizes how a central component of our relationship with places is the subjective experience of human beings, who seek positive basic emotions in order to have a pleasant experience of a space (Ivi, pp. 90-91). Inghilleri reminds us how also Donald Norman in a number of his researches, but particularly in his famous text *Emotional Design* (2004), also addresses our emotional relationship with inanimate objects and spaces. Norman recognizes three levels of emotional processing: a *visceral level* – first impressions and quick judgments –, a *behavioral level* – the practical use of an object and its usability –, and a *reflective level* – deeper and more symbolic processing (Ivi, pp. 129-130); accounting for all three of these layers of emotional experience in the design process of a space is essential in any

project, and these reflections lend themselves not only to theoretical speculation but equally to tangible applications (Ivi, p. 132).

Thus, wanting to provide a design meaning to the term perception, we could define it as the active and emotional processing of sensory stimuli given by the space in which we find ourselves.

Designing the emotional quality of a space may be especially important in a historical period in which large-scale mental health problems have emerged as a result of both the pandemic crisis (Lloyd et al., 2023; Ahmed, 2023) and as a result of conflicts (Iannitelli & Biondi, 2024), as in fact one of the fundamental purposes of design as a discipline is «to meet the physical and psychological needs of users» (Xu & Wu, 2022). Therefore, it can be noted how a series of design elements, classically considered "soft" ones or of mere decoration, take on a fundamental role in our relationship with space due to their ability to create a feeling of well-being in the user of a space.

Addressing the issue of perception from a spatial perspective is not an easy task, as «In architecture, three-dimensional space is the primary medium, and creation of spatial compositions is the fundamental task. However, its definition as well as the way it is perceived is extremely diverse. The lack of learned or scholarly defined appraisal parameters, units of values, or simply insufficient information and knowledge on the subject of spatial relationships, may restrict the ability to certainly predict the users' respond to a particular space» (Zejnilovic, Husukic & Licina, 2023, p. 15). The task is even more challenging if we consider that «the majority of architecture is designed for the eye of the beholder, and tends to neglect the non-visual senses of hearing, smell, touch, and even taste» (Spence, 2020).

Although man can indeed be defined, at least neuroscientifically, as a creature whose dominant sense is sight (Hutmacher, 2019; Spence, 2020), there are some notable anthropological exceptions: one of these is the Kaluli people of New Guinea who, over centuries, have developed a predominantly auditory culture where the recognition of birdsong constitutes the main element both for orientation in the dense rainforest and for poetic, dramatic and musical creations, as described in Steven Feld's ethnographic treatise *Sound and Sentiment* (2012).

Western architectural practices have traditionally been accustomed to following a visual-centric tendency in design; however, it is difficult in the contemporary era not to question the hegemony of sight and one should ask the question of what we have been missing in centuries of buildings and interiors designed around this single sense (Spence, 2020); indeed, «Spaces, places, and buildings are undoubtedly encountered as multi-

sensory lived experiences. Instead of registering architecture merely as visual images, we scan our settings by the ears, skin, nose, and tongue» (Pallasmaa, 2011, p. 595 – as cited by Spence, 2020) and the lack of consideration of the actual presence of these multisensory stimuli in a space can be detrimental both to our experience of it, but also to our general well-being (Ibid.).

Sight

The role and influence of the senses can, according to Spence, either be considered all together from a synaesthetic perspective or be divided analysed one by one; being sight the pivotal sense in our relationship with the outside world, we cannot avoid considering it first. If we consider the history of architecture and art, sight has often been used creatively and "improperly", to playfully create altered perception of reality – one only needs to think of some masters of the Italian Renaissance and their skillful use of perspective, or the widespread use of *trompe l'oeils* in both ancient and modern architecture – but in contemporary times discussing about sight in the creation of spaces means primarily making conscious and judicious use of colour and patterns, as they can have a lasting impact on the mood of the user of a space by directly influencing his or her psychological well-being (Lòpez & Dìaz, 2022).

From a cultural standpoint, we cannot forget the vast neuro-psychological relationships of colours with human well-being, so their use, whether unrestricted for the delineation of floors and walls or incorporated within materials, may prove to be one of the most effective tools at our disposal to establish a new way of living interiors. In this regard, it is interesting to report an observation of the American Coatings Association: by comparing emerging trends of some leading wall-painting producers, during the Covid-19 pandemic an emerging preference for shades of green in the domestic environment was seen (Challener, 2021). The domestic environment in fact, during these uncertain times, could benefit from looking as clean and as fresh as possible: green is associated both to hues ordinarily used in health care, and to colours that recall a contact with nature; the psychological effects of green, both as a botanical element and as a pure colour, on our well-being are well known. The growth in popularity of this colour may also be due to the emerging trend of biophilic design, which can help to develop positive emotional responses directly related to our relationships with nature. A wise use of colour has the power to evoke feelings beyond the physical boundaries of the architectural artifact, and its use can relate to cultural legacies and therefore stimulate positive feel-

ings or memories in the users of a space: a careful chromatic an visual pattern selection should well be part of heritage-centred design practices, understood both as a skillful juxtaposition of cultural heritage and modern architectural design (Kuipers & De Jonge, 2017, p. 23), but also as design languages that are able to respect the cultural, socio-political and historical background of an individual or group of individuals. Colours, textures, patterns, symbols can in fact be tightly related to one's perception of his or her identity, and their wise use can be soothing as it makes the user feel connected to their origins; it is therefore important to think about the perceptual role of heritage in contemporary design practices and aesthetics as «Dealing with heritage, especially the environmental aspects associated with it, and learning from past experiences in creating solutions to the current problems build a link between interior architectural heritage and contemporary designs. Moreover, dealing with heritage and integrating it with contemporary architecture leads to an understanding of heritage and an evaluation of requirements that match and reflect current times» (Elnaggar, 2017, p. 7).

The artist and writer David Batchelor (2000) however points out how the use of colour has been cyclically rejected by Western culture over the centuries, and how adopting it in interiors, objects or garments is often identified as creating havoc and fear, which he calls a genuine Chromophobia. One only needs to think of the inordinate and ostentatious use of the colour white to evoke a feeling of order and clarity – possibly in contrast to black alone – in certain interiors peculiar to the Western upper middle class (Batchelor, 2000, p. 10) to understand how the use of colours has often been singled out as a bearer of meanings and values considered unpalatable:

> Chromophobia manifests itself in the many and varied attempts to purge colour from culture, to devalue colour, to diminish its significance, to deny its complexity. More specifically: this purging of colour is usually accomplished in one of two ways. In the first, colour is made out to be the property of some 'foreign' body – usually the feminine, the oriental, the primitive, the infantile, the vulgar, the queer or the pathological. In the second, colour is relegated to the realm of the superficial, the supplementary, the inessential or the cosmetic. In one, colour is regarded as alien and therefore dangerous; in the other, it is perceived merely as a secondary quality of experience, and thus unworthy of serious consideration. Colour is dangerous, or it is trivial, or it is both. (It is typical of prejudices to conflate the sinister and the superficial). Either way, colour is routinely excluded from the higher concerns of the Mind. It is other to the higher values of Western culture. Or perhaps culture is other to the higher values of colour. Or colour is the corruption of culture. (Ivi, pp. 22-23)

In the contemporary era, therefore, the use of colour in spaces and objects also becomes a matter of large-scale inclusivity and social sustainability of a project, rejecting obsolete cultural values that may be linked to its use and embracing its infinite expressive potential can also provide technical solutions to spatial problems: the first decades of the 21st century saw a disproportionate division of domestic space in Europe that favoured open-plan living areas, merging them with spaces for food preparation and consumption, while disfavouring more private areas such as bathrooms and bedrooms.

This approach proved unsuccessful during lockdowns, as it often prevented families and domestic partners from having sufficient private space to work and study from home, and consequently was detrimental to proper work-life balance (Scullica, Elgani & Monchiero, 2021).

In situations where there are limitations to the physical separation of spaces, graphic connotations through the use of colour, be it a coloured material or paint, can better suggest the functions assigned to a given space and thus induce the inhabitant to develop healthy habits to avoid further contamination of the indoor environment – such as taking off shoes at the entrance of the house or being mindful with other workers on a workplace (Ibid.).

Touch and Olfaction

Another technical function of colour concerns its use within materials, as the relationship with material is probably one of the most important ones in the way humans experience interiors (Dümen, Koyaz & Çeliker-Cenger, 2022). For many years from the second half of the 20th century to the present day, a marked "materiality" has been sought in interiors, which has determined trends such as considering unfinished cladding materials as decorative and functional elements, often regardless of colour but by virtue of their other tactile and visual characteristics (Scullica, Elgani & Monchiero, 2021). The pandemic has instead brought the attention towards the hygiene of interiors, not only in public places but also inside private ones (WHO, 2020): it is easy to understand how porous or uncoated materials or ones with crevices, ridges, grout lines are difficult to thoroughly clean, and also disinfecting could damage surfaces not designed to withstand chemical stresses (Ibid.).

Therefore, materials that naturally repel bacteria and germs, or that are easy to wash, are often preferable (Schneider, 2021): fortunately materials such as stoneware, ceramics, polymers and many others allow for the possibility of being paste-coloured and they often offer a fair

amount of durability; therefore, a shift toward materials whose main strengths is colour and other visual characterizations and that do not instead rely on heavy texture or an intrusive component of materiality can be hoped for in interior design and architecture during these new uncertain times.

Surface sanitation can also be achieved in another, more technological, way: through the help of lighting. For example, the Italian lighting brand Artemide has developed, in response to the health crisis, a way to turn lamps into room sanitizing devices through ultraviolet rays (Hahn, 2020). The technology is called Integralis, can be used in a wide variety of the company's products, and can be remotely controlled so that it functions as a simple lamp while people are using the space and instead disinfects surfaces when the room is empty (Ibid.). Although the actual functionality of ultraviolet lighting against Sars-CoV2 is debated (Alnaser et al., 2020), this innovative use of light as an aid in cleaning can help us calm any insecurities in inhabiting both public and private spaces, but it can also buy us valuable time to devote to other matters or to taking care of ourselves.

Along with the loss of materiality, another sense whose value has been challenged by the changes of the past few years due to the use of face masks is the sense of smell. However, it is a sense to be held in primary consideration when reflecting on the perception of work, retail and care spaces (Barbara & Perliss, 2023, p. 10), as «An olfactory education not only increases sensitivity, but also becomes an indispensable tool for designers to ensure that the invisible qualities of space are consistent with those of the other senses and are not out-of control or even adverse variables» (Ibid.). Barbara, theorizing the emergence of a new discipline she calls *olfactory design*, recognizes the coexistence of two planes of an architectural artifact/space existence, one tangible and one invisible-but no less real or of less importance in its perception: «When these two buildings, the visible and the invisible, are coherent, they produce pleasure, narrative and comfort; when they are not, the generated effect is one of discomfort, disorientation, and even illness» (Ivi, p. 17).

The intangible elements of experiencing a space, however, do not stop at the olfactory component, but rather include many parameters whether measurable or subjective: measurable parameters are those pertaining to IEQ, the Indoor Environmental Quality of a space, such as the indoor air quality, thermal comfort, artificial and natural lighting and acoustic performance (Laurìa, Secchi & Vessella, 2020, p. 1); more subjective and non-measurable parameters may be the ability to understand the surrounding context, one's orientation, satisfaction or stress caused by the environ-

ment etc. (Ibid.) – all of these can influence one another and contribute to altering even radically our perception of a space.

The olfactory component is closely related to the indoor air quality parameter, which proves to be «one of the main health and well-being factors» (Šenitková, 2016, p. 1) for our indoor life; in fact, we often fail to consider how the indoor environments in which we spend a good part of our existence can reach even higher levels of pollution than the outdoor one in large, highly industrialized cities (Ibid.).

Improving indoor air quality has been a crucial issue during the pandemic to contain the spread of the virus in both hospital and non-hospital spaces, as VOCs (Volatile Organic Compounds) and even Bio-Aerosols are the main source of indoor pollution (Ivi, p. 3); there are many ways in which indoor air quality can be managed, but it is especially important to investigate during the design process the ventilation of the space. Such ventilation can mainly be natural, through windows or other openings, but it can also be implemented artificially through the use of HVAC systems (possibly combined with filtering systems), or through the use of CMVs, which are systems that mechanically ensure continuous recirculation and exchange of air in interior spaces that are possibly not provided with direct openings to the outside.

Hearing

Among other intangible but measurable elements, we cannot forget the acoustic comfort of a space, as the perception of the same varies depending on people and situations, for example, due to the natural aging process of our hearing that results in a decreased sensitivity to certain high frequencies, but acoustic comfort can also be influenced by environmental, cultural and behavioural parameters (Laurìa, Secchi & Vessella, 2020, p. 3) that contribute to the formation of a complex phenomenon called *Soundscape*.

Although the first rudimentary definition of the term «sounds occurring over an area» (Soutworth, 1969) first appeared in the late 1960s in a publication on the perceptual experience of urban spaces (Ibid.), the term was extended, studied and brought into prominence by Canadian composer Raymond Murray Schafer in *The tuning of the world* (1977). Originating from combining the word "sound" with the word "landscape", the term refers to the ecosystem of natural and anthropogenic sounds located in a specific geographic or architectural space and could be in the contemporary era defined as «the collection of biological, geophysical and anthropogenic sounds that emanate from a landscape and which vary over space

and time reflecting important ecosystem processes and human activities» (Pijanowski et al., 2011) – although there is no shortage of both scientific and artistic debates about this term. Raymond Murray Schafer is also the creator of the *World Soundscape Project*, a Canadian observatory established with the intention of developing critical thinking that explores and interprets various phenomenologies of sound in the environment, around which a good deal of the electroacoustic composing experimentation of the second half of the 20th century in North-America was condensed (Galante & Sani, 2000, p. 340); the Soundscape theme thus takes on an interdisciplinary relevance, both artistic, planning, and scientific.

Indeed, research on Soundscapes also extends to issues of environmental sustainability, such as noise pollution and acoustic ecology, the latter defined by Barry Truax as «the study of the effects of the acoustic environment on the physical responses or behaviour of those living in it» (1978, p. 127); the emergence of a new discipline defined as *Soundscape Ecology* by Pijanowski et al. (2011) could also help us preserve panoramas, both visual and aural, that are at risk of extinction due to increasing anthropogenic activities, actively reuniting human beings with the landscapes around them and enticing them to care for these environments (Ivi, p. 1227).

Designing human relationship with sound is usually the prerogative of a Sound Designer, that is «one who carries out sound-design in order to arrive at a dimensional and functional definition, at the qualification of the processes necessary for the production of a sound object-event»[1] (Marchetta, 2010, p. 26).

Sound Design understood in this way – the same term in fact might also be used to refer to sound effects in film and animated cinema – often lends itself to Branding operations, creation of sound logos, advertising communication, websites and applications, and the careful design of the sound experience collateral to the use of an object etc.; however, Schafer originally seems to determine another path to the development of the design of sound in the contemporaneity than the one just set forth, which Marchetta defined later as a result of observations of evolutions of the genre:

> It devolves on us now to invent a subject which we might call acoustic design, an interdiscipline in which musicians, acousticians, psychologists, sociologists and others would study the world soundscape together in order to make intelligent recommendations for its improvement. This study would consist of documenting

1. Translation from original: «chi svolge una progettazione sonora per giungere ad una definizione dimensionale e funzionale, alla qualifica dei procedimenti necessari alla produzione di un oggetto-evento sonoro».

important features, of noting differences, parallels and trends, of collecting sounds threatened with extinction, of studying the effects of new sounds before they are indiscriminately released into the environment, of studying the rich symbolism sounds have for man and of studying human behaviour patterns in different sonic environments in order to use these insights in planning future environments for man. Cross-cultural evidence from around the world must be carefully assembled and interpreted. New methods of educating the public to the importance of environmental sound must be devised. The final question will be: is the soundscape of the world an indeterminate composition over which we have no control, or are we its composers and performers, responsible for giving it form and beauty? (Schafer, 1977, p. 5)

Such a definition of sound design could be partially superimposed on the however uncommon term *Acoustic Design*, and better meet the research needs of Sound Ecology and on noise pollution studies in our cities. According to Schafer, an acoustic designer should curate the following principles:

Acoustic design does not, therefore, consist of a set of paradigms or formulae to be imposed on lawless or recalcitrant soundscapes, but is rather a set of principles to be employed in adjudicating and improving them. In addition to the lessons taught by music, these principles consist of:

1. a respect for the ear and voice – when the ear suffers a threshold shift or the voice cannot be heard, the environment is harmful;
2. an awareness of sound symbolism – which is always more than functional signaling;
3. a knowledge of the rhythms and tempi of the natural soundscape;
4. an understanding of the balancing mechanisms by which an eccentric soundscape may be turned back on itself. (Schafer, 1977, p. 238)

Thus, clear parallels and differences between the role of the Sound Designer and Schafer's identified role of Acoustic Designer emerge: both approaches present themselves as a technical-scientific way, with communicative rather than artistic purposes, of approaching the sound-object, be it abstract or physical; however, the former acts in a more invasive and proactive manner, its purpose being to create something new, while the latter acts in a more delicate and restorative manner, its purpose being to protect the existing environment.

As the work of the acoustic designer is rare (if not totally non-existent), his or her role falls among the skills that a designer concerned with the topics of spatial perception must develop, making use of architectural acoustics knowledge, to control the narrative of the interior soundscape. In fact, although at first the term Soundscape referred mainly to the outdoors,

it has increasingly conquered the realm of interior built environments (Hasegawa & Lau, 2021) and, professionally, the steps of conceiving a project of interior design and studying and creating an interior soundscape can be directly related and performed simultaneously, and it is also possible to apply them in various architectural contexts (Ercakmak & Yorukoglu, 2020).

From a practical point of view, the designer or architect must first understand the auditory requirements of a space by starting with its intended use; Mahmoud (2019) divides interior spaces into five categories according to the acoustic functions they must fulfill: spaces for speech intelligibility, spaces for quietness needs, spaces for music enhancements, spaces for privacy needs and spaces for public announcements (Ivi, pp. 5-7). According to the author, the *spaces for speech intelligibility* include those places where communicative clarity is essential such as classrooms or courtrooms that require the total absence of echoes or reflections, the *spaces for quietness needs* are spaces that require a low level of background noise such as hospitals and museums in order to make the best use of their services, *spaces for music enhancements* are recording studios, theatres and auditoriums that require a high level of reflective materials to achieve the ideal acoustic performance, *spaces for privacy needs* are spaces such as residential ones that require high levels of sound absorption to promote the necessary feeling of privacy, while finally *spaces for public announcements* are those spaces such as institutional and government buildings, malls, airports and stations where clarity of speech is once again quite important (Ibid.). Understanding the different needs of spaces is important as ambient sound can convey varying levels of people's presence or absence, contributing to making us feel more or less safe in experiencing both a public or private space (Sayin et al., 2015), and can also have beneficial effects in the medical field on patients' tranquillity and, consequently, on the pace and quality of their recovery (Watts, Khan & Pheasant, 2016).

While some spaces, such as theatres, make use of reflectors or sound diffusers, a good portion of the typologies of spaces highlighted – for example, residential, hospitality, work, and related spaces – rely on insulating or absorbent materials to provide a good level of acoustic comfort. There are various types of such materials on the market that can be adapted to different uses: use of panels that are placed vertically on the walls of a space, for example, is a popular choice for the purposes of interior design as they present many possible aesthetic characterizations due to the variety of shapes, sizes and finishes available, as well as being easy to install (Laurìa, Secchi & Vessella, 2020, p. 7); alternatively, hanging

panels suspended from the ceiling can be used when there is a preference to leave walls uncluttered, and they can be laid either horizontally or vertically (Ivi, p. 8), possibly configuring themselves (depending on their size) also as elements of demarcation for different uses or "sub-spaces" within a larger environment. Finally, there are also mobile sound-absorbing elements laid on the ground that can be configured two-dimensionally, namely vertical panels, or in 3D, namely volumes (Ibid.). This last typology is the one that allows the designer the most room for creativity, as they can also be conformed as furniture: an example of this kind is Pedrali's *buddyhub* series of pieces of furniture (Pedrali, 2020); designed by the Busetti Garuti Redaelli studio, they constitute a multipurpose and very versatile pieces of furniture thought mainly for offices, contract and hospitality areas, as their conformation is able to create acoustically isolated niches by using a sound-absorbing panel that embraces the seat (Ibid.).

The creation of "sub-spaces", such as those created by such furniture that creates visually and acoustically isolated cocoons or others brought about by the use of colour or patterns to demarcate specific functions, is a central subject for the perception of place during this new era of uncertainty, as it helps us redefine the role of public and private space in interiors. Contemporary trends have led us toward open interiors regardless of their function and the privacy they require, and the dematerialization of fixed indoor structural elements that were traditionally a hindrance to our senses (such as walls or columns) has resulted in a consequent vanishing of their roles of masking (Mahmoud, 2019, p. 4) and dividing functions; such wide open contemporary spaces, however, can be subdivided at will not through physical elements, but rather through more abstract ones such as sound, colour, a variation in temperature, or an olfactory stimulus.

It would also not be the first time historically that, at a time of crisis and in response to it, mindful architectural designers have reflected on the role of the all-round perception of a space; for example, in the *Paimio Sanatorium* designed in 1933 by Alvar and Aino Aalto for people suffering from Tuberculosis, «The colour of the ceiling is chosen for quietness, the light sources are outside of the patient's field of vision, the heating is oriented toward the patient's feet, and the water runs soundlessly from the taps to make sure that no patient disturbs his neighbor» (Colimina, 2018 – as cited in Chayka, 2020). However, the designer must be judicious in the creation of multisensory spaces, as a non-observant approach could create incongruent experiences in the user and thus create a feeling of alienation that, if not explicitly intended, can negatively impact the perception of a place; it is therefore essential to create coherent interior spatial experiences: for example, the architectural amplitude of worship spaces

is usually also supported by a vast sonic reverberation, contributing to the construction of a spiritual experience of recollection and contemplation (Saxena, 2019).

Nevertheless, ultimately, rethinking the perception of a space can also have the added benefit of democratizing design processes: indeed, the pandemic has shown us a creative and resourceful spirit of the inhabitants of most places who, through plexiglass, curtains, plastic bags and much more have adapted by improvising in response to the imposed restrictions, in order to continue living a semi-normality (Chayka, 2020).

Each individual human being can therefore – relying on his or her own perception of a given context, necessities, and employing them as resources to establish design practices (Torresin et al., 2020, p. 6) that are both apocryphal and imagined – be an author or co-participant in the creation of more comfortable and enjoyable visual environments or soundscapes, for oneself and for others.

3.2 Adaptive scenarios: virtual and physical responses to new challenges

As anticipated in paragraph 3.1, one can appreciate the tangible and objective components of the physical elements of a space, but one can also value more subjective and intangible elements by reasoning about the perception of said space. The simultaneous perceiving of those elements contributes to creating what the Finnish architect and educator Juhani Pallasmaa defines as the *Atmosphere* of a place: «Atmosphere is […] an exchange between material or existent properties of the place and the immaterial realm of human perception and imagination. Yet, they are not physical "things" or facts, as they are human experiential "creations"» (Pallasmaa, 2014, p. 3).

The co-presence of these elements can also be seen through our relationship with new technologies that accompany us every day, and whose use is constantly growing; in fact, it is relevant to mention that during the pandemic «it is from the technological front that there have been a number of contributions on, for example, the accelerated development of digital technologies, which have offered possibilities in the sphere of remote work but also of "remote relations", which prior to 2020 were rarely used» (Scullica & Monchiero, 2023). This happened because in 2020 a surge in teleworking practices was seen in many countries around the globe as a way to ensure business continuity while complying with health emergency restrictions (Corso, 2020). Similarly, the education of the younger

generation also switched, for most of the students worldwide, to almost exclusively online (Mascheroni et al., 2021, p. 6). These mutations in the way of working and studying are noteworthy in order to understand the continuous evolution of the boundaries between the physical and virtual worlds; as Byung Chul Han (2017) denotes the main transformation that has taken place in the transition from the industrial to the digital era is that of the change in the relationship between work and home, as the new mobile devices allow us to work anywhere and at any time (Ibid.) and, while on the one hand they have ensured that we can continue our usual activities even if socially distanced, they have also contributed to erasing every boundary necessary to define a correct work-life balance. This paradigmatic shift can have negative effects on people's health: «The continuity of using *home* as a permanent workplace may lead to the risk of losing home as a place of intimacy and recovery from work life, threatening home-dwellers mental health and wellbeing. These threats are exacerbated by household crowding» (Erfani & Bahrami, 2022).

The role of digital technologies in reshaping spaces and arts

However, since in recent years IT devices have indeed become inseparable companions in our everyday lives, a question naturally arises: how have indoor spaces changed to adapt to this sudden change? Although many have been the changes that have taken place in immediate reaction to the pandemic, quite as many predictions made at that time have not then come true; as a mere illustration, although it was hoped that workplaces would largely change in the post-Covid era as corporate towers would be entirely replaced by smaller touch-down hubs to be used as occasional meeting points, while most of the work could be conducted from home or from Co-Working spaces (Peach, 2020), this radical change has not then actually happened.

Instead, what has indeed been radically altered is our interactions with the space and the objects in it; the extensive use of new technologies and of computers, tablets, phones, and other devices has been completely unleashed, and therefore the way we work, study, move, and live had to adjust to the use of these new elements in pre-existing spaces.

Space design in contemporary times thus blends with user-interface design; for instance, the tourism industry has had to innovate its services during the pandemic through the introduction of new technologies, such as «delivery robots, digital menus and in-app ordering» (Awasthi & Awasthi, 2021) for the food & beverage sector, or self-check-in and other automated front-office functions in hotel facilities via various devices, as «practi-

cally most aspects of the hospitality activity can now be accessed by customers' own mobile devices» (Rahimizhian & Irani, 2021). However, such options bypass human contact, an essential factor in hospitality; a survey conducted by Arribatec hospitality, a leading Norwegian manufacturer of self-check-in kiosks and ticketing machines, shows that although hotel guests appreciate the use of new technologies that remove the need for interpersonal contact with the facility's Staff, «a significant 67% felt that technology has made it more challenging to make meaningful connections. They believed that technology-led interactions further decrease empathy and social skills» (Arribatec, 2023). However, the employment of new technologies does not necessarily need to be contrasted with the human contact with the staff: for example, by having guests check in and open the room via their cell phones, the reception usually set up for this purpose can disappear and turn into a space for customer-staff interactions (Hancz, 2023); an example is that of the Boutiques hotels chain *Schani* in Vienna, where the space classically designated for a reception becomes a bar where a free drink is offered, which helps to «preserve the feeling of personalization while offering a digital-first experience» (Ibid.).

To address the influence of new technologies in contemporary design one cannot avoid mentioning some comparable experiences in a related, sometimes parallel and at other times interconnected field: that of contemporary arts, and especially multimedia art, understanding the latter term as: «the simultaneous use of multiple modes, tools or media of communication of a technological nature»[2] (Balzola & Monteverdi, 2019, p. 7). Multimedia arts find indeed a fertile ground for growth and development in the digital age:

> The digital thus becomes the specific of contemporary multimedia, that which marks the discontinuity with the specific of analogue photographic, cinematographic, video and electronic audio techniques, and at the same time redefines their linguistic status. The possibility of numerical synthesis, then transfer, processing and interaction (interdependence) of any text, image or sound, within the same metamedium, independently of the original source (which becomes its 'peripheral'), marks the third 'revolution' in the sphere of the relationship between art, communication and technique. The first revolution was that of *technical reproducibility* (from the printing press to photography and cinema), described by Walter Benjamin in the 1930s; the second revolution came about with the transmission and *live technical reproducibility at a distance* (telegraph, telephone, radio, television), studied in its psychological and social effects by

2. Translation from original: «l'utilizzo simultaneo di più modalità, strumenti o supporti di comunicazione a carattere tecnologico».

Marshall McLuhan in the early 1960s; the third revolution, introduced at the end of the twentieth century, is precisely what some have called, paraphrasing Benjamin, *digital reproducibility* (F. Ciotti & G. Roncaglia, 2000), and which we prefer to call the *connective digital synthesis* (computer and network)[3] (Balzola & Monteverdi, 2019, pp. 10-11).

One of the pivotal themes of this shift toward a digital and interconnected world of fruition and realization is that of *virtuality*, in that «the ideation and design moment no longer precedes the communicative or expositional moment; the idea is already the virtual body of the work and as such can be enjoyed. With virtual realities, the idea and the project can materialize into a multisensory experience before giving rise to their material realization»[4] (Ivi, p. 14).

Thanks to such technological components that simplify their distribution, these forms of artistic expression have seen an increasing fruition during the pandemic period. On the one hand, a growth in the consumption of traditional art forms and museum exhibits through the mediation of new digital media could be observed during the pandemic (Amorim & Teixeira, 2020), such as the recreation of exhibition spaces in the metaverse and the subsequent virtual visits; on the other, according to a study commissioned by the National Arts Council of Singapore, during lockdowns 88% of the participants consumed digital arts content (NAC, 2020) through Social Media and on Demand Streaming platforms, and 81% of them said they would continue to enjoy such content even after the pandemic (Ibid.). In fact, the positive effect brought by consuming

3. Translation from original: «il digitale diventa quindi lo specifico della multimedialità contemporanea, ciò che segna la discontinuità con lo specifico delle tecniche fotografiche, cinematografiche, video e audio elettroniche analogiche, e nel contempo ridefinisce il loro statuto linguistico. La possibilità di sintesi numerica, quindi di trasferimento, elaborazione e interazione (interdipendenza) di qualsiasi testo, immagine o suono, nell'ambito dello stesso metamedium, indipendentemente dalla fonte originaria (che diventa una sua "periferica"), segna la terza "rivoluzione" nell'ambito del rapporto tra arte, comunicazione e tecnica. La prima rivoluzione è stata quella della *riproducibilità tecnica* (dalla stampa alla fotografia e al cinema), descritta da Walter Benjamin negli anni Trenta; la seconda rivoluzione si è realizzata con la trasmissione e la *riproducibilità tecnica a distanza in diretta* (telegrafo, telefono, radio, televisione), studiata nei suoi effetti psicologici e sociali da Marshall Mc Luhan nei primi anni Sessanta; la terza rivoluzione, introdotta a fine del Novecento, è appunto quella che alcuni hanno definito, parafrasando Benjamin, della *riproducibilità digitale* (F. Ciotti e G. Roncaglia, 2000), e che noi preferiamo definire la *sintesi digitale connettiva* (computer e rete)».

4. Translation from original: «il momento ideativo e progettuale non precede più il momento comunicativo o espositivo, l'idea è già corpo virtuale dell'opera e come tale può essere fruita. Con le realtà virtuali l'idea e il progetto possono concretizzarsi in un'esperienza multisensoriale prima di dare luogo a una loro realizzazione materiale».

(or possibly even making) artworks of various types on the psychological well-being of human beings during times of crisis cannot be underestimated (Bradbury et al., 2021, p. 17) due to «specific effects on individuals' abilities to manage circumstances and regulate their emotions» (Ibid.). According to Paola Antonelli in fact, through the use of electronic devices such as laptops, smartphones and headphones everyone can be the maker of his or her own personal virtual space: «"I have a bubble of personal space that is metaphysical, that is bigger than the physical space around me", Antonelli said. "I can be squeezed into a subway car and I still have my world"» (Chayka, 2020).

The experience of digital multimedia arts, due to the technical limitations of our technological devices, forcibly spans only two senses: sight and hearing. Among visual forms, we cannot but mention *videoart*, which in the mid-21st century applied film technologies to methodologies of thought and realisation typical of the avant-gardes of the period (Amaducci, 2019, p. 162); one of the very first works that can be ascribed to the genre is *13 Distorted Tv Sets* by Nam June Paik, where cathode ray tube televisions are understood as ready-made objects and their potential for projecting light, colours and images is altered through magnetic interference and direct interventions on the screen (Ibid., p. 163), thus opening up infinite new potentials. The new technologies have also led to an undeniable dematerialisation of artistic forms: a significant example is *Net Art*, which with the birth of the World Wide Web concretises the possibility of creating through strings of code an infinity of different genres of works with the aim of being disseminated and enjoyed via the Internet (Tanni, 2019).

Although the sense of sight is still the undisputed protagonist of both most multimedia artworks and of architectural design research, new scenarios are emerging on the horizon: an example is a new research approach called *Sound-Driven Design*, which aims to shift from sound design to the design of the complex listening experience, targeting applicative impacts from the sound object to soundscapes in every relevant area of the lived environment in contemporary times[5].

Thus, wanting to refer to new paradigms that no longer regard sight as the primary sense of our relationship with space but instead open up to further experiences, we can study the role of the auditory not only for its scientific component of acoustics, but also for its contributions in

5. This novel approach of the *SIG Sound-Driven Design* community was established by dr. Stefano delle Monache, dr. Elif Özcan (TU Delft) and dr. Nicolas Misdariis (IRCAM); www.designresearchsociety.org/cpages/sdd-sig.

establishing an intangible poetics of space; sound atmospheres, however intangible, sometimes have even more powerful impacts than architectural spaces themselves (Sioli & Kiourtsoglou, 2022), for music enjoys the privilege of being «the most immaterial art» (Kandinskij, 1989, p. 39). In the discussion that follows, some notable historical and contemporary examples of how sound can both integrate into space and shape it to its own likeness will be analysed.

Integrating music in interiors

The design of auditory experiences in interiors can either be juxtaposed after the creation of a space or directly integrated into its conception, thus leaving room for cooperation with composers or other professionals; Palma (2011) presents two different artistic ways of interacting sonically with a pre-existing environment:

- *Music in Landscape*, that is, insertion of (usually electronic) sounds into the natural and urban landscape (installations, "multimedialisation" of places such as airports, shops, squares etc.) (Ivi, p. 28);
- *Landscape in Music*, that is, the decontextualization of the soundscape and its reuse for musical purposes (concrete, electronic, aleatory music, progressive rock etc.) (Ibid.).

Composers such as Barry Truax (Ivi, p. 35), a leading exponent of the musical genre defined as *Soundscape Composition*, refer to the first approach, which transfers and elaborates the sounds of the landscape in a studio using electroacoustic editing and montage techniques in order to produce new pieces, while still remaining faithful to the original sound characteristics of the place where the recordings were made.

At the opposite end of the spectrum of musical interactions with the pre-existing environment, we have *Ambient* music.

The unknowing creator of the genre is Erik Satie; with his *Musique d'Ameublement* (1917-1923), the eccentric French composer presents his revolutionary notion of music as a background to normal everyday activities (Belford, 2021, p. 119), a perspective by now well known and very dear to us in the age of Spotify and other such means of mass music reproduction and distribution. The first performance of the work took place at the Barbazanges galleries in Paris in March 1920, during the break of Max Jacobs' *Ruffian toujours, truand jamais* (1920) (Ibid.). While the short pieces created for the purpose were played repetitively, Satie would circulate among the spectators inviting them to talk to each other, walk around,

drink and carry on with their activities as if nothing was happening (Potter, 2015) although with poor results as the audience, unaccustomed to this music fruition methodology, would silently and attentively listen to the performers (Ibid.).

It would take many decades for the listening and music consumption paradigms to sufficiently change to allow the audience to accept music as a background; in the 1970s, the British producer Brian Eno composed *Music for Airport*: it was realised using 22 magnetic tapes with very little musical material (just a few notes on each), and the tapes overlapping randomly to create results that were always different, but at the same time had a high degree of recurrence (Palma, p. 34). This compositional methodology aims to replicate the isolated but repetitive flow of people in a "non-place" such as an airport, a liminal space with a specific function of passage and distribution, but without the possibility of establishing social relations or collective and shared histories (Augé, 1992).

This compositional experience laid the foundations for the creation of the thriving *Ambient* genre, whose name was coined and given by Eno himself in the liner notes to the American version of *Music for Airport*:

> The concept of music designed specifically as a background feature in the environment was pioneered by Muzak Inc. in the fifties, and has since come to be known generically by the term Muzak. The connotations that this term carries are those particularly associated with the kind of material that Muzak Inc. produces: familiar tunes arranged and orchestrated in a lightweight and derivative manner. Understandably, this has led most discerning listeners (and most composers) to dismiss entirely the concept of environmental music as an idea worthy of attention. Over the past three years, I have become interested in the use of music as ambience, and have come to believe that it is possible to produce material that can be used thus without being in any way compromised. To create a distinction between my own experiments in this area and the products of the various purveyors of canned music, I have begun using the term Ambient Music. (Eno, 1978)

To summarise the main differences between *Soundscape Composition* and *Ambient* music, one can see how the former starts from the intention of gently integrating itself into the surrounding sound environment, modifying it in different ways and in various degrees of intensity while never masking it or making it unrecognisable, whereas Ambient music translates the characteristics of the environment to radically transform its perception, actively covering any original environmental sound (Palma, 2011, p. 34).

Although both are valid options, understanding the difference in the intrusiveness of seemingly analogous artistic interventions to alter the perception of a space is essential for a designer in order for him or her to

make conscious choices in the incorporation of sonic experiences within interior spaces that are not museums or theatres, namely those spaces whose primary function is not to enjoy that specific artistic medium, but instead is to experience retail, dining or other activities.

Sound Art: Installations and sonic spaces

Sound Art works are examples of objects and spaces that are actively shaped by sound and whose conception of both their artistic/sound and physical/design characteristics occurred in the same primordial moment, requiring a dual knowledge of both design and auditory disciplines. Although there is no scholarly consensus on a precise definition of what exactly can be defined as *Sound Art* (Grant, Matthias & Prior, 2021), Italian musicologist and professor Laura Zattra provides us with a suitably concise and accurate definition of the term:

> Firstly, Sound art is any total sound-based experience that calls into questions traditional "time" and "space" categories. […]
> Secondly, Sound art is an art form that challenges traditional ideas of musical notation and score (the "neutral level" in semiotics).
> Thirdly, Sound art is not based in the Romantic musical production chain ("composer-score-orchestra/performers-concert-listeners"); quite the contrary, it is most of the time shaped by a collaborative activity […].
> Finally, Sound art involves the use of machines, technology, instruments or dispositifs in general, in search of forward-looking experimentation to generate original musical ideas. (Zattra, 2020, p. 274)

Among the subcategories of this vast (as well as vague) art genre, we can identify mainly two that are of particular interest in the context of rethinking design practices: the "Sound-Art Sculpture", which consists of a work that plays on the interaction between sound and object, and the "Sound-Art Installation", which instead aims to have the user interact with the auditory space. The following discussion proposes an analysis of a selection of sound installations that, more than others, have explored in-depth interactions with the architectural artefact, sometimes directly informing its design and construction – or at least mutually influencing one another. The objective of these case studies is to understand how musical and/or compositional parameters can influence the forms taken by architecture, as well as when the definition of a physical space and a sonic environment become indissociable from one another.

One of the main examples of architecture created in function of a sound installation is also itself one of the earliest sound installations ever

created: the *Philips Pavilion* of 1958 saw a co-design effort by French architect Le Corbusier and Greek composer and architect Iannis Xenakis (Belford, 2021, p. 76) who, by virtue of his dual background, was the author of one of the very first and most important existing texts regarding the interactions between sound, music and built environment in the 1900s (Xenakis, 1971)[6].

The load-bearing structure is S-shaped, and required the spectator to enter from one vertex of it and exit from the opposite one: inside were projected clips of human life on black-and-white film prepared by Le Corbusier himself, and the fruition was accompanied by the music of Edgard Varèse, who was excited by the idea of being able to interact with an architectural space; indeed, he compared the addition of a spatial parameter to the musical composition to the discovery of a fourth dimension (Belford, 2021, p. 77).

The work was presented at the Universal Exhibition in Brussels in 1958, and Xenakis's interdisciplinary approach between music and architecture became essential for the definition of its both architectural and compositional forms: if, in fact, Le Corbusier approached mathematical calculation to increase the perceptive complexity of space, Xenakis made the calculations a real part of the creative process itself (Ivi, p. 80), almost approaching the realisation of a space in the same way as an atonal composition.

The composition created for the occasion by Varèse, who holds the merit of having been a pioneer in the use of new electro-acoustic technologies to ascribe spatial trajectories to sounds (Quinz, 2019, p. 115), is the homonymous *Poème Electronique*, an eight minute mixture of synthesis and "concrète" sounds, which was diffused in the space through 425 loudspeakers (Belford, 2021, p. 77); Xenakis also composed a brief interlude for the installation, *Concret PH* (Ibid.).

At the same time, the video produced by Le Corbusier was diffused on the walls without any intention of synchronising with the audio tracks of Varèse and Xenakis. Prof. Chiara Lecce, in her book *The "Smart" Home* (2020), defines the visual components conceived by Le Corbusier for the installation in the *Philips Pavillion* as follows:

The aspect of rhythm presents in the architect's original formulation regulated the other media. The single element all four pieces had in common was time,

6. Since Xenakis's text, the literature on the subject of the contaminations between music and architecture has been extensive; for further exploration please consult: Capanna, 2009; Comes, 2018; Felix & Elsamahy, 2016; Forsyth, 1985; Langat, 2015; Lee, 2008; Morimoto, 2017; Tayyebi, 2013; Wismer, 2004.

which provided the base upon which the spectacle would be constructed: it would last precisely 480 seconds. The visual components of *Poème électronique* were four: a film (écran, literally 'screen') presenting images illustrating the course of human civilization and the threats to its prolongation; coloured lighting (ambiance) within the pavilion to manipulate atmosphere and mood; simplified shapes superimposed upon the film by projectors (tri-traus, so named for the three holes, or trous, in the projection device); and three-dimensional forms (volumes) to be illuminated with ultraviolet light for maximum effect. Unlike most buildings which are measured in linear and areal dimensions, the Philips Pavilion was a space calculated in seconds». (Lecce, 2020, p. 22)

If the *time* parameter is therefore essential for *Poème électronique*, different approaches are followed by Bernard Leitner in defining his works:

My work deals with the audio-physical experience of spaces and objects which are determined in form and content by movements of sound. The focus is the relationship between built structures of sound and the human body. The scale ranges from small objects directly applied to the body to large-scale architectural spaces. (Leitner, 1978, p. 13)

He too, like Xenakis, an architect, he created perhaps his most famous work in 1980: in his *Sound Cube* he linearly arranges speakers on six walls and allows sound to define geometries in space: planes, circles, lines (Licht, 2009, p. 7). He therefore understands sound as a physical object, not an abstract and intangible one, to be actively shaped as such, in order to be able to attribute movement or staticity to it in space and time.

In the design process of his *Sound Cube*, he acts on a pre-defined architectural space by enhancing it with sound rather than constructing a whole new space around it; his approach to the definition of sound installation works more closely resembles that of a small-scale designer or interior decorator rather than the large-scale definition of new buildings of an architect or building engineer: he displays an instinct for the conservative modification of a sound-space, rather than its creation from scratch.

The technical developments of the present day eventually pave new roads: space itself can actively and willingly bow to the will of sound. Through the use of flexible partitions, textile materials and more, and thanks to the mediation of technological or mechanical devices that can make extemporaneous changes in response to a sound stimulus, the canons of designing installations that interact with the architectural level can be subverted; an example of this is *Spaces that perform themselves*, a sound installation created by architect and media artist Nicole l'Huillier in 2017. In creating the work, she asks herself a question:

how does a kinetic architectural system change the way we think about and perceive sound? This project's objective is to create a new relationship between sound and space: currently, we generally build static spaces to contain dynamic sounds, but what if we start building dynamic spaces to contain dynamic sounds? By integrating kinetic behaviour as part of the performance of a space, one is able to give life to a container that morphs along with a musical piece: bringing to life an emerging aesthetic form of expression, augmenting the field of exploration that combines architecture, music, science and technology. (L'Huillier, 2017, p. 16)

The work consists in the creation of a cubic space, approximately 1.80 metres per side, suspended and without a bottom to allow a visitor to enter it. The inner faces of the cube, by means of a mechanical system, move thanks to the action of acrylic rods acting on the flexible walls (Ivi, p. 18), thus creating each time a completely different room from itself a few seconds earlier in response to sound stimuli. The aim of the work, according to its author, is to «present an architectural typology that re-configures itself and presents a multisensory scenario to perceive sound. "Spaces That Perform Themselves" is a project that will allow music to give shape to a dynamic room that is both alive and in constant flux: it moves, changes its geometry and size, breathes, feels and responds» (Ibid.).

In this way, even the physical structure of the room itself, and not only the sound, can take on the "fourth dimension" previously mentioned by Varèse, as it becomes capable of changing over time.

Sound sculptures, furniture and objects

One of the most prominent creators of Sound Sculptures in the second half of the 20th century is a renowned Italian-American designer.

Arieto Bertoia, known as Harry Bertoia emigrated as a young man from Udine (IT) to Detroit (USA), and after meeting Charles & Ray Eames and Florence Knoll (born Schust) – who were soon to establish themselves as the leading exponents of American Furniture Design of the period – he was to collaborate with them extensively; in 1952 he designed and produced for Knoll the *Diamond* chair, a comfortable and light seat made of thin but strong metal wires, which was extremely innovative for the time and immediately determined a huge success for its designer (Chmelar, 2010, p. 33).

Subsequently, he decided to leave his work as a designer and move to the countryside with his family to devote himself almost entirely to his sculptural works, while not overlooking the skillful metal manipulating experiences from which he was coming. On his early intuition of using metal rods as the source material (term that, in this case, can be under-

stood in both a structural and musical sense) for his works he states: «I accidentally struck one rod when I wanted to bend it. The sound echoed in my mind for a very long time. Then it initiated a deliberate gesture in search of understanding what a group of wires would do-and that process is still going on» (Bertoia, Marchal University, Art Gallery Catalog, 1977 – as cited in Schiffer, 2003, p. 177).

The sculptures he created as a result of this enlightenment are known as *Sonambient Sculptures* and consist mainly of three types: Rods (vertical rods), Singing bars (tubular bells) and Gongs (Chmelar, 2010, p. 51). The former are his most famous works, nothing more than a series of metal rods placed vertically, welded to a metal base, but instead left free to move at the upper end: and the sonic result depends on the number, length, mass and especially material of the rods.

The moment of touch is the one that activates the function of the structure, revealing both its bodily and sonic presence, making a highly valuable artifact contemporary and alive: the object thus loses its value as an untouchable sculpture in that context; the sonic element and its spatio-temporal mutation are thus revealed to be actually the very heart of the work (Cahill, 2018, p. 785).

The interaction between sound and object can take on many shapes, can be high-tech as well as low-tech, and can also have a more functional than expressive purpose: an example of the latter concept are pieces that could be defined as *Sounding furnitures*, that have been emerging in recent years, mostly as speculative or radical design exercises. An example of this current thread is the *Möbler som låter* (Audible Furniture) series of furniture by the Finnish designer Hemmo Honkonen; he created for research purposes a range of furniture (mostly seats and cabinets) that mechanically produces a sound when in interaction with a human being (Honkonen, 2022). The cabinets he designed produce a different sound – generated either by cymbals or by guitar strings tuned to a predetermined scale – every time the door is opened or closed, whereas the action of sitting on a chair or stool activates bellows which, like an accordion, play accordion-like reeds when sufficient pressure is produced, which then return to a resting position and therefore stop playing as soon as the person gets up (Ibid.).

Another possible way of presenting or understanding the intentional production of sound for communicative/design purposes is the one proposed in the *Sound Objects* exhibition curated by Marco Ferreri and Patrizia Scarzella (2009) at the Milan Triennale Museum, which, in retrospect, was in some ways a premonition of the dematerialisation that we would witness in the following decade of physical spaces and objects in favour of new virtual and interactive environments (Ivi, p. 11).

The main peculiarity of the exhibition, compared to the others usually displayed at the Triennale, is that it does not focus on the physical object, but instead on the sensation given by it; it is an exhibition in which there are no products to look at, but the objects are instead to be listened to – it is not their visual presence (or absence) that is important, but rather it is the listening that identifies them and relates us to them that is of significance (Ibid.). Hence the curators' choice to make the objects in the exhibition invisible, in order to remove any possible doubt as to how they should be experienced. *Sound Objects* attempted to propose pieces and objects that well defined our domestic (e.g. in the kitchen) or urban habitat (Ivi, pp. 25-28), and was also the first to raise the problem of defining the role of the sound-designer in the Italian context (Ivi, pp. 31-34), which is sometimes erroneously seen as a hybrid between a composer and a designer working in the field of cinema and not as a professional figure in its own right capable of spanning the disciplines, and it is because of its innovativeness that this exhibition is still unparalleled – at least on the Milanese scene – in its attempt to bring sound and design disciplines together, unconsciously laying the foundations for a complex discourse regarding who the sound-designer is and what role he or she plays.

These stimuli are useful expedients to make us approach the design of a space not in terms of square metres, partitions and functions, but rather by thinking of it in terms of experiences of environments capable of provoking emotions and reflections and which, due to their uniqueness and peculiarities, enjoy their own *Aura*, defined by Benjamin as the intangible authenticity enjoyed by a work derived from the fact of experiencing it *hic et nunc* – that is, at a given time and place – which cannot be equally reproduced in another context (Benjamin, 1936).

Design implications of artistic sound disciplines

Comparing experiences of architectural and interior design with musical and artistical ones, we also see some interesting points of discussion surface: first of all, sound is ephemeral, it ceases to exist as soon as the vibration that caused it ends. Music, understood in its fundamental meaning of «humanly organised sound» (Blacking, 1974) is set integrally in the sphere of time and unfolds its forms and patterns in it; the temporal dimension, on the other hand, is all too often ignored in the design and fruition of a space/object.

Furthermore, the role of the musician or composer within *Sound Art* works can help designers to transform their perception about the use of a space: the visitor does not necessarily have to be a passive user but can be

an active "performer" of his or her own spatial experience of a place, to actively shape it around one's own needs and desires.

The creation of a unique experience of fruition or interaction of a space by means of multisensory or multimedia elements, which does not necessarily have to be ostentatious and extravagant but can also be barely perceptible – suffice to mention the *Times Square* installation designed by Max Neuhaus in 1977, where a very light drone-sound came ceaselessly from a manhole cover in the homonymous square in New York, 24/7 for many years – can help us consciously re-inhabit spaces that have fallen into disuse or create new ones with more deliberate usages in this time of major insecurities.

In particularly, the function of sound installations in the urban environment has long been recognised, as they are able to create spaces that are perceived as interiors despite being in open air: by creating places that oscillate on the boundary between indoor and outdoor, they result in being "transitional" spaces in a psychophysical as well as political and cultural sense (Klein, 2009). However, a similar implementation can also be applied indoors: the use of sounds and non-design expedients that draw on contemporary arts can help us to create sub-spaces with well-defined roles and functions, but above all can enable the user to attribute permanent poetic meanings to a place or object through a unique and unrepeatable interactive experience.

In an era of uncertainty, it is therefore up to the designer to understand and embrace multidisciplinary contaminations in the sphere of sensory perception, also by making use of and investigating the potential of new technologies, as «The future of architecture depends on the interdisciplinary character of the discipline and the progressive, innovative ways in which it is practiced» (Borucka, 2014). The employment of artistic forms of expression can indeed help in the development of new design approaches that no longer begin with the individual designer or architect alone, but rather include the user and the community in the discourse on the evolution of design disciplines, in order to jointly reflect on the future functions of interiors and architecture (Ibid.).

Conclusions
Expanding future interior ecologies

This volume is the result of a process of observation and reflection on spaces that began precisely during the Covid-19 pandemic, when both individually and collectively important transformations, depending on the health situation, were forcefully observed in the living space of everyone on Earth.

Temporary, and in some cases permanent, transformations in the activities of individuals and in the way they use spaces and objects have initiated mutations in the relationship of everyone with the system of spaces-products-services of reference. During the pandemic and in its immediate aftermath, recurring themes emerged of vulnerability and uncertainty, which «frequently speaks to the influence of things that are unknown, unforeseen, and often unimaginable» (Tipene & Preston, 2021).

The theme was investigated here by considering uncertainty as an opportunity, since as exposed by the curators of the Spanish pavilion at the *17th Biennale di Architettura Exhibition* in Venice (2021), Domingo J. González, Sofía Piñero, Andrzej Gwizdala, Fernando Herrera: uncertainty is a tool that generates opportunities and an unquenchable source of resources. «Design, for example, is characterised by a certain level of uncertainty every time a new project is initiated. When uncertainty is accepted as an opportunity, as a resource that invites a higher abstraction, to enclose more variables (such as different disciplines) to leave the established path, that is when answers are reached for every situation». In this sense uncertainty can be read as «a cabinet of curiosities; a wide range of unorthodox objects not found in traditional conceptions of architecture (en. and probably design) that will lead us to explore new territories» (Dejtiar quoting *Biennale's* website, 2021).

The contribution therefore focused on the issues of sustainability, flexibility and perception in an attempt to describe how the complex and

accelerating changes in our environmental, economic and social spheres will affect and transform the relationship of design with the domestic sphere, enclosed in the private spaces of the home, and with the collective dimension of public spaces that are shared on a daily basis. Above all, the contribution trying to explore the approaches, strategies and processes of generating sustainable and flexible future interiors.

Certainly, the current condition of uncertainty continues to redefine the spheres of intervention of design and to question certain consolidated practices of life, such as the way of carrying out work activities, the relationship with a system of objects and services, the times of rest and leisure, the possibility of travelling and meeting, but also certain design practices focused on customised design, hyper specialization, consumption and waste of depleting resources and raw materials.

In this scenario, an ecological approach can help identify new ways forward, according to the Belgian philosopher Isabelle Stengers, quoted by Gini Lee «ecology of practices can aid in the transformation of old to new creative practices through articulation rather than replacement» (Lee, 2010).

The period of crisis, which seems to be the only current certainty, then becomes an opportunity to initiate an eco-systemic, strategic and processual transition processes towards a development that is concretely and ethically sustainable in environmental, social, and economic terms.

This means being aware that «the design of a domestic object is but the molecular dimension of this energy (en. energy of transformation of the world) and as such contributes to modifying the space of the world», as affirmed by Andrea Branzi[1] (Cattaneo, 2023, p. 82).

Indeed, in the current condition it has become fundamental to understand the interdependence of processes, in and out of the design field, as well as the multi-species coexistence, the climate variable, the value and role of nature, and even the perception and the participation of everyone in complex networks. This means making choices regarding the relationship with the natural environment and the species with which individuals share the planet, as well as rethinking the role of the human species, shifting from a human-centric vision to a bio-centric vision, as predicted by Andrea Branzi in *Per una nuova Carta d'Atene* (2010; 2022).

Transition requires taking the risk of experimenting with innovative design processes and new implementation methodologies, which allow for

1. Translation from orig.: «Il progetto di un oggetto domestico non è che la dimensione molecolare di queste energia (n.d.r. energia di trasformare il mondo) e come tale concorre a modificare lo spazio del mondo». Andrea Branzi in *Andrea Branzi E=mc²*. *Il Progetto nell'Epoca della Relatività*, p. 82 (Cattaneo, 2023).

the conception and equipping of systems of spaces that can accommodate changing behaviour during the life cycle of the space.

Solutions, in fact, have been replaced by strategies and tactics (Brooker et al., 2019), as well as processes that allow governing the mutability of situations by promoting adaptability and flexibility in an archipelago of possible interiors yet to be designed.

The new adaptive dynamics should consider the entire life cycle of products and space-product-service systems from a circular perspective. Individual strategies and tactics can be integrated to promote restorative and, above all, regenerative approaches that can take care of the environment as well as the species that inhabit it, seeking to contribute to a positive impact on ecosystems. This means works on design sustainable strategies as well as on narrative paths and responsive experiences, accessible to the majority of individuals. In addition, the transition necessitates the conception and use of new materials and the exploration of unpredictable aesthetic scenarios that emphasise responsibility and equity in the use of resources.

Thus, «engaging in risky thought and action promotes invention and an ecology of practice made visible as a collaboration between different domains» (Lee, 2010). All this makes it possible to explore the extraordinary capacity of spatial design, as a field of study, to interpret the permeable and porous edges of interiors by considering physical and temporal issues and additionally various social, cultural, emotive, but also technical and material exchanges between the design and complex systems of spaces-products-services (Tipene & Preston, 2021).

The outputs that will emerge in the future will probably not be linear and will be an expression of multiple paths of research and speculation, however, according to what Gini Lee predicted in 2010: «If future existence is predicated on rapidly altering and dematerialising material and political environments, then interiors that embrace and demonstrate risk and relational thinking predicated on an ecological turn, offer a critical perspective on the transformation of spatial and material worlds» (Lee, 2010).

Additionally, the interior designer should not overlook the fact that at times the way a space is perceived is of greater importance than the physical characteristics of the space itself. In times of crisis, it is particularly important to feel at ease in the spaces one lives and uses, which can be summarised in terms of ensuring privacy in private spaces and encouraging interactions in public spaces. The perception of an interior space proceeds along two parallel but interconnected paths: one is the measurable, scientifically tangible one, the other is the immaterial sphere, consisting of subjective sensations; the clever use of colour to define func-

tions, the judicious choice of materials, the improvement of auditory characteristics and air quality are elements that are part of both these realms, which are often considered as secondary characteristics in a project but should instead be treated a priori as they influence the psychological, physical and cultural well-being of the user in an all-round way.

Similarly, the relationship with new intelligent technologies, multimedia devices and contemporary arts, digital or otherwise, should also be integrated and addressed in the project from the earliest stages and not instead considered a fleeting juxtaposition in the final stages of realisation; the designer or architect is therefore expected to take on some new demanding tasks in the present day, such as keeping up to date with rapid technological advancements, and developing the cultural tools to judge, utilise or disregard these after careful consideration of both their potential and/or shortcomings.

Understanding and deepening the relationship with new arts and technologies can lead the designer to the development of a design-approach that is open to contaminations with other disciplines, in order to foster lateral thinking that could help in dealing with complex implementation issues, with the ultimate goal of applying the same attention to the material and immaterial elements of a place.

Taking inspiration from different planning and production methodologies than those of interiors can contribute to conquering new extra-spatial realms; just as happened to music which, having always been considered an art of time, over the course of the 20th century progressively conquered the dimension of space (Quinz, 2019, p. 114), it is now up to design disciplines to explore new topics that would defy conventional paradigms in order to innovate the field and provide new tools for being better equipped in the upcoming times of uncertainty. The inter- and multi-disciplinary approach, as analysed in some case studies in paragraph 3.2, provides us with the opportunity to create perceptual experiences of the use of an object or the living of a space that are barely perceptible, unobtrusive or, on the contrary, very invasive and overpowering; it is therefore necessary for the designer to understand how and when to create a simple or complex, natural or artefactual perceptual experience that is commensurate and coherent with the end function of the space being shaped.

Understanding and studying contemporary artistic forms, such as digital ones, in particular, can help the designer realise how cohesive experiences can be generated precisely from the perception of the object or space, and not from constructive or technical characteristics; the long-standing question of the prevalence of the role of aesthetics versus functionality in architecture and interiors can therefore only benefit from such

insights: contemplating the spatial peculiarities of seemingly distant or abstract disciplines can indeed provide new tools to understand how multisensory perception is not simply a decorative quirk, but rather a central functional component of the human being's relationship with the built and other environments.

In conclusion, the ability of designers to read "everyday micro phenomena", transformations and evolutions in processes, and even pick up the "weak and diffuse signals", long investigated on Branzi's instructions, and that even in the condition of perpetual uncertainty can be traced, will make it possible to recognize «interiors as unbounded and undefined – more as actions than as forms – constructed from constellations of relations and interactivities» (Tipene & Preston, 2021).

All this will make it possible to explore those undefined situations, still fluid, that can concretely promote «the *planetary coexistence* between man and animals, between technologies and divinities, between the living and the dead', to define cities, future interiors landscapes, as places of *cosmic hospitality*» (Branzi, 2010).

References

Ahmed, N., Barnett, P., Greenburgh, A., Pemovska, T., Stefanidou, T., Lyons, N., … & Johnson, S. (2023). Mental health in Europe during the COVID-19 pandemic: a systematic review. In *The Lancet Psychiatry Review*, 10 (7), 537-556. https://doi.org/10.1016/s2215-0366(23)00113-x

Alnaser, W., Ghanem, A., Alnaser, N., Alaraibi, Q. & Alshaikh, F. (2020). The Null Effect of UVC Ceiling Light Exposure on SARS-CoV2. In *Health*, 12, 1481-1495. https://doi.org/10.4236/health.2020.1211108.

Amaducci, A. (2019). Prime luci elettroniche: le tante origini delle videoarte. In Balzola, A., & Monteverdi, A. M. (Eds.), *Le arti multimediali digitali: Storia, tecniche, linguaggi, etiche ed estetiche del nuovo millennio* (3rd ed.). Garzanti, Milano.

Ambasz, E. (1972). *Italy: The New Domestic Landscape*. Museum of Modern Art, New York.

Amorim, J. P., & Teixeira, L. (2020). Art in the Digital during and after Covid: Aura and Apparatus of Online Exhibitions. In *Rupkatha Journal on Interdisciplinary Studies in Humanities*, 12 (5). https://doi.org/10.21659/rupkatha.v12n5.rioc1s1n2

Antonelli, P., & Rawsthorn, A. (2022). *Design Emergency: Building A Better Future*. Phaidon, New York.

Antonelli, P., & Tannir, A. (2019). *Broken Nature. Design Takes on Human Survival*. Electa, Milano.

Anzani, A., & Scullica, F. (Eds.) (2022). *The City of Care*. Springer Series in Design and Innovation, 26. Springer, London. https://doi.org/10.1007/978-3-031-14608-4_3

Arribatec Hospitality (2023). *Striking a balance: self-service vs the human touch*. Arribatec. Retrieved March, 2024, from: https://hospitality.arribatec.com/striking-a-balance-between-tech-and-human-touch/#

Assumma, V., & Bonini, S. (2020). *Il business ibrido resterà nel post-Covid*. Pambianco News Hotellerie. Retrieved March, 2024, from: https://hotellerie.pambianconews.com/2021/07/19/il-business-ibrido-restera-nel-post-covid/

Atelier LUMA (2023). *Bioregional Design Practices – Pratiques de design bioregional*. Atelier LUMA, Arles.

Augé, M. (1992). *Non-lieux. Introduction à une anthropologie de la surmodernité*. SEUIL, Paris.

Aulisio, A., Barbero, S., & Pereno, A. (2023). Design Research towards socio-technical complex systems: A designerly systemic impact of Tourism value-chain. In *What Got Us Here, Won't Get Us There*, *Proceedings of the International Conference of the European Academy of Design*, 19 October 2023, 759-770, Helsinki.

Awasthi, A. & Awasthi, C. (2021). Post-Covid-19: Hospitality and F&B Operations Adapting to a New Reality. *Proceedings of 5th international i-Host conference*. Retrieved March, 2024, from: www.researchgate.net/publication/355701456

Balducci, A. (Ed.) (2023). La città invisibile. Quello che non vediamo sta cambiando le metropoli. In *57° Annale della Fondazione Giangiacomo Feltrinelli*. Fondazione Feltrinelli, Milano.

Balzola, A., & Monteverdi, A. M. (2004). *Le arti multimediali digitali: storia, tecniche, linguaggi, etiche ed estetiche delle arti del nuovo millennio*. Garzanti Libri, Milano.

Bar, H. (2021). COVID-19 lockdown: animal life, ecosystem and atmospheric environment. In *Environment, Development and Sustainability*, 23, 8161-8178. Springer, London. https://doi.org/10.1007/s10668-020-01002-7

Barbara, A., & Perliss, A. (2023). *Invisible architecture*. FrancoAngeli, Milano. https://doi.org/10.3280/oa-1073

Barber, D.A. (2020). *Modern Architecture and Climate: Design before Air Conditioning*. Princeton University Press, Princeton.

Bassanelli, M. (Ed.) (2020). *Luoghi e modi dell'abitare, dalla pandemia in poi*. LetteraVentidue, Siracusa.

Bassanelli, M. (2022). *Abitare oltre la casa. Metamorfosi del domestico*. DeriveApprodi, Roma.

Bassanelli, M., & Sacchetti, V. (Eds.) (2023). Post-Domestic Revolution. In *PAD #25 – Post-Domestic Habitat*, 16(1), 6-17. AIAP, Milano.

Bassoli, N. (2020). *Lockdown Architecture. Architettura e Pandemia. Quaranta Lettere per Lotus*. Editoriale Lotus, Milano.

Bassoli, N. (Ed.) (2023). *Home Sweet Home*. Mondadori Electa, Milano.

Batchelor, D. (2000). *Chromophobia*. Reaktion Books, London.

Bateson, G. (1972). *Steps to an Ecology of Mind*. Chandler, New York.

Battistoni, C., Giraldo Nohra, C., & Barbero, S. (2019). A Systemic Design Method to Approach Future Complex Scenarios and Research Towards Sustainability: A Holistic Diagnosis Tool. In *Sustainability*, 11, 4458-4488. MDPI, Basel. https://dx.doi.org/10.3390/su11164458

Belford, L. (2021). *Toward Listening as a Curatorial Method: Histories, Methodologies, Propositions*. Doctor of Philosophy thesis in Art History, University of Toronto, 2021. Retrieved March, 2023, from: https://tspace.library.utoronto.ca/bitstream/1807/104976/4/Belford_Liora_202103_PhD_thesis.pdf

Bellato, L., Frantzeskaki, N., & Nygaard, C. A. (2022). Regenerative tourism: a conceptual framework leveraging theory and practice. In *Tourism Geographies*, 25(4), 1026-1046. Taylor & Francis, London. https://doi.org/10.1080/14616688.2022.2044376

Benjamin, W. (1936). *Aura e Choc – Saggi sulla teoria dei Media*. Einaudi, Torino. (Filippini, E., Italian translation 2012)

Benjamin, W. (1936). *L'opera d'arte nell'epoca della sua riproducibilità tecnica*. Einaudi, Torino. (Pinotti, A., & Somaini, A., Italian translation 2014)

Benyus, J.M. (1997). *Biomimicry: Innovation Inspired by Nature*. Perennial, New York.

Bernardi, M., Cognetti, F., & Delera, A. (2021). *Di-stanza: la casa a Milano in tempi di Covid-19*. LetteraVentidue, Siracusa.

Bersano, G. (2019). *Post-Design*. Meltemi, Milano.

Bertola, P., & Manzini, E. (2004). *Design Multiverso. Appunti di fenomenologia del design*. Edizioni POLI.design, Milano.

Besch, K. (2005). Product-service systems for office furniture: barriers and opportunities on the European market. In *Journal of Cleaner Production*, 13(10-11), 1083-1094. Elsevier, Amsterdam. https://doi.org/10.1016/j.jclepro.2004.12.003

Bishara, M. (2023). The world after the Ukraine war. *Al Jazeera*. Retrieved March, 2024, from: www.aljazeera.com/opinions/2023/2/20/the-world-after-the-ukraine-war

Bistagnino, L. (2011). *Design Sistemico, progettare la sostenibilità produttiva e ambientale*. Slow Food Editore, Bra.

Bituin Eriksson, A.V. (2021). *For sustainable transformation, education must address how to live responsibly*. Retrieved March, 2024, from: www.sei.org/features/education-for-sustainable-lifestyles/

Blacking, J. (1974). *How Musical is man?*. University of Washington, Seattle.

Blauert, J. (1996). *Spatial hearing: the psychopysics of human sound localization*. MIT Press, Cambridge MA. https://doi.org/10.7551/mitpress/6391.003.0001

Boehnert, J. (2018). *Design, Ecology, Politics: Towards the Ecocene*. Bloomsbury, London.

Borucka, J. (2015). Sound art and Architecture: New Horizons for Architecture and Urbanism. In *Procedia – Social and Behavioral Sciences*, *174*, 3903-3908. https://doi.org/10.1016/j.sbspro.2015.01.1131

Bosoni, G., Rebaglio, A., & Scullica, F. (2012). *The Contemporary Interior Landscape*. Abitare, Milano.

Bradbury, A., Warran, K., Mak, H.W. & Fancourt, D. (2021). *The Role of the Arts during the COVID-19 Pandemic*. UCL, London. Retrieved March, 2024, from: www.artscouncil.org.uk/sites/default/files/download-file/UCL_Role_of_the_Arts_during_COVID_13012022_0.pdf

Braidotti (2013). *The Posthuman*. Polity Press, Cambridge.

Branzi, A. (2010). "Interni", voice definition in *Enciclopedia Treccani*. Retrieved March, 2024, from: www.treccani.it/enciclopedia/interni_%28XXI-Secolo%29/

Branzi, A. (2010). *Per una nuova Carta d'Atene*. Manifesto presented at 12th Biennale di Architettura Exhibition, Venezia.

Branzi, A. (2022). *Interni o esterni. Per una nuova Carta d'Atene*. Libri Scheiwiller, Milano.

Brooker, G. (2016). *Adaptation strategies for interior architecture and design*. Bloomsbury Visual Arts, London.
Brooker, G. Harriss, H., & Walker, K. (Eds.) (2019). *Interior Futures*. Crucible Press, Yountville.
Brooker, G., & Stone, S. (2010). *What is interior design?*. RotoVision Books, Mies.
Brooks, A.C. (2023). *Come disimparare a vivere in solitudine*. Internazionale. Retrieved March, 2024: www.internazionale.it/opinione/arthur-c-brooks/2023/01/14/vivere-solitudine-covid
Brower, T. (2021). *The Secrets to Happiness at Work: How to Choose and Create Purpose and Fulfillment in Your Work*. Simple Truths, New York.
Brownell, B. (2022). *The Pandemic Effect. Ninety Experts on Immunizing the Built Environment*. Princeton Architectural Press, New York.
Cacciari, P. (2016). *101 piccole rivoluzioni. Storie di economia solidale e buone pratiche dal basso*. Altreconomia, Milano.
Caffo, L. (2022). *Velocità di fuga. Sei parole per il contemporaneo*. Einaudi, Torino.
Cahill, Z. (2018). Notes on Nonsculpture Sculpture: Figures of Sonic and Mirrored Infinity. In *Critical Inquiry*, 44 (4). The University of Chicago Press, Chicago. Retrieved March 2023, from: www.journals.uchicago.edu/doi/abs/10.1086/698185
Camocini, B. (2016). *Adapting reuse. Strategie di conversione d'uso degli interni e di rinnovamento urbano*. FrancoAngeli, Milano.
Camocini, B., & Dominoni A. (2022). *Engaging Spaces. How to increase social awareness and human wellbeing through experience design*. FrancoAngeli, Milano.
Camocini, B., & Fassi, D. (Eds.) (2017). *In the Neighbourhood. Spatial Design and Urban Activation*. FrancoAngeli, Milano.
Camocini, B. & Vergani, F. (Eds.) (2021). *From Human-centered to More-than-Human-Design*. FrancoAngeli, Milano.
Canepa, S. (2023). Diaframmi, arredi, sistemi. Per una casa flessibile. In Bassanelli, M., Forino, I. Lanini, L., & Lucchini, M. (Eds.) *Per una Nuova Casa Italiana. Prospettive di ricerca e di progetto per la post-pandemia*. Pisa University Press, Pisa.
Capanna, A. (2009). Music and Architecture: A Cross between Inspiration and Method. In *Nexus Network Journal*, 11(2), 257-271; Springer, London. https://doi.org/10.1007/s00004-008-0092-z
Cattaneo C., E. (Ed.) (2023). *Andrea Branzi E=mc2. Il Progetto nell'epoca della relatività*. Actar Publishers, Barcelona.
Ceschin, F., & Gaziulusoy, İ. (2016). Design for Sustainability: An Evolutionary Review. In Lloyd, P., & Bohemia, E. (Eds.) *Future Focused Thinking*, *DRS International Conference*, 27-30 June 2016. Brighton.
Ceschin, F., & Gaziulusoy, İ. (2016). Evolution of design for sustainability: From product design to design for system innovations and transitions. In *Design Studies*, vol. 47, 118-163.
Ceschin, F., & Gaziulusoy, İ. (2020). *Design for Sustainability: A Multi-level Framework from Products to Socio-technical Systems*. Routledge, London.

Challener, C. (2021). *How Covid-19 is influencing trends in painting colors*. American Coatings Association – Coatings Xperience. Retrieved July, 2021, from: www.paint.org/coatingstech-magazine/articles/how-covid-19-is-influencing-trends-in-paint-colors/

Chaney, P., & Jones, I. (2022). *Civil society in an age of uncertainty: Institutions, Governance and Existential Challenges*. Policy Press, Bristol UK.

Chayka, K. (2020). How the Coronavirus Will Reshape Architecture. *The New Yorker*. Retrieved March, 2024, from: www.newyorker.com/culture/dept-of-design/how-the-coronavirus-will-reshape-architecture

Chmelar, A. (2010) *Integrating the Senses: an Architecture of Embodied Experience*. M. Sc. thesis in Architecture, University of Cincinnati. OhioLink Electronic Theses and Dissertations Center, Cincinnati. Retrieved March, 2023, from: http://rave.ohiolink.edu/etdc/view?acc_num=ucin1275666649

Chomsky N., Derber, C., Moodliar, S., & Shannon, P. (Eds.) (2019). *Internationalism or Extinction*. Routledge, London.

Ciotti, F., & Roncaglia, G. (2000). *Il mondo digitale – Introduzione ai nuovi Media*. Editori Laterza, Roma.

Ciravegna, E., Formia, E., Gianfrate, V., Sicklinger, A. & Zannoni, M. (2022). *Proceedings of the 8th International Forum of Design as a Process – DIID*. Bologna University Press, Bologna.

Ciravegna, E., Giardina, C., & Pletto, D. (2023). There's No Plan(et) B. Sustainable Transitions to Systemic Planet-Centric Design in Disrupting Geographies in the Design World. In *Proceedings of the 8th International Forum of Design as a Process – DIID*, 1, 30-39. Bologna University Press, Bologna. https://doi.org/10.30682/diiddsi23t1a

Clement, G., Rahm, P., & Borasi, G. (Eds.) (2006). *Environ(ne)ment: Manieres d'Agir Pour Demain / Approaches for Tomorrow*. CCA, Montreal; Skira, Milano.

Coccia, E. (2021). *Filosofia della casa: lo spazio domestico e la felicità*. Einaudi, Torino.

Collina, L. (2005). *Design e metaprogetto: Teorie, strumenti, pratiche*. Edizioni POLI.design, Milano.

Collina, L. (2015). Flexible living. In Vercelloni, M. (Ed.), *Temporary Living. Ideas, projects, solutions for the Expo Village* (29-38). Mondadori, Milano.

Comella Darda, S., Gard, L., Thareja, S. & Vasquez-McCall, B. (2020). *Revisiting agile teams after an abrupt shift to remote*. McKinsey & Company – organization practice. Retrieved May, 2021, from: www.mckinsey.com/business-functions/organization/our-insights/revisiting-agile-teams-after-an-abrupt-shift-to-remote

Comelli, E. (2024). Clima, 2023 anno più caldo di sempre. Ma nel 2024 potrebbe andare peggio. *Il Sole 24 Ore*. Retrieved March, 2024, from: www.ilsole24ore.com/art/clima-2023-anno-piu-caldo-sempre-ma-2024-potrebbe-andare-peggio-AFAO1AIC

Comes, F. (2018) *Architettura e Musica – dall'antica Grecia al primo Novecento*. Editrice ZONA, Genova. Retrieved March, 2023, from: www.academia.edu/39004316/Architettura_E_Musica_2018_Editrice_ZONA

Comoglio, G. (2023). *Stefano Mancuso: L'intelligenza delle piante chiede l'audacia dei progetti*. Domus web. Retrieved March, 2024, from: www.domusweb.it/en/architecture/2023/06/15/stefano-mancuso-the-intelligence-of-plants-calls-for-the-boldness-of-projects.html

Corà T., Fazio L., & Collura, F. (2023). *Futures by Design*. Guerini Editore, Milano.

Corbellini, G. (2020). Senza avanzi non si avanza. Per un'ecologia del discorso sulla sostenibilità in architettura / The Surplus Value of Surpluses: For an Ecology of the Debate About Sustainability in Architecture. In *Ossigeno,* Elements of Life, 7, 128-139. Nutsforlife, Faenza.

Corbellini, G. (2016). La sega giapponese. in *Viceversa*, Padiglione Italia, n. 5/2016, 58-75.

Corso, M. (2020*). Smart working during the time of the Coronavirus*. Politecnico di Milano – School of Management. Retrieved May, 2021, from: www.som.polimi.it/en/smartworking-during-the-time-of-the-coronavirus/

Cramer, J. (2022). *Building a Circular Future. Ten Takeaways for Global Changemakers.* Retrieved March, 2024, from: https://circulareconomy.europa.eu/platform/sites/default/files/building-a-circular-future-jacqueline-cramer-amsterdam-economic-board.pdf

Cremascoli, R. (2023). *Amicizia sociale incontrarsi nel giardino.* Skira, Milano.

Crespi, L. (2013). *Da spazio nasce spazio. L'interior design nella trasformazione contemporanea*. Postmedia Books, Milano.

Crespi, L. (Ed.) (2017). *Design Innovations for Contemporary Interiors and Civic Art*. IGI Global, Hershey PA.

Crespi, L. (Ed.) (2021). *Design of the Unfinished. A New Way of Designing Leftovers Regeneration*. Springer, London.

Crespi, L. (2023). *Design del non-finito: l'interior design nella rigenerazione degli avanzi*. Postmedia Books, Milano.

Crutzen, P., & Stoermer, E. (2000). The Antropocene. In *Global Change Newsletter*, 41, 17-18. IGBP.

Cucinella, M. (2022). *The Future Is a Journey to the Past. Ten Stories About Architecture*. Quodlibet, Macerata.

Cushman & Wakefield (2020). *Demographic Shifts: the world in 2030 Report*. Retrieved March, 2024, from: www.cushmanwakefield.com/en/insights/demographic-shifts-the-world-in-2030

Davidová, M., & Zavoleas, Y. (2020) Post-Anthropocene: The Design after the Human Centered Design Age. In Holzer, D., Nakapan, W., Globa, A., Koh, I. (Eds.), *RE: Anthropocene, Design in the Age of Humans – Proceedings of the 25th CAADRIA Conference*, 2, 203-212. Chulalongkorn University, Bangkok TH.

Dejtiar F. (2021). *Uncertainty, The Spanish Pavilion in the 2021 Biennale of Venice: Is Uncertainty Our Only Certainty?.* ArchDaily. Retrieved April, 2024, from: www.archdaily.com/961733/uncertainty-the-spanish-pavilion-in-the-2021-biennale-of-venice-is-uncertainty-our-only-certainty

De Rosa A., & Galluzzo L. (2024). Aesthetics of Design for Social Innovation. Pathways for a Dialogue with Everyday Aesthetics. In Zanella, F., Bosoni, G., Di Stefano, E., Iannilli, G.L., Matteucci, G., Messori, R., & Trocchianesi, R.

(Eds.), *Multidisciplinary Aspects of Design. Objects, Processes, Experiences and Narratives*; Springer Series in Design and Innovation, 37, 485-492. Springer, London.

Dominoni, A., & Scullica F. (Eds.) (2022). *Designing Behaviours for well-being spaces. How disruptive approaches can improve living conditions*. FrancoAngeli, Milano.

Dümen, A.Ş., Koyaz, M., & Çeliker-Cenger, Y. (2022). Unfolding the material: A proposal of a multi-sensory experience oriented material exhibition medium. In *Materials & Design*, 219. Elsevier, Amsterdam. https://doi.org/10.1016/j.matdes.2022.110740

Dunne A., & Raby F. (2013). *Speculative Everything: Design, Fiction and Social Dreaming*. MIT Press, Cambridge MA.

Elgani, E. (2024 forthcoming). *Redefining priorities in the design of spaces for hospitality. Interior design strategies for sustainable contract design*. Proceedings of SID Conference, Pescara.

Elgani, E., Caldarella, R., Ettori, G., Grasso, D., & Schembri E. (2024 forthcoming). Regenerative Spaces for Hospitality. Exploring innovative design strategies for sustainable tourism experiences. [Unpublished Manuscript]. In *Proceedings of EIMAD'24 – International Meeting of Research in Music, Arts and Design*, 27-29 June 2024. Castelo Branco, Portugal.

Ellen MacArthur Foundation (2013). *Towards the Circular Economy Vol. 1: an Economic and Business Rationale for an Accelerated Transition*. Retrieved March, 2024, from: www.ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an

Ellen MacArthur Foundation (n.d.). *Design and the circular economy – deep dive: Circular Design Guide*. Retrieved March, 2024, from: www.ellenmacarthurfoundation.org/circular-design-guide/overview

Elnaggar, H.B. (2017). Heritage Resources as a Method to Reviving the identity of contemporary Interior Designs: a comparative analysis of users' preferences of interior space. In *Proceedings of 1st international conference on Cities Identity through Architecture and Arts*, 1(1), 8. ARCHive-SR. https://doi.org/10.21625/archive.v1i1.109

Eno, B. (1978). *Linear Notes From the Initial American Release of "Music for Airports / Ambient 1"*. PVC 7908 (AMB 001). Retrieved March, 2023, from: http://music.hyperreal.org/artists/brian_eno/MFA-txt.html

Egenhoefer R. B. (Ed.) (2018). *Routledge Hanbook of Sustainable Design*. Routledge, London.

Ercakmak, U.B., & Yorukoglu, P.N.D. (2020). Indoor soundscaping and its applicability in architectural practice. In *Forum Acusticum* convention, Lyon FR (1465-1469). https://doi.org/10.48465/fa.2020.0628

Erfani, G., & Bahrami, B. (2022). COVID and the home: the emergence of new urban home life practised under pandemic-imposed restrictions. *Cities & Health*, *7*(4), 548-555. https://doi.org/10.1080/23748834.2022.2029241

EU (2020). *A new Circular Economy Action Plan or a Cleaner and more competitive Europe*. Retrieved April, 2024, from: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0098

EU (2023). *The reference document for the Construction sector*. Retrieved from: https://susproc.jrc.ec.europa.eu/activities/emas/construction.html

European Commission (2020). *In focus: Energy efficiency in buildings*. Retrieved March, 2024, from: https://commission.europa.eu/news/focus-energy-efficiency-buildings-2020-02-17_en

Faré, I., & Piardi, S. (2003). *Nuove specie di spazi*. Liguori Editore, Napoli.

Fassi, D. & Manzini, E. (2022). Project-based communities: lessons learned from collaborative city-making experiences. In *CoDesign*, 18(1), 4-15. Taylor & Francis, London. https://doi.org/10.1080/15710882.2021.2001535

Fassi, D., & Scullica, F. (Eds.) (2008). *The hospitable city*. Maggioli Editore, Santarcangelo di Romagna.

FederlegnoArredo Plus, & Fondazione Symbola (2023). *La Sostenibilità al centro*. Greenitaly 2023. Retrieved March, 2024, from: www.federlegnoarredo.it/it/federazione/la-sostenibilita-al-centro/ecomondo-2023/greenitaly-2023

Feld, S. (2012). *Sound and Sentiment: Birds, Weeping, Poetics, and Song in Kaluli Expression* (3rd ed). Duke University Press, Durham.

Felix, M.N., & Elsamahy, E. (2016). Visualizing Music Compositions in Architectural Conceptual Design. *Proceedings of the first international conference Rethinking Architectural Education*, 2016. Retrieved from: www.researchgate.net/publication/298405364_visualizing_music_compositions_in_architectural_conceptual_design

Ferreri, M., & Scarzella, P. (2009) *Oggetti Sonori: La Dimensione Invisibile del Design*. Mondadori Electa, Milano.

Findeli A. (2001), Rethinking Design Educaton for the 21st Century: Theoretical, Methodological, and Ethical Discussion. In *Massachusetts Institute of Technology Design Issues*, 17(1), 5. MIT Press, Cambridge MA.

Findeli A. (2018). The Metamorphosis of the Designer: A Prerequisite to Social Transformation by Design. In *Un/Certain Futures – Rollen des Designs in gesellschaftlichen Transformationsprozessen*, 103–114. Transcript Verlag, Bielefeld, 272.

Findeli, A., & Bousbaci, R. (2005). L'éclipse de l'object dans les théories du projet en design. In *Design-Système-Évolution – 6ième colloque international et biennal de l'Académie européenne de design (European Academy of Design, EAD)*, 29-31 March 2005. Brême, Germany.

Finessi, G. (2016). *Stanze. Altre filosofie dell'abitare – Rooms. Novel Living Concepts*. Marsilio, Venezia.

Finizio, M. (2022). Il Covid spinge verso i centri minori e accelera la fuga dalle grandi città, *Il Sole 24 Ore*. Retrieved January, 2024, from: www.ilsole24ore.com/art/il-covid-spinge-i-centri-minori-e-accelera-fuga-grandi-citta-AE7KJIWB

Fitz, A. & Krasny, E. (2019). *Critical Care. Architecture and Urbanism for a Borken Planet*. MIT Press, Cambridge MA.

FleishmanHillard (2022). *The Togetherness Economy Report*. Retrieved March, 2024, from: https://fleishmanhillard.com/wp-content/uploads/2022/06/The-Togetherness-Economy-Report.pdf

Flores, R., & Prats, E. (2020). *Sala Beckett. International Drama Centre*. Arquine, Barcelona.
Fondazione Symbola, Deloitte Private, & POLI.design (2023). *Design Economy 2023*. Quaderni di Symbola, Roma.
Fondazione Symbola, & Unioncamere (2023). *GreenItaly, 2023*. Quaderni di Symbola, Roma.
Fondazione Symbola, Deloitte Private, POLI.design, & ADI (2024). *Design Economy 2024*. Quaderni di Symbola, Roma.
Forino, I. (2011). *Uffici. Interni, arredi, oggetti*. Einaudi, Torino.
Forino, I., & Bassanelli, M. (2021). From the office to the post-pandemic worksphere. In *Compasses*, 36(1), 25-32. E.Built srl, Napoli.
Forlano, L. (2017). Posthumanism and Design. In *She Ji: The Journal of Design, Economics, and Innovation*, 3(1), 16-29. Elsevier, Amsterdam.
Forsyth, M. (1985) *Buildings for Music: The Architect, the Musician, and the Listener from the Seventeenth Century to the Present Day*. MIT Press, Cambridge MA.
Franklin K. & Till C. (2018). *Radical Matter*. Thames & Hudson, New York.
Fromm, E. (1964). *The Heart of Man: its genius for good and Evil*. Harper & Row, New York.
Galante, F., & Sani, N. (2000). Musica espansa – Percorsi elettroacustici di fine millennio. In *Le Sfere – Collana di studi musicali*. LIM editrice, Lucca; Ricordi, Milano.
Galimberti, U. (2023). *La responsabilità del cambiamento per il benessere delle persone*. Lectio Magistralis 14 Dec. 2023; Green Building Council Conference, Roma.
Galloway, S. (2020). *Post corona*. Bantam Press, London.
Gaziulusoy, İ., Veselova, E., Hodson, E., Berglund, E., Erdogan Öztekin, E., Houtbeckers, … Ferreira Litowtschenko, M. (2021). Design for Sustainability Transformations: A 'Deep Leverage Points' Research Agenda for the (Post-) pandemic Context. In *Strategic Design Research Journal*, 14(1), 19-31. UniSinos, São Leopoldo BR. https://doi.org/10.4013/sdrj.2021.141.02
Gerosa, G., & Manciaracina, A. (2023). *Multiple-scalarities. Environmental systems as a combination of interior design, services, communication and technologies*. FrancoAngeli, Milano.
Giammetta, R. (2020). *Il vintage è conforto ma anche paralisi*. Interni Magazine. Retrieved March, 2024, from: www.internimagazine.it/approfondimenti/opinioni/nostalgia-vintage
Gianni, R., Pearson, J., & Reber, B. (2019). *Responsible Research and Innovation: from concepts to practices*. Taylor & Francis, London.
Giovara, B. (2020). Boeri "Via dalle città nei vecchi borghi c'è il nostro futuro". *La Repubblica*. Retrieved March, 2024, from: www.repubblica.it/cronaca/2020/04/20/news/coronavirus_boeri_via_dalle_citta_nei_vecchi_borghi_c_e_il_nostro_futuro2-301026866/
Goodwin, H. (2011). *Taking Responsibility for Tourism*. Goodfellow Publishing Ltd, Oxford.

Grant, J., Matthias, J., & Prior, D. (Eds.) (2021). *The Oxford Handbook of Sound Art*. Oxford University Press, Oxford. https://doi.org/10.1093/oxfordhb/9780190274054.002.0006

Gregotti, V. (Ed.) (1979). *Rassegna. Problemi di architettura dell'ambiente (Recinti).* 1(1), december. Editrice CIPIA, Bologna.

Hahn, J. (2020). Artemide unveils Integralis ultraviolet technology that transforms lights into sanitisers. *Dezeen*. Retrieved March, 2024, from: www.dezeen.com/2020/08/20/artemide-integralis-uv-light-coronavirus/

Han, B.C. (2017). *In the Swarm: Digital Prospects*. MIT Press, Cambridge, MA.

Hancz, P. (2023) *Contactless doesn't mean humanless: hospitality technology & the human touch.* Apaleo. Retrieved March, 2024, from: https://apaleo.com/blog/industry-trends/contactless-does-not-mean-humanless-hospitality-technology

Haraway, D.J. (2016). *Staying with the trouble: making kin in the Chthulucene*. Duke University Press, Durham.

Hasegawa, Y., & Lau, S. (2021). Audiovisual bimodal and Interactive effects for soundscape design of the indoor environments: A Systematic review. *Sustainability*, 13(1), 339. https://doi.org/10.3390/su13010339

Heidegger, M. (1954). Bauen, Wohnen, Denken. In *Vorträge und Aufsätz*e, Pfullingen (145-162). (Italian translation *Saggi e Discorsi*, 1976, 97-108, Mursia, Milano)

Heisel, F., Hebel, D. E., & Webster, K. (2022). *Building Better – Less – Different: Circular Construction and Circular Economy: Fundamentals, Case Studies, Strategies.* Birkhäuser, Berlin.

Hertzberger, H. (1996). *Lezioni di architettura*. Editori Laterza, Roma.

Honkonen, H. (2022). *Möbler som låter.* Retrieved March, 2024, from: www.hemmohonkonen.com/moumlbler-som-laringter.html

Hutmacher, F. (2019). Why is there so much more research on vision than on any other sensory modality?. In *Frontiers in Psychology*, 10. Frontiers Media, Lausanne. https://doi.org/10.3389/fpsyg.2019.02246

Iannitelli, A., & Biondi, M. (2024). La guerra come fatto psichico. In *Rivista di Psichiatria*, 59(1), 1-3. https://doi.org/10.1708/4205.41942

Inghilleri, P. (2021). *I luoghi che curano.* Raffaello Cortina Editore, Milano.

Ingram, T. (2023). Fragile. Scalable systems. In *FRAME 151 – The Big Shift. How to Design for Change*, 36-41. Frame Publishers B.V., Amsterdam.

Interreg Project North-West Europe (2023). *Facilitating the Circulation of Reclaimed Building Elements: a review of 5 years of methods and experiments in North-West Europe.* Retrieved March, 2024, from: https://vb.nweurope.eu/projects/project-search/fcrbe-facilitating-the-circulation-of-reclaimed-building-elements-in-northwestern-europe/

Interreg Project North-West Europe (2023). *32 Detailed Project Sheets. Projects Info, Reuse Rates and Reused Elements*. Retrieved March, 2024, from: https://vb.nweurope.eu/media/21046/dt4_2_2_project-sheets_041023_lr.pdf

Inti, I., & Mastropirro, R. (2020). Andiamo all'aria! Strategie adattive per riabitare la città. In *Urbanistica Informazioni*, 289, 43-46. INU, Roma.

Jakobsen, S.E., Fløysand, A., & Overton, J. (2019). Expanding the field of Responsible Research and Innovation (RRI) – from responsible research to

responsible innovation. In *European Planning Studies*, 27(12), 2329-2343. Taylor & Francis, London.
Jaque, A., Otero Verzier, & M., Pietroiusti, L. Eds. (2020). *More-than-Human*. Het Nieuwe Instituut, Rotterdam.
Jol, A., & Füssel, H.S. (2017) *European Environment Agency Report No 1/2017. Climate change impacts and vulnerabilities*. European Environment Agency. Retrieved Novermber, 2023, from: www.eea.europa.eu/publications/climate-change-impactsand-vulnerability-2016
Jones, E.R., Bierkens, M.F.P., Van Puijenbroek, P.J.T.M., Van Beek, L.P.H., Wanders, N., Sutanudjaja, E.H., & Van Vliet, M.T.H. (2023). Sub-Saharan Africa will increasingly become the dominant hotspot of surface water pollution. In *Nature Water*, 1, 602-613. Springer, London. https://doi.org/10.1038/s44221-023-00105-5
Joshi, S.M. (2008). The Sick Building Syndrome. In *Indian Journal of Occupational and Environmental Medicine*, 12(2), 61-64. https://doi.org/10.4103/0019-5278.43262
Kandinskij, V. (1989). *Lo spirituale nell'arte*. (Pontiggia, E., Ed.). SE, Milano. (Original work *Über das Geistige in der Kunst*, 1911).
Kellert, S.R., Heerwagen J., & Mador M. (Eds.) (2008). – Biophilic Design: The Theory Science and practice of bringing building to life. Hoboken (NJ) John Wiley & Sons.
Klein, G. (2009) Site-Sounds: On strategies of Sound Art in public space. In *Organised Sound*, 14(1), 101-108. Cambridge University Press, Cambridge UK. https://doi.org/10.1017/S1355771809000132
Klein, N. (2014). *This Changes Everything: Capitalism vs. the Climate*. Simon & Schuster, New York.
Klepeis, N.E., Nelson, W.C., Ott, W.R., Robinson, J.P., Tsang, A.M., Switzer, P., … Engelmann, W.H. (2001). The National Human Activity Pattern Survey (NHAPS): A Resource for Assessing Exposure to Environmental Pollutants. In *Journal of Exposure Analysis and Environmental Epidemiology*, 11, 231-252. Springer, London. https://doi.org/10.1038/sj.jea.7500165
Krasniqi, V., & McPherson, J. (2022). *Human Rights in this Age of Uncertainty: Social Work Approaches and Practices from Southeast Europe*. Springer, London.
Kuipers, M., & De Jonge, W. (2017). *Designing from Heritage: Strategies for Conservation and Conversion*. BK Books, TU Delft. https://doi.org/10.7480/isbn.9789461868022
Kuitert, F. (2023). Ossidiana Studio. In *FRAME Issue 154 – All Together Now. Welcome to the 'co' era. Are you in?*, 46-55. Frame Publishers, Amsterdam.
Kurapov, A., Kalaitzaki, A., Keller, V., Danyliuk, I., & Kowatsch T. (2023). The mental health impact of the ongoing Russian-Ukrainian war 6 months after the Russian invasion of Ukraine. In *Frontiers of Psychiatry*, July 2023. Frontiers Media, Lausanne. https://doi.org/10.3389/fpsyt.2023.1134780
Langat, V. (2015). *Music as Inspiration for Architectural Form: A Comparative Analysis of Mijikenda Traditional Architecture and Music*. University of Nairobi – School of the built environment. Retrieved March, 2023, from: www.academia.edu/24127806/music_as_inspiration_for_architectural_for

Lansink, A. (2017). *Challenging Changes – Connecting Waste Hierarchy and Circular Economy*. LEA Nijmegen, the Netherlands.
Larcher, C., & Dalla Costa, V. (2020). *Disegnare un cucchiaio per cambiare la città*. Quodlibet, Macerata.
Latour, B. (2018). *Down to Earth – Politics in New Climatic Regime*. Polity Press, Cambridge.
Laurìa, A., Secchi, S., & Vessella, L. (2020). Acoustic Comfort as a Salutogenic Resource in Learning Environments – A proposal for the design of a system to improve the acoustic quality of classrooms. In *Sustainability*, 12 (22), 9733. MDPI, Basel. https://doi.org/10.3390/su12229733
Lavagna, M. (2008). *Life Cycle Assessment in edilizia. Progettare e costruire in una prospettiva di sostenibilità ambientale*. Hoepli Editore, Milano.
Lavagna, M. (2022). *LCA IN EDILIZIA. Ambiti applicativi e orientamenti futuri della metodologia Life Cycle Assessment nel settore delle costruzioni*. Maggioli Editore, Santarcangelo di Romagna.
Lawrence, M., Janzwood, S., & Homer-Dixon, T. (2022). *What Is a Global Polycrisis? and How is it Different from a systemic risk*. Cascade Institute. Retrieved March, 2024, from: https://cascadeinstitute.org/wp-content/uploads/2022/04/What-isa-global-polycrisis-v2.pdf
Lecce, C. (2022). *The "Smart" Home: An exploration of how Media Technologies have influenced Interior Design visions form the last century til today*. FrancoAngeli, Milano.
Lee, G. (2010). Interior Ecologies: exposing the evolutionary interior. In *IDEA Journal Interior Ecologies*, 2010, 6-13. IDEA Publishers Group.
Lee, S. (2008). Barry Blesser and Linda-Ruth Salter: Spaces Speak, Are You Listening? Experiencing Aural Architecture. In *Computer Music Journal*, 32(4), 82-83. MIT Press, Cambridge MA. https://doi.org/10.1162/comj.2008.32.4.82
Leitner, B. (1978). *Sound: Space*. NYU Press, New York.
Leveratto, J. (2023). *Biotopia*. The Design of Decentered Domesticities. In *PAD #25 – Post-domestic habitat*, 16, 20-37. AIAP, Milano.
Lévi-Strauss, C. (1962). *La Pensèe Sauvage*. Plon, Paris.
L'Huillier, N. (2017). *Spaces That Perform Themselves*. MIT Media Lab – Thesis Archive, Cambridge MA. Retrieved March, 2023, from: https://dspace.mit.edu/bitstream/handle/1721.1/114067/1026503540-MIT.pdf
Licht, A. (2009). Sound Art: Origins, development and ambiguities. In *Organised Sound*, 14(1), 3-10. Cambridge University Press, Cambridge UK.
Lloyd, K., Schubotz, D., Roche, R., Manzi, J., & McKnight, M. (2023). A Mental Health Pandemic? Assessing the Impact of COVID-19 on Young People's Mental Health. In *International Journal of Environmental Research and Public Health*, 20(16), 6550. https://doi.org/10.3390/ijerph20166550
Lo Coco, G., Gentile, A., Bosnar, K., Milovanović, I., Bianco, A., Drid, P., & Pišot, S. (2021). A Cross-Country Examination on the Fear of Covid-19 and the Sense of Loneliness during the First Wave of Covid-19 Outbreak. In *International Journal of Environmental Research and Public Health*, 18(5), 2586. https://doi.org/10.3390/ijerph18052586

Lokko, L. (2023). *Biennale Architettura 2023. The Laboratory of the Future*. Catalogo della 18. Mostra Internazionale di Architettura. La Biennale di Venezia, Venezia.
Lòpez, L.M., & Díaz, A. F. (2022). Interior environment design method for positive mental health in lockdown times: color, textures, objects, furniture and equipment. In *Designs,* 6(2), 35. MDPI, Basel. https://doi.org/10.3390/designs6020035
Lotti, G., Marseglia M., Vacca, M., & Sottani, M. (2022) *Designing Futuring. Beyond the emrgency scenario.* Altralinea Edizioni, Firenze.
Lowenhaupt Tsing, A. (2015). *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton University Press, Princeton.
Mahmoud, N.S.A. (2019). Acoustics from Interior Designer Perspective. In *Acoustics of Materials*, IntechOpen eBooks. https://doi.org/10.5772/intechopen.84167
Maldonado, T. (1970) *La speranza progettuale. Ambiente e società*. Einaudi, Torino.
Mang, P., & Reed, B. (2011). Designing from place: a regenerative framework and methodology. In *Building Research and Information*, 40(1), 23-38. Taylor & Francis, London. https://doi.org/10.1080/09613218.2012.621341
Mang, P., & Haggard, B. (2016). *Regenerative Development: A Framework for Evolving Sustainability.* John Wiley & Sons, Hoboken US.
Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020). Environmental and Health Impacts of Air Pollution: A Review. In *Frontiers in Public Health*, 8(14). Frontiers Media, Lausanne. https://doi.org/10.3389/fpubh.2020.00014
Mannheimer, R. (2023). *Edifici sostenibili: la percezione degli italiani*. Research by Eumetra, 14.12.2023; Roma: Green Building Council Conference.
Manzini, E. (1990). *Artefatti. Verso una nuova ecologia dell'ambiente artificiale*. Domus Academy, Milano.
Manzini, E. (2018). *Politiche del quotidiano.* Edizioni di Comunità, Roma.
Manzini, E. (2021). *Abitare la prossimità. Idee per la città dei 15 minuti*, Egea Editore, Milano.
Manzini, E. (2021). Abitare la prossimità. In *Dialoghi Oltre il Visibile.* IUAV Venezia. Accessed 2nd January 2022. www.youtube.com/watch?v=v2S6GVjmBSU
Manzini, E., & Jégou, F. (2003). *Quotidiano sostenibile. Scenari di vita urbana*. Edizioni Ambiente, Milano.
Marchetta, V. (2010). *Passaggi di Sound Design. Riflessioni, Competenze, Oggetti-Eventi*. FrancoAngeli, Milano.
Mariotti, W. (Ed.) (2023). *EcoWorld. Speciale design*. Attachment to Domus #1080, June 2023. Domus, Milano.
Mascheroni, G., Saeed, M., Valenza, M., Cino, D., Dreesen, T., Zaffaroni, L.G., & Winther, D.K. (2021). *La didattica a distanza durante l'emergenza COVID-19: l'esperienza italiana*. Unicef. Retrieved March, 2024, from: www.unicef.org/innocenti/media/5506/file/UNICEF-La-didattica-a-distanza-2021.pdf
Massaro, S. (2022). *Abitare Circolare – Circular Living.* D Editore, Roma.
Matthews, E. (2006). Maurice Merleau-Ponty: Phenomenology of Perception. In Shand, J. (Ed.), *Central Works of Philosophy vol. 4*, 429-467. Routledge, London.

McDonough, W., & Braungart, M. (2022). *Cradle to Cradle: Remaking the Way We Make Things* (1st ed.). North Point Press, Berkeley US.
McGuirk, J., & Steierhoffer, E. (2018). *Home Futures: Living in Yesterday's Tomorrow.* Design Museum, London.
McLuhan, M. (1961). Inside the five sense sensorium. Canadian Architect, 6(6), 49-54. Reprinted in Howes, D. (Ed.) (2004). *Empire of the senses: the sensual culture reader* (42-52). Routledge, London.
McNeill, J.R., & Engelke, P. (2014). *The Great Acceleration: An Environmental History of the Anthropocene since 1945.* Harvard University Press, Cambridge MA.
Mendoza, E., Ferrero, G., Slokar, Y.M., Amores, X., Azzellino, A., & Buttiglieri, G. (2022). Water management practices in Euro-Mediterranean hotels and resorts. In *International Journal of Water Resources Development,* 39(3), 485-506. Taylor & Francis, London. https://doi.org/10.1080/07900627.2021.2015683
Merleau-Ponty, M. (2002). *Phenomenology of perception* (2nd ed.). Routledge, London.
Ministero delle Imprese e del Made in Italy. *Piano Nazionale di Ripresa e Resilienza (PNRR), 2021* (n.d.). *National Recovery and Resilience Plan*. Retrieved March, 2024, from: www.mimit.gov.it/it/pnrr/piano
Molinari, L. (2016). *La casa che siamo.* Nottetempo, Milano.
Morelli, J. (2011). Environmental Sustainability: A Definition for Environmental Professionals. In *Journal of Environmental Sustainability*, 1(1). https://doi.org/10.14448/jes.01.0002
Morimoto, M. (2017). *Music and Architecture: Notes on Experiencing The Convergence of Music and the Built Environment.* Doctoral Thesis digital Archive, University of Hawaii. Retrieved March, 2023, from: https://core.ac.uk/download/pdf/211328532.pdf
Morin, E. (1999). *Homeland Earth: A Manifesto for the New Millennium.* Hampton Press, New York.
Morin, E. (2018). *From Homeland Earth; A New Manifesto for the New Millennium*. In Journal of Conscious Evolution 1(1), Article 10. Retrieved March, 2024, from https://digitalcommons.ciis.edu/cejournal/vol1/iss1/10
Morin, E. (2020). *Changeons de voie. Les leçons du coronavirus.* Edition Denoël, Paris.
Morton, T. (2018). *Iperoggetti – Filosofia ed ecologia dopo la fine del mondo.* Nero, Roma.
Morton, T. & Boyer, D. (2021). *Hyposubjects: on becoming human*. Open Humanities Press, London.
Moxon, S. (2012). *Sustainability in Interior Design*. Laurence King Publishing, London.
Müller, H. (2023). *Challenging economic journalism: Covering Business and Politics in an Age of Uncertainty.* Springer, London.
Murphy-Greene, C. (2022). *Environmental justice and resiliency in an age of uncertainty.* Routledge, London.
National Arts Council Singapore (2020). *Digital Arts Consumption during Covid-19.* Retrieved March, 2024, from: www.nac.gov.sg/docs/default-source/

resources-files/research/digital-engagement/covid-19-arts-consumption-study---full-survey-1.pdf
National Geographic Society (2024). Human Impacts on the Environment. Retrieved March, 2024, from: https://education.nationalgeographic.org/resource/resource-library-human-impacts-environment/
NEB High-Level Round Table (2021). *New European Bauhaus Concept Paper NEB High-Level Round Table*, 30 June 2021. Retrieved March, 2024, from: https://new-european-bauhaus.europa.eu/high-level-roundtable-visions_en
Neuhofer, B., Celuch, K. & To, T.L. (2020). Experience design and the dimensions of transformative festival experiences. In *International Journal of Contemporary Hospitality Management*, 32(9), 2881-2901. https://doi.org/10.1108/IJCHM-01-2020-0008
Nicolin, P. (2020). *Lezioni di Interior Design*. Postmedia Books, Milano.
Norman, D.A. (2004). *Emotional design*. Apogeo, Milano.
Obeng-Odoom, F. (2020). *The Commons in an age of uncertainty: Decolonizing Nature, Economy, and Society.* University of Toronto Press, Toronto.
OECD (2001). Human Health and the Environment Report. OECD Publications, Paris. Retrieved March, 2024, from: www.oecd.org/health/health-systems/32006565.pdf
Ottolini, G. (1996). *Forma e significato in architettura*. Libreria Clup, Milano.
Ottolini, G. (2015). *Architettura degli interni domestici. Per una storia dell'abitare occidentale*. Libreria Cortina, Milano.
Ottolini, G., & De Prizio, V. (2005). *La casa attrezzata. Qualità dell'abitare e rapporti di integrazione fra arredamento e architettura*. Liguori Editore, Napoli.
Oxfam Report (2023). *Climate Equality: A planet for the 99%*. Retrieved March, 2024, from: https://policy-practice.oxfam.org/resources/climate-equality-a-planet-for-the-99-621551/
Pallasmaa, J. (2011). Architecture and the existential sense: Space, body, and the senses. In Bacci, F., & Melcher, D. (Eds.), *Art and the senses* (579-598). Oxford University Press, Oxford.
Pallasmaa, J. (2014). Space, place and atmosphere. Emotion and peripherical perception in architectural experience. In *Lebenswelt: Aesthetics and Philosophy of Experience*, 4(1), 230-245. Riviste UniMi, Milano. https://doi.org/10.13130/2240-9599/4202
Palma, G. (2011). Paesaggi sonori, tecnologia, multimedialità. In *SCIentific RESearch and Information Technology*, 1(1), 13-52. SCIRES-IT. https://doi.org/10.2423/i22394303v1n1p13
Paoletti, I. (2021). *Siate materialisti!*. Einaudi, Torino.
Papanek, V. (1971). *Design for the Real World: Human Ecology and Social Change*. Bantam Books, New York.
Pazzaglia, F., & Tizi L. (2022). *Che cos'è il restorative design*. Carocci, Roma.
Peach, S. (2020). The role of the office will be challenged – a conversation with Sevil Peach. *Vitra Magazine*. Retrieved March, 2024, from: www.vitra.com/enus/magazine/details/the-role-of-the-office-will-be-challenged
Pedrali (2020). *Buddyhub*. Retrieved March, 2024, from: www.pedrali.com/it-it/news/buddyhub

Perkins & Will (2021). *Net-Zero Now. Hospitality.* Retrieved November, 2023, from: https://issuu.com/perkinswill_london/docs/net-zero_now_hospitality_issuu

Perolini, P.S. (2011). Interior Spaces and the Layers of Meaning. In *Design Principles and Practices: An International Journal*, 5(6). Design Principles & Practices Book Imprint.

Petroni, M. (2022). *Studio Formafantasma – Il design degli iperoggetti.* Postmedia Books, Milano.

Pijanowski, B.C., Farina, A., Gage, S.H., Dumyahn, S.L., & Krause, B.L. (2011). What is soundscape ecology? An introduction and overview of an emerging new science. In *Landscape Ecology,* 26(1), 1213-1232. Springer, London. https://doi.org/10.1007/s10980-011-9600-8

Plevoets, B., & Van Cleempoel, K. (2019). *Adaptive Reuse of the Built Heritage: Concepts and Cases of an Emerging Discipline*. Routledge, London.

PNAT (2022). *Linee guida alla progettazione di plant based solutions alla scala dell'edificio e delle sue pertinenze per interventi di urban jungle*. EU European Union, Città di Prato. Retrieved March, 2024, from: www.pnat.net/it/works-2/prato-urban-jungle-linee-guida/

PNAT (2024). *Here is Key Topics*. Retrieved March, 2024, from: www.pnat.net/key-topics/

Poloz, S. (2022). *The next age of uncertainty: How the World Can Adapt to a Riskier Future*. Penguin Random House Canada.

Potter, C. (2015). Erik Satie's "musique d'ameublement" and Max Jacob's "Ruffian toujours, truand jamais". In *Revue de Musicologie*, 101(2), 345-366. Société Française de Musicologie, Paris. Retrieved March, 2023, from: www.jstor.org/stable/24751000

Quaglio, C., Todella, E., & Lami, I.M. (2021). Adequate Housing and COVID-19: Assessing the Potential for Value Creation through the Project. In *Sustainability* 13(19), Article 10563. MDPI, Basel. https://doi.org/10.3390/su131910563

Quinz, E. (2019). Dal Gesamtkunstwerk agli ambienti sonori. Linee di deriva della musica. In Balzola, A., & Monteverdi, A.M. (Eds.), *Le arti multimediali digitali: Storia, tecniche, linguaggi, etiche ed estetiche del nuovo millennio* (3rd ed.). Garzanti, Milano.

Quinz, E. (2020). *Contro l'oggetto. Conversazioni sul design*. Quodlibet, Macerata.

Rahimizhian, S. & Irani, F. (2021). Contactless hospitality in a post-Covid-19 world. In *International Hospitality Review*, 35(2), 293-304. Emerald Publishing, Miami. https://doi.org/10.1108/IHR-08-2020-0041

Rahm, P. (2018). The Anthropocene Style: Towards A New Decorative Reality. in *PIN-UP 25*, Fall-Winter 2018. Retrieved March, 2024, from: https://archive.pinupmagazine.org/articles/philippe-rahm-the-anthropocene-style-impact-of-climate-change-on-architecture-interior-design-essay

Rahm, P. (2023). *The Anthropocene Style – Manifestes 6*. HEAD Publishing, Geneve.

Rahm, P. (2023). *Climatic Architecture*. Actar Publisher, Barcelona.

Rahm, P., & Scuderi, M. (2014). *Philippe Rahm Architects. Atmosfere costruite: l'architettura come design meteorologico. Constructed atmospheres: architecture as meteorological design.* Postmedia Books, Milano.

Rahmat, A.F., El Archi, Y., Putra, M.A., Benbba, B., Mominov, S., Liudmila, P., … & Dávid, L.D. (2023). Pivotal Issues of Water-Based Tourism in Worldwide Literature. In *Water* 2023, 15(16), 2886. MDPI, Basel. https://doi.org/10.3390/w15162886

Rashdan, W. (2015). Exploring sustainability impact on interior design solutions. In *Proceedings of International Conference on Engineering Design*, 15, 27-30 July 2015. Politecnico di Milano, Milano.

Rathjens, B., Gunden, N., Zhang, L., Jain, G., & Law, R. (2023). A Systematic review of Contactless Technologies research in hospitality and tourism during the Covid-Pandemic. In *Journal of Hospitality & Tourism Research*. Sage Journals, Thousand Oaks CA. https://doi.org/10.1177/10963480231191192

Raworth, K. (2017). *Doughnut Economics: Seven Ways to Think Like a 21st-century Economist*. Random House Business Books, New York.

Rawsthorn, A. (2018). *Design as an Attitude*. Documents, 28. JRP|Ringier, Zurich.

Reed, B. (2007). Shifting from "sustainability" to regeneration. In *Building Research & Information*, 35(6), 674-680. https://doi.org/10.1080/09613210701475753

Reike, D., Vermeulen, W.J.V., & Witjes, S. (2018). The circular economy: New or Refurbished as CE 3.0? – Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. In *Resources, Conservation & Recycling*, 135, 246-264. Elsevier, Amsterdam.

Renna, A. (2018). *Andrea Branzi: "Riportiamo gli animali al centro del progetto urbano"*. Domus Web. Retrieved March, 2024, from: www.domusweb.it/it/architettura/2018/05/31/andrea-branzi-riportiamo-gli-animali-al-centro-del-progetto-urbano.html

Ricci, M. (2019). *Habitat 5.0*. Skira, Milano.

Rognoli, V., Ayala Garcia, C., & Pollini, B. (2021). DIY Recipes: Ingredients, processes & materials qualities. In Clèries, L., Rognoli, V., Solanki, S., & Llorach, P. (Eds.), *Material designers: boosting talent towards circular economies*, 27-33. Elisava, Barcelona; Politecnico di Milano, Milano.

Rosa, H. (2010). *Alienation and acceleration. Towards a critical theory of late-modern temporality.* NSU Press, Malmö.

Rota, I., Marasco, A., & Terna, D. (Eds.) (2018). *The Book Is Small Architecture. Interior of an Interior.* Quodlibet, Macerata.

Rottle, N., & Yocom, K. (2010). *Ecological Design*. AVA Publishing, Lausanne.

Ruby, I., Ruby, A., Kries, M., Müller, M., & Niggli, D. (Eds.) (2017). *Together! The New Architecture of the Collective*. Vitra Design Museum, Weil am Rhein.

Rume, T., & Islam, S.M.D. (2020). Environmental effects of COVID-19 pandemic and potential strategies of sustainability. In *Heliyon 6*(9). https://doi.org/10.1016/j.heliyon.2020.e04965

Rumiz, P. (2020). *Il veliero sul tetto. Appunti per una clausura*. Feltrinelli, Milano.

Sabbah, C., & Namias, O. (2019). *Hôtel Métropole Depuis 1818*. Editions du Pavillon de l'Arsenal, Paris.

Sachs, J., Schmidt-Traub, G., Kroll, C., Durand-Delacre, D. & Teksoz, K. (2017). *SDG Index and Dashboards Report 2017.* Bertelsmann Stiftung & Sustainable Development Solutions Network (SDSN), New York.

Salvadeo P., & Bassanelli, M. (2022). *Towards a Sustainable Post Pandemic Society*. LetteraVentidue, Siracusa.

Sandlin, J., & Wallin, J.J. (2022). Decluttering the Pandemic: Marie Kondo, Minimalism, and the "Joy" of Waste. In *Cultural Studies – Critical Methodologies*, 22(1), 96-102. Sage Journals, Thousand Oaks CA. https://doi.org/10.1177/15327086211049703

Sarkis, H. (2021). *Biennale Architettura 2021: How Will We Live Together?*. Catalogo della 17a Mostra Internazionale di Architettura. La Biennale di Venezia, Venezia.

Saxena, A. (2019). Religious buildings and sustainable behaviour: understanding impact of design elements on human behaviour. In *Proceedings of 3rd LeNS world distributed conference*, 4, 1094-1099. Edizioni POLI.design, Milano. Retrieved March, 2024, from: https://lensconference3.org/images/program/VOLUME4.pdf

Sayin, E., Krishna, A., Ardelet, C., Briand Decré, G., & Goudey, A. (2015). "Sound and safe": The effect of ambient sound on the perceived safety of public spaces. In *International Journal of Research in Marketing*, Volume 32/2015, 343-353. Elsevier, Amsterdam. https://doi.org/10.1016/j.ijresmar.2015.06.002

Schafer, R.M. (1977). *The soundscape: Our Sonic Environment and the Tuning of the World*. Destiny Books, Rochester VT.

Schiffer, N. & Bertoia, V. (2003). *The World of Bertoia*. Schiffer Art Book, Schiffer Publishing Ltd, Lancaster PA.

Schultz, L. (2009). *Nurturing resilience in social-ecological systems. Lessons learned from bridging organizations*. Doctoral Thesis in Natural Resource Management. Stockholm University, Sweden.

Scullica, F. (2008). *Interni Ospitali*. FrancoAngeli, Milano.

Scullica, F., Borella, M.A., Postel, J.C., & Veronese, G. (2022). How to live together? Co-living for future dwelling. In Dominoni, A., & Camocini, B. (Eds.), *Engaging spaces*, 15-54. FrancoAngeli, Milano.

Scullica F., & Elgani, E. (2015). Hotels Interior Spaces: an Example of Cross Fertilization. In Collina, L., Galluzzo, L., & Meroni, A. (Eds.), *The Virtuous Circle. Design Culture and Experimentation – Prooceedings of the Cumulus Conference, Milan*, 143-151. McGraw-Hill Education, Milano.

Scullica, F., & Elgani, E. (Eds.) (2019). *Living, Working, Travelling. New Processes of Hybridization for the Spaces of Hospitality and Work*. FrancoAngeli, Milano.

Scullica, F., & Elgani, E. (2020). Questa casa (non) è un Albergo. In Cafiero, G., Flora, N., & Giardiello, P. (Eds.), *Costruire l'abitare contemporaneo. Nuovi temi e metodi del progetto*. Il Poligrafo, Padova.

Scullica, F., Elgani, E. & Monchiero, U. (2021). The relevance of color in post Covid-19 interior design. In *Proceedings of the International Colour Association (AIC) Conference 2021*, 849-854. Associazione Italiana Colore, Milano. Retrieved April, 2024, from: https://aic-color.org/resources/Documents/Proceedings_AIC2021_r10.pdf

Scullica, F., & Monchiero, U. (2023). Post-COVID Interiors in the City of Care. In Anzani, A., & Scullica, F. (Eds.) *The City of Care*, 26(1), 29-38. Springer, London.

Selloni, D., Meroni, A., & Corubolo, M. (2023). Co-design as a public service to support social innovations in city making. In Cipolla, C., Mont'Alvão, C., Farias, L., & Quaresma., M. (Eds.), *ServDes 2023 Entanglements and Flows Service Encounters and Meaning – Conference Proceedings*, 276-295. Linköping University Electronic Press, Linköping SE. https://doi.org/10.3384/ecp203014

Šenitková, I. (2016). Indoor air quality – buildings design. In *MATEC Web of Conferences*, *93*, Article 03001. EDP Sciences, Les Ulis FR. https://doi.org/10.1051/matecconf/20179303001

Sennet, R. (2018). *Building and Dwelling: Ethics for the City.* Allen Lane – Penguin Books, London.

Sheivachman, A. (2019) *The Greening of Travel. Embracing the Responsibility.* Skift Global Forum. Retrieved March, 2024, from: https://skift.com/sgf-magazine-2019/

Silvestrini, G. (2022), Rivoluzione edilizia. In *Seed. Design Actions for future*, 00, 72. Istituto Nazionale di Architettura, Roma.

Sioli, A. & Kiourtsoglou, E. (2022). The sound of architecture. *Leuven University Press eBooks*. https://doi.org/10.11116/9789461664563

Soutworth, M. (1969). The sonic Environment of Cities. In *Environment and Behaviour*, 1(1). Sage Journals, Thousand Oaks CA. https://doi.org/10.1177/001391656900100104

Spanedda, F., & Fusaro, M.C. (2022). The flipped house and the bubble. Domestic space in the time of coronavirus. In *City Territory and Archit*ecture, 9(1), Article 35. Springer, London. https://doi.org/10.1186/s40410-022-00173-2

Sparke, P., Ioannidou, E., Kirkham, P., Knott, S., & Scholze, J. (Eds.) (2023). *Interiors in the era of Covid-19: Interior Design Between the Public and Private Realms*. Bloomsbury Visual Arts, London.

Spathonis, A., Thorsen, D., & Mitic, J. (2020). *The Sustainable Hotel: Designing for Wellness and Resilience.* Retrieved November 17, 2023, from: www.gensler.com/blog/the-healthy-hotel-designing-for-a-new-experience

Spence, C. (2020). Senses of place: architectural design for the multisensory mind. In *Cognitive Research*, 5, Article 46. Springer, London. https://doi.org/10.1186/s41235-020-00243-4

Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O. & Ludwig, C. (2015). The Trajectory of the Antropocene: The Great Acceleration. In *Anthropocene Review,* 2, 81-98. Sage Journals, Thousand Oaks CA. https://doi.org/10.1177/2053019614564785

Talamo, C. (2022). *Re-manufacturing networks for tertiary architectures. Innovative organizational models towards circularity.* FrancoAngeli, Milano.

Tamborrini, P., & Tartaro, G. (2010). "design sostenibile". Voice definition in *Enciclopedia Treccani*. Retrieved March, 2024, from: www.treccani.it/enciclopedia/design-sostenibile_(XXI-Secolo)/

Tanni, V. (2019). Net Art: genesi e generi. In Balzola, A., & Monteverdi, A.M. (Eds.), *Le arti multimediali digitali: Storia, tecniche, linguaggi, etiche ed estetiche del nuovo millennio* (3rd ed.). Garzanti, Milano.

Tayyebi, F. (2013). *A Quest on the Relationships between Music and Architecture*. Eastern Mediterranean University digital archives, Cyprus. Retrieved March, 2023, from: http://i-rep.emu.edu.tr:8080/jspui/bitstream/11129/2026/1/TayyebiFarhad.pdf

Thackara, J. (2005). *In the Bubble: Designing in a Complex World*. MIT Press, Cambridge MA.
Thackara J. (2017). *Progettare oggi il mondo di domani. Ambiente, economia e sostenibilità*. Postmedia Books, Milano.
Thiemann, R. (2023). The Future of Hospitality won't Only be About Having Good Time; Interview to Ade Herkarisma and Andreu Carulla. In *FRAME 152 – Low Impact*, 56-60. Frame Publishers B.V., Amsterdam.
Thiemann, R. (2024). Nouvelle Vague; Embracing spatial ambiguity in an age of uncertainity. In *FRAME 155 – The State of Spatial Design*, 58-63. Frame Publishers B.V., Amsterdam.
Tipene, L., & Preston, J. (2021). Introduction: Extra's Ordinary Interiors. In *IDEA Journal 18 – (extra) ordinary interiors: practising critical reflection,* 1, 7-12. IDEA Publishers Group. https://doi.org/10.37113/ij.v18i01.450.
Torresin, S., Aletta, F., Babich, F., Bourdeau, E., Harvie-Clark, J., Lavia, L., … Albatici, R. (2020). Acoustics for Supportive and Healthy Buildings: Emerging Themes on Indoor Soundscape research. *Sustainability (Basel)*, 12(15), Article 6054. MDPI, Basel. https://doi.org/10.3390/su12156054
Truax, B. (1978). *The world soundscape project's handbook for acoustic ecology.* ARC Publications, Vancouver BC.
Turnbull, N. (2022). Permacrisis: what it means and why it's word of the year for 2022. *The Conversation*. Conversation Media Group, Melbourne. https://theconversation.com/permacrisis-what-it-meansand-why-its-word-of-theyear-for-2022-194306
UN (2018). *Population Division. 2018 Revision of the World Urbanization Prospects*. United Nations Department of Economi and Social Affairs. Retrieved March, 2024, from: https://population.un.org/wup/
UN (2018). *Revision of World Urbanization Prospects.* Retrieved March, 2024, from: www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html
UN (2021). *Race to Zero Report*. Retrieved March, 2024, from: https://racetozero.unfccc.int/wp-content/uploads/2021/09/2030-breakthroughs-upgrading-our-systems-together.pdf
UN Climate Change (2022). *What is the Triple Planetary Crisis?*. Retrieved March, 2024, from: https://unfccc.int/news/what-is-the-triple-planetary-crisis
University of Brighton (2021). School of Re-construction – Summer School. Retrieved March, 2024, from: https://blogs.brighton.ac.uk/schoolofreconstruction/
Urry, J., & Elliott, A. (2010). *Mobile Lives*. Routledge, London.
Valenti, A. (2022). *Verso nuovi paesaggi domestici. L'abitare ai tempi del Coronavirus rappresentato in 3 atti (e 3 epiloghi).* SAGEP. Genova.
Valenti, A., Trimarchi, A., & Farresin, S. (2023). Design and ecological thinking; The new narratives of contemporary design placing Earth on centre stage. In *AGATHÓN – International Journal of Architecture, Art and Design*, 13, 19-30. Palermo University Press, Palermo. https://doi.org/10.19229/2464-9309/1312023
Van den Heuvel, M. (Ed.) (2023). *Volume 63 – The Not-so-easy Guide to Circular Interior Design*. Archis, Amsterdam.
Verganti, R. (2016). *Overcrowded. Designing Meaningful Products in a World awash with ideas*. MIT Press, Cambridge MA.

Vezzoli, C. (2018). *Design For Environmental Sustainability. Life Cycle Design of Products.* Springer, London.

Vezzoli, C., Conti, G., Macrì, L., & Motta, M. (2022). *Designing Sustainable Clothing Systems. The design for environmentally sustainable textile clothes and its Product-Service Systems.* FrancoAngeli, Milano.

Vezzoli, C., Garcia Parra, B., & Kohtala, C. (2021) *Designing Sustainability for All. The Design of Sustainable Product-Service Systems Applied to Distributed Economies.* Springer, London.

Vezzoli, C., Kohtala, C. & Srinivasan, A. (Eds.) (2014) *Product-service system design for sustainability.* Greenleaf Publishing, Sheffield UK.

Vezzoli, C., Macrì, L., Takacs B., & Yang, D. (2022). *System design for sustainability in practice. Methods, tools and guidelines to design Sustainable Product-Service Systems applied to Distributed Economies.* Maggioli Editore, Santarcangelo di Romagna.

Vezzoli, C., & Manzini, E. (2007). *Design per la sostenibilità ambientale*. Zanichelli, Bologna.

Vezzoli, C., & Yang, D. (2021). A case study analysis of the furniture system from sustainable Product-Service System Design perspective. In *Proceedings of the 27th Annual Conference, International Sustainable Development Research Society – Accelerating the progress towards the 2030 SDGs in times of crisis*, 1, 565-583. Mid Sweden University, Östersund SE.

Wakkary, R. (2021). *Things We Could Design: For More-Than Human-Centered Worlds*. MIT Press, Cambridge MA.

Watts, G.R., Khan, A., & Pheasant, R.J. (2016). Influence of soundscape and interior design on anxiety and perceived tranquillity of patients in a healthcare setting. In *Applied Acoustics*, 104, 135-141. https://doi.org/10.1016/j.apacoust.2015.11.007

Wilson, E.O. (1984). *Biophilia*. Harvard University Press, Cambridge MA.

Wismer, L.R. (2004). *Musical Architecture: Layers of Sound and Space*. B. Arch Thesis. Ball State University, Muncie IN. Retrieved March, 2023, from: https://cardinalscholar.bsu.edu/items/a46c6502-edce-4ad2-9fc6-11f4eae946b6

WGSN (n.d.). *Future Consumer 2024 Report*. WGSN Limited, London. Retrieved March, 2024, from: https://mlp.wgsn.com/future-consumer-2024-download-en.html

WGSN (n.d.). *Future Consumer 2025 Report.* WGSN Limited, London. Retrieved March, 2024, from: https://lp.wgsn.com/future-consumer-2025-download-en.html

WHO (2020). *Cleaning and disinfection of environmental surfaces in the context of Covid-19.* World Health Organisation. Retrieved June, 2021, from: https://apps.who.int/iris/bitstream/handle/10665/332096/WHO-2019-nCoV-Disinfection-2020.1-eng.pdf

WHO (2023). *Number of COVID-19 deaths reported to WHO*. Retrieved March, 2024, from: https://data.who.int/dashboards/covid19/deaths

Xenakis, I. (1971). *Musique. Architecture*. Casterman, Tournai BE.

Xu, Y., & Wu, S. (2022). Indoor color and space humanized design based on emotional needs. In *Frontiers in Psychology*, 13. Frontiers Media, Lausanne. https://doi.org/10.3389/fpsyg.2022.926301

Yellowtrace (2022). *Marni's new milan flagship with a creative intervention by Brinkworth & the Wilson Brothers*. Accessed March, 2024, from: www.yellowtrace.com.au/marni-flagship-milano-via-montenapoleone-retail-design/

Zattra, L. (2020). Audiogrammi of a Collective Intelligence: The Composers-Researchers of S2FM, SMET, N.P.S. and other Mavericks. In Krogh Groth, S. & Schulze, H. (Eds.), *The Bloomsbury Handbook of Sound Art*, 273-294. Bloomsbury, London.

Zejnilovic, E., Husukic, E., & Licina, D. (2023). Perception and evaluation of interior space: Experimental study on color and pattern. In *IDA: International Design and Art Journal Volume*, 5(1), 13-30. IDA, Bodrum TR.

Zhong, W., Schröder, T.W.A., & Bekkering, J.D. (2022). Biophilic Design in Architecture and Its Contributions to Health, Well-being, and Sustainability: A Critical Review. In *Frontiers of Architectural Research*, 11(1), 114-141. Higher Education Press, Beijing. https://doi.org/10.1016/j.foar.2021.07.006

Zigman, P. (2018). *Theories of Perception and Recent Empirical Work*. PhD Dissertation repository. CUNY, New York. Retrieved March, 2024, from: https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=3837&context=gc_etds

Zurlo, F. (2004). Della relazione tra design e strategia: note critiche. In Bertola, P., & Manzini, E. (Eds.), *Design Multiverso. Appunti di fenomenologia del design*, 75-84. Edizioni POLI.design, Milano.

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The early years of the second decade of the 21st century marked a profound change in humankind's living and interacting experiences. Humans' relationship with their surrounding environment – both natural and antropic – was vehemently challenged during the COVID-19 global pandemic and in the immediately following period that everyone is experiencing. These transformations will be threatened and altered again in the future by the risks posed by climate change and by economic, political, and social issues, and by other unforeseeable circumstances that delineate this historical period as one of great uncertainties.

In this context the constellation of spaces – both interior and exterior, both public and private ones – requires new approaches and systemic redefinitions that stems from their roots: design strategies, tacticts, processes, and practices for designing spaces, especially interiors, that are able improve the quality of people's living. The spontaneous questions that arise from this research are answered through the delineation of three macro-themes: sustainability, flexibility, and the role of perception.

The aim of this publication is to investigate how spatial design, and in particular interior design, has reacted and continues to respond to the ever-changing transformations of the contemporary scenario, considering both the conceptual-designing dimension in the definition of spaces and the operational-executive dimension, which cannot be separated from the completion of a design process.

This research encourages analytical and critical reflection on contemporary design processes in order to support researchers and students, as well as practitioners in design and architecture, to experiment with and to innovate design processes and to implement positive paradigmatic transformations for sustainable models of living both in the present and in the future.

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La passione per le conoscenze