

Springer Series in Design and Innovation 38

Claudio Gambardella *Editor*

# For Nature/With Nature: New Sustainable Design Scenarios

 Springer

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Claudio Gambardella  
Editor

# For Nature/With Nature: New Sustainable Design Scenarios

 Springer

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# Series Editor's Foreword

*Springer Series in Design and Innovation* (SSDI) explores all aspects of design that provide innovative innovation-oriented approaches in the different fields of application and design development, with a particular focus also on cross-cutting approaches and emerging research areas that can represent essential opportunities for economic and social development.

The design culture is committed to addressing the growing environmental concerns carefully considered by the 193 UN member countries that signed the 2030 Agenda for Sustainable Development in 2015. And in order to give adequate answers, I believe that we must look at a broad horizon that includes a technical/humanistic approach.

It is in this frame of reference that the series welcomes the volume *For Nature/With Nature: New Sustainable Design Scenarios* on the crucial theme of Nature, which results from the homonymous call launched in November 2022 by the Department of Architecture and Industry of the University of Campania “Luigi Vanvitelli”.

“What does ‘Nature’ mean nowadays? What effort is required of us to reposition ourselves with respect to it? How can we reconsider our history, our being in the world and the future with respect to a new idea of Nature? Finally, what is our correct position to establish the most effective actions in order to improve the living conditions of men on Earth?” These are the enlightening questions that have been posed to the scientific community by the Publisher of the call and of the book, Prof. Claudio Gambardella.

In our opinion, these ideas are useful for interweaving new visions of nature with new lines of design research.

The book, divided into three parts, Nature and artifacts, Nature and digital technologies, Nature and “fourth environment”, deals with the theme of the relationship with nature from multiple points of view. Starting from the relationship between human and nature, the essays collected in the book investigate the main sectors of intervention of design. From product design to design for living environments, to fashion design, through studies on innovative materials and sustainable industrial production processes, up to the relationship between design, craftsmanship, and innovation.

Particular attention is paid to the theme of technological innovation dealt with in the second part of the book, from the opportunities of digital innovation to artificial intelligence's ethics, from design for robotics to biomedical design, up to sustainable innovation for the "fourth environment" dealt with in the third part.

In conclusion, the book presents a very interesting reflection on a particularly topical theme, offering a broad and articulated reading that opens up new terrains of comparison and debate for design.

Francesca Tosi

# Foreword

## *For Nature/With Nature. A New Awareness*

Today the lifestyle. A sustainable global issues of ecology and consumerism impose a call to the consciousness of design to assume its responsibility with respect to the environmental sustainability of a contemporary process that must use natural resources at a rate so that they can be regenerated naturally. Today, humanity is living in an unsustainable manner, consuming the limited natural resources of the Earth faster than it can regenerate them. The collective social effort to adapt the human consumption of these resources within a level of sustainable development is a matter of paramount importance for both the present and future of mankind.

Since the 1980s, the term “sustainability” has been used in the sense of human sustainability on planet Earth and this has resulted in the definition of sustainable development as a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. While raising the living standards of the developing world, the challenge for sustainability is to limit Western consumption without increasing the use of the resources as well as the environmental impact. This must be done by using strategies and technology that break the bond between economic growth and environmental damage.

In the context of development economics, the concept of economic sustainability is at the core of the considerations. In this perspective, consumers are using their purchasing power for ‘ethical consumerism’ practiced through either “positive buying” (the ethical products are favored) or “moral boycott”. A major hurdle to achieving sustainability is the alleviation of poverty, one of the main sources of environmental degradation. It is therefore futile to attempt to deal with environmental problems without a broader perspective that encompasses the factors underlying world poverty and international inequality. In this sense, the environmentally conscious design is the philosophy of designing physical objects, built environment, and services to comply with the principles of social, economic, and ecological sustainability. The intention of sustainable design is to eliminate negative environmental impact completely through skillful, sensitive design, that requires renewable resources, minimizing the environmental impact, and relating people with the natural



environment. Beyond the elimination of negative environmental impact, sustainable design must create innovative projects capable of shifting behavior, generating the respect of both the environmental and social differences.

In a memorial service held in Tucson (Arizona, 2011-01-12), President Barack Obama called on the Americans to sharpen the instinct for empathy to become a more civil people. In the opinion of Jeremy Rifkin (*The Empathic Civilization: The Race to Global Consciousness in a World in Crisis*), being empathic means being open to the plight of others. For Rifkin, empathy is the emotional and cognitive means by which we express intimacy and sociability. To empathize is to experience another's condition as if it were our own. It is to recognize their vulnerabilities and struggle to flourish and be. Empathy is the real "invisible hand" of history. Today, empathy includes the whole of humanity. We are coming to see the biosphere as our indivisible community, and our fellow human beings and creatures as our extended evolutionary family. In this sense, empathic design is a user-centered design approach that pays attention to the feelings toward a product.

In 1967, the first long play by the Italian singer-songwriter Francesco Guccini, *Folk Beat No. 1*, contained a song, *Noi non ci saremo* (We won't be there) that told of the rebirth of life after an atomic war, a threat considered at the time as very likely. The lyrics, poetic like all of Guccini's songs, drew an apocalyptic vision of a planet that, destroyed by a fiery event "greater than the sun", like a phoenix "after a thousand centuries at least" was able to rise from its ashes, bringing once again the waves of the sea to resound on the beaches, snow and fir forests to cover the mountains, rainbows to shine high in the sky. One bleak truth accompanied the rebirth: the "new world" witnessed the self-destruction of the human species and the crumbling of houses, buildings, and cities. The refrain that accompanied each verse, *Ma noi non ci saremo/Noi non ci saremo* (but we won't be there/We won't be there), thundered like an epitaph and drew the bitter vision of a definitive disappearance, whose conscious and historical reference to the dramatic events of Nagasaki and Hiroshima attributed the cause to the human hand.

The recent events between Russia and Ukraine have reawakened the fear of nuclear war throughout the world. But there is now an equally powerful, possible, and imminent risk: the disappearance of the human species from planet Earth due to harmful climate and environmental change. This risk makes it necessary to speak out on urgent issues such as building a healthy continent, combating climate change, and environmental challenges, and an economy at the service of people: an awareness of a countdown that, if not reversed, cannot avoid asking in the near future: but won't we be there?

Aversa, Italy

Ornella Zerlenga

## Preface

July 16th, 1945—the date of Trinity Test in Alamogordo, New Mexico, just three weeks before the launch of “Little Boy” on Hiroshima City—is considered the symbolic date of the end of Holocene and the beginning of Anthropocene, the name created in 2000 by Paul Crutzen in order to indicate the present glacial era. The latter has this name because to condition the terrestrial environment is the «telluric force» of man—as Stefano Mancuso defines it—so much so that in 2020 “[... ] the weight of materials produced by man—cement and plastic—has exceeded the weight of life on the planet” (Tonfoni 2021). However, it is relevant to declare that the increasing of CO<sub>2</sub> and CH<sub>4</sub> concentrations in the atmosphere is the most significant signal that human actions negatively influence life conditions on the planet; that means they cause desertification, pluvial wood destructions, increasing of ground karst phenomena, loss of usable surface for agricultural crops due to erosion or over-fertilization, ozone hole, and climate alterations. In order to oppose such events, the 193 UNO member countries signed the 2030 Agenda for Sustainable Development in 2015 (Nazioni Unite n.d.). The 2030 Agenda indicates 17 Sustainable Development Goals and 5 key concepts such as to grant prosperous and full lives in harmony with nature; to protect the natural sources and climate of the planet for the future generations. On the basis of its 2050 long-term strategy (Unione Europea n.d.), the EU has the ambitious objective to reduce net emissions by 55% by 2030 in respect of 1990 levels and to become the first climate-neutral continent by 2050. It needs to consider how much the recent energy crisis due to the Ukraine war will slacken decarbonization plans and the process of abandoning fossil fuels by modifying the European Green Deal program and its timescale.

Nevertheless, “[...] to say that the nature is in a dangerous situation is senseless”, Salvatore Natoli says in his *lectio magistralis* in 2011: (Festival *Filosofia* dedicated to the Nature theme). “Man hasn’t the [...] force to destroy something more powerful than him and in which he was generated [...] eventually man by abusing of nature or not using it in the right way destroys the conditions of his life and so puts himself in danger [...]” (Natoli 2019). This behavior is due to the consideration that man doesn’t feel, as in the ancient world, “[...] a being created in the φύσις [...] its own product”, but he is separated from it (Natoli 2019). Science has increased the sense of alienation

toward nature lived in tragic way by our present society by arriving at paradox “[science] identifies itself with nature in order to allow men to detach from it as possible [becoming the manipulative dimension], in these two centuries in particular; this means science has become our natural way to live [...]” (Natoli 2019) through the use of “[...] technique which has become the essence of science” (Galimberti 2019). “This industrial society had upset the relationship between man and nature by subjecting the nature to man so the technological society that was born through the quantitative increase of industrial society produces qualitative transformation which is the subordination of nature and man to technology” (Galimberti 2016, p. 356). “The unfolding of the Baconian formula [scientia est potentia] has changed the scenario: no longer the power of man over nature, but the power of technology over man and nature. In this type of condition, the anthropocentric horizon is already dissolved because the power belongs to technique now and no longer to man. The technique imposes to the supposed holder of power (man) its correct use, so man becomes a passive executor of the technical possibilities that are exercised over nature, which suffers them passively” (Galimberti 2016, p. 524). The self-governing of technique which “moves over the human-nature relationship” (p. 524) emphasizes the skill to diagnose—one by one—in a “technical” way the pathologies affecting the planet and to answer with right “technique” remedies to the same pathologies. Plants are considered machines—that set humidity, produce oxygen, absorb CO2 and microparticles—in green architecture and urban furniture in order to give the present towns a way to live better.

What does “Nature” mean nowadays? What effort of repositioning is required of us with respect to it? How can we reconsider our history, our being in the world also future with respect to a new idea of Nature? Finally, what is our correct position to establish the most effective actions in order to improve the living conditions of man on the Earth? These “human” questions are necessary to find our nature vision, to found it again and put it into new topics of research in disciplines which seem so far from philosophy.

First of all, the culture of the project such as scientific research and training is involved in the necessary change of course to establish a new balance between man and nature because “Many problematic situations of our world are the result of planning decisions” (Thackara 2005, p. 1). They are often wrong decisions not due to mistakes of calculi but to the approach they are derived from. Nature is considered as consumer goods in exhaustion because of a pervasive and reductive economic vision of the world. Therefore, we prefer simpler names instead of Nature to avoid philosophical or religious problems and to keep it under the easy control of a fragmenting thought, so we use words as “planet”, “earth”, “biosphere”, etc.

The German philosopher Gernot Böhme (2012), overcoming the representation of a world shaped by circulating conceptions of Nature and the Man-Nature relationship, shows new scenarios in which “[...] nature presents itself today [...] as a task that is in front of us” (p. 5). Therefore, we are invited to “[...] recognize as our great collective task not the defense, but the construction of nature as a foundation for human life, and to work in a serious way in respect of it” (p. 24). Böhme’s suggestion (2012)

can wisely be taken up by the person who works within the project culture in order to feel fully involved in this “task”.

Scholars have been invited to contribute to the construction of a multi-voice mosaic on the theme of nature and the relationship between Man (understood as designer) and Nature through the call *For Nature/With Nature: New Sustainable Design Scenarios*, which was issued in the autumn of 2022 by the Architecture and Industrial Design Department of Vanvitelli University. To be more precise, innovative, and sustainable proposals from the field of design were requested, in its many facets and interdisciplinary contributions. Although it is indisputable the creative and economic effort that designers, institutions, and companies carry out for years to improve human living conditions, in this volume preference has been given to scientific contributions (unpublished or not yet fully known case studies, projects of strategies, products, systems and services, theoretical contributions, communication) that are the expression of a new approach to Nature, seen as our ally and subject of an Ethic of Care.

The focus was the design both in its role as innovation driver and interpreter of social evolution that must be considered within the human-nature relationship.

The following topics identify some of the most relevant fields of development in which “Design Driven Innovation” can be developed in the respect of perspective of a new relationship with nature.

#### A. Nature and artifacts

- biomimicry and biocompatible materials in industrial, fashion, and textile design;
- project, production, design management for sustainability (packaging, communication, etc.);
- memory and innovation of processes and products in handmade design.

#### B. Nature and digital technologies

- toward sustainable, humancentric, and resilient industry 5.0;
- smart mobility and green vehicles;
- pervasiveness and sustainability of apps.

#### C. Nature and “fourth environment”

- Orbiting stations: design for living;
- dress design and new materials for space tourism;
- the design of new low orbit habitats.

Many scholars responded to the call and among the numerous papers received, after a first screening of the abstracts, sixty-one were selected through a process of double-blind peer review. The result is reasonably satisfying, especially given the brief time spent promoting the call. Certain authors have focused only on some of the subtopics

indicated in the call, while others have preferred to compete on a mainly theoretical treatment and, for this reason, they have been placed at the beginning of the first part. Moreover, it was not always easy to find the exact location of a paper within the first and second parts of the book relating to the first two topics. While it was obvious the placement of papers in the part related to the fourth topic, definitely specialized and, therefore, treated only by some scholars. The succession of papers within each part was made starting from broader arguments, proceeding successively along the lines of subtopics and, therefore, for increasingly specialized themes. For these reasons, each part is named with the topic only, without specifying subtopics.

Aversa, Italy

Claudio Gambardella

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Claudio Gambardella



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# **Nature and Artifacts**



# Eco-Energy of Subtle Design



Gianpiero Alfarano 

**Abstract** In the twenty-first century, accumulating new things generally does not offer new opportunities but instead creates new problems. What moves design today towards its responsibilities? The implications in ecological terms, the weight of this in the disruption of biological cycles and its green footprint condition and sharpen the challenge in rethinking the relationship with nature that design faces in giving new awareness to its work. This exhibition brings together experiences of point elements that take on the character of subtle design. These are studies aimed at recovering all forms of energy from the involvement of artefacts about the environment. In both the scientific and technological fields, some research is already yielding promising results through symbiotic properties with natural phenomena from which energy can be drawn, provided one operates with a soft attitude. It is a matter of activating new sensitivities that, starting from sensory perception, lead to greater attention to detail. An invitation to the wonder of subtle, imperceptible, evanescent, fleeting, invisible and impalpable things that contribute to changing our conceptions and actions, making us more aware and responsible for more human relations among humans and osmotic with nature, respecting it and exchanging new forms of energy with it. A new course can be charted by integrating all human actions with the phenomenologies of nature using a ‘subtle’ contribution. A fulcrum that acts as a flywheel for proposing values and knowledge that penetrates deep inside without intrusiveness, making new knowledge of new behaviour.

**Keywords** Sensibility · Eco-energy · Soft design · Smart surfaces · Lighting design

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## 1 Introduction

In the twenty-first century, accumulating new things does not generally offer new opportunities but creates new problems.

Laying the foundations for practical and responsible design in a world lacking resources and energy, Victor Papanek was one of the pioneers who was ahead of his time by tackling significant issues at an early stage that have become indispensable prerequisites today. With his most influential book ‘Design for the real world’ first published in 1971 and later translated into numerous languages, Papanek raised concerns about a future corroded by the accumulation of goods and the waste of all forms of energy, including creative energy. In no time, his book became a true manifesto of realistic criticism of blind faith in consumerism. Throughout his work, he specifically addresses various aspects of alarm and urgency towards those urgencies that we relate to the concept of sustainability today (Fig. 1).

With a different sensitivity but with just as much critical depth and exquisite refinement of exposition, Alessandro Mendini, in the 1980s, hit the mark by urging self-critical reflections on the role of design in assuming ecological responsibilities.

Several times in his writings and public speeches, he took sides with subtle annotations on the effectiveness of the designers’ position in producing new things. In one of his writings reported in the exhibition catalogue ‘From the Infinite to the Infinitesimal’ at the Ara Pacis in Rome in 2009, we read, ‘Objects are sometimes waste. The



**Fig. 1** Victor Papanek, Design Museum Barcelona, Catalonia, Spain. 30 October 2019—Co-curated by Prof. Alison J. Clarke



**Fig. 2** Alessandro Mendini. Photo by Giorgio Casali

risk is to fill the world with things that are difficult to eliminate. Conversely, thoughts are less cumbersome than objects; they are less heavy’ (Finessi 2009, p. 34) (Fig. 2).

His work is also helpful in talking about design as a prevaricating and obstinate action to add new to the new. A position that urges the possible meaning of ‘deproject’. It is essential to think of a development of an inverse action of the project, where the hypothesis is that of removing rather than accumulating, that of thinning rather than encrusting, of not contributing to constructive saturation and destruction by excess. Moreover, today, what moves the project towards its responsibilities?

## 2 Overcoming Dominance Over Nature

The implications in ecological terms, the weight of this in disrupting biological cycles and its green footprint are more relevant than ever. The challenge lies in rethinking the relationship with Nature that Design faces in giving new awareness to its work.

In years of reflections and cultural positions, including operational ones, what is perhaps still struggling to be fully taken on is an “ecological attitude of design” (Manzini 1990) that does not have nature as an opposition but includes respect for it and the reciprocity factor as an operational coefficient. As Paolo Rossi writes, ‘adopting this position of respect means overcoming the ideology of dominion over nature that has characterised modern thought but, at the same time, it also means

not falling into the naive position of submission to an idealised nature' (Rossi 1988, pp. 190–204).

Scientific data indicating that humans are living beyond the carrying capacity of planet Earth are widely disseminated and known.

The impact of the human species on natural systems was summarised in a famous equation published in 'Science' in 1971 by the renowned Stanford University ecologist Paul Ehrlich and John Holdren (1971, pp. 1212–1217).

Since that date, the implementation of this phenomenon has been backed up by further scientific evidence presented in detail in the Millennium Ecosystem Assessment from 2005 onwards (Millennium Ecosystem Assessment 2005).

The concept of "Carrying Capacity", a fundamental term in ecology used emphatically in the 1950s to define the biological limits of a natural system related to population size, became widespread thanks to Eugene Odum's 1953 book "Fundamentals of Ecology", which rendered the term in its broadest meaning corresponding to the equilibrium value of the logistic model of growth not only of the population but also of the products of human activities.

It was precisely from the concept of 'Carrying Capacity' that a saturated model of industrial society with profound contradictions to be resolved came to the fore. This reference definition has been used to define a certain degree of responsibility that can be extended to various aspects of growth phenomena and taken as a detector by ecologists and biodiversity scholars. At the same time, it still seems insufficiently attested to detecting long-term repercussions from the industrial production sector. About environmental impact, more detailed accounts are provided by the 'ecological footprint' accounting coined by William Rees et al. (1996) and periodically updated by the WWF since 1999 in its 'Living Planet Report'.

The culture of the project is no stranger to taking a position on this issue and assuming responsibility in terms of the impact of its work. However, there have become so many such emergencies on which to intervene that as needs grow, the level of possibility of direct evidence of results is no longer given by direct experience. For a project loaded with intentions of responsibility, no matter how much it is potentially projected to restore value and respect to natural factors, it is difficult to have and read the fallout of an intervention in the immediate visibility of the benefit. Artefacts "no longer exhibit structures and 'mechanisms' to which effects can be perceptually linked" (Manzini 1990). Hence, the project, in addition to being projective, must be able to direct the benefits of the effects to be seen from the outset in order of time that goes beyond that of the intended use or immediate enjoyment. Willingness and decisions that responsibly consider the effects even each small intervention will have on future generations. The farsightedness latent today makes it an essential component of the very essentiality of practices and ideas. In symbiosis with nature, we will have the correspondence dialogue to guide us.

### 3 Designing Proposals for Soft Decisions

For a long time, any human intervention in the environment was considered a trivial matter in the face of the immeasurable forces of nature. The artificial, however, has taken such possession of physicality and relationships that one has had to rely on the easy schematism of binary logic to recognise it.

The pair Nature/Artifice coined to make a distinction has led to division and given a bad reputation to artificial things by pitting them against those borne by nature. However, if by Artifice we mean what man has achieved on a cultural basis almost to the exclusion of all biological aspects, the distinction is only a specious position. While it is true that we live in intensely artificial environments, it is equally valid that producing artificial for humans is an entirely natural activity. It is, therefore, not difficult to realise that this polarity not only does not help distinguish but even goes so far as to complicate the issue, if not confusing. Nevertheless, it must be taken for granted, and we must admit that the history of man and the artificial are coincident. The Artificial, therefore, is inherent in human nature for good and evil. Here, rather than analysing the existence or otherwise of a contraposition, it is interesting to note that Artifice and Design identify the design dimension in the condition of an obsolete polarity. What they have in common are the cultural instances that drive them. Artifice, therefore, no longer makes sense to refer to a specific condition of making but rather to the expression that concerns the orientation of the project (Dorfles 2003).

Design, for its part, has now matured an awareness of having to assume the role of a proponent of proposals that merge the richness of human experience with the relationship of reciprocity with nature.

This is the starting point for a subtle reflection that opens an interest not in ‘what’ to produce but essentially in ‘how’. It is a matter of considering everything that includes decision-making factors in designing.

Today, more than distinguishing Artifice from Nature, it is, and will increasingly be, necessary to emphasise the ‘criterion of choice’.

Choice, which for the existentialists was the source of all our anxieties (Kierkegaard 2016), and after the Freudian propagation of the need to be aware of the unconscious, for some decades now, it has been neuroscience that has been focusing on the criterion of choice as an unconscious factor in human cognitive faculties (Dooley 2011; Godin 2014). Over the years, other disciplines, such as cognitive and social psychology and behavioural economics, have also endeavoured to demonstrate what drives decisions and what unconscious motivations drive decisions. In 2002, at the Rotterdam School of Management, Ale Smidts established a new area of study and research called ‘neuromarketing’.

One of the most excellent experts in neuromarketing, Martin Lindstrom, presented this discipline as the key to understanding “the subconscious thoughts, emotions and desires that drive the decisions we make every day of our lives” (Lindstrom 2009). It is worth mentioning the unusual and exciting approach that Lindstrom proposes to understand the power of decisions: in an era dominated by big data, he invites us to

start instead with ‘small data’, i.e. the tiny clues that can be observed in everyday life of individuals and that, according to the author, can bring considerable advantages in knowing how decisions are made. Today more than ever, attention to soft elements of design is experiencing great revolutions from a scientific and industrial point of view; it is a field in which we have a unique opportunity to generate a new quality of life and new habitability of the world. What is now termed ‘multi-sensory experience’ is a widespread and much sought-after need to have full-bodied virtues in detail. To move the substance of things from physical perception to the perception of content. To make them visible for their effectiveness that goes beyond the solidity of form. This requires that designers, and especially those who research finishes, can break through the limitations embedded in custom.

A subtle yet substantial way of addressing contemporary and future design issues for man and the planet. A fulcrum that acts as a flywheel for proposing values and knowledge that penetrate deeply without intrusiveness, making new knowledge of new behaviours.

The hyper-technological and computational dimension of our existence has at its base the concept of ‘energy’ understood in its broad interpretation, which requires the efficiency of present and available resources and the imagination to have regenerative viability.

The exploration of material and immaterial energies capable of giving back much more than what we are accustomed to must be brought into play: savings, low cost, perception, well-being, communication, information, and care.

Subtle interventions can change much of our way of perceiving if we pay attention to them.

An invitation to pay attention to and marvel at subtle, imperceptible, evanescent, fleeting, invisible and intangible things that help change our conceptions and actions, making us more aware and responsible for more human and osmotic relationships with nature by respecting it and exchanging new forms of energy with it.

What is the energy of silence? Or rather, what power of it do we neglect? How can silence be the bond that overcomes contemplative oblivion to give more concreteness to real listening? The answer to these questions comes through the new possibilities of designing silence in colour.

Even silence can be coloured. White Noise Machine is one of the many devices now accessible to produce a noise that soothes physical pain by fuelling the production of adrenalin and endorphins and, in a broader sense, can calm noise pollution (Brera 2009).

A sound like wind blowing imperceptibly through trees or other similar serene sounds of nature acting as natural ‘narcotics’ that are not harmful at all. Such devices often produce white noise and so-called ‘pink’ or ‘flicker’ noise. This is a type of noise in which the low-frequency components have greater power, unlike white noise, whose power is attenuated at higher frequencies to the point of having fundamental subtle colour nuances in the sound (Spirito 2021).

## 4 Designing the Intangible First Stage of Subtle Design

There is an increasing need to consider the intangible aspects of artefacts for design and production processes. Ecology and sustainability are commonly used in the exclusive sense of the visible and measurable. However, multiple entities ascribable to such concepts and belonging to the world of the intangible, the invisible, and the non-quantifiable are nevertheless perceivable because they are easily detected as determinants in individual and social choices and behaviour. Indeed, indispensable in consideration of the attitudes to be assumed in practising transformations towards green tenors. The intangible increasingly has a fundamental value that must be acknowledged with new analysis tools. The ability to design the intangible needs new methodologies and, above all, new capillary skills and training with new proposition criteria. There is a need for new planning skills that are no longer declined or appropriate to current trends but focused on easily shared enduring values capable of providing new awareness starting from minor details or slender interventions.

The know-how concept is often used to identify the knowledge possessed, but it defines what escapes.

Insistent in every production system is the need to appropriate a heritage that is not only difficult to define and describe but is also the will to the perimeter and manage that which does not yet have practical references to be mastered. For some realities, know-how takes on the aspect of a satisfying macro-container in which to group intangibles and many other elusive properties. This testifies to the presence of entities that are as evident as they are little considered, or rather, little managed according to scientific principles and above all measurable (Varvelli Lombardi et al. 2005).

Certain aspects of design hitherto considered fascinating and poetic, but in some ways still regarded as marginal, are now emerging factors. Growing sensitivities, identify them as relevant to the point of considering them fundamental in any operational intervention that deals with the conception and construction of any product's new perceptive and fruition values.

So how do you choose a colour? And perfume? How do you guarantee pleasantness to the sound of a car door closing? And to trolley wheels? In the single, perhaps they produce tolerable noise, but in transit with many, the din even drowns out the warnings to passengers from the station loudspeakers.

What light do we need to taste the authenticity of food? Moreover, how do we manage our relationship with artificial light about the biorhythm of the Circadian cycle?

It is all too well known how prolonged exposure to artificial lighting quickly throws our sleep-wake cycle out of synchronisation and, consequently, how significant this is in causing sleep problems.

The 2017 Nobel Prize in Physiology or Medicine award to Jeffrey C. Hall, Michael Rosbash and Michael W. Young demonstrated this topic's relevance. Their discoveries on the molecular mechanisms that regulate circadian rhythms have witnessed

how the quantity and quality of light in the environment adapts to the overexposure to which we are now subjected, negatively impacting our health (Rossi 2019).

The emotional state is also subjected to dysfunctional stress when under the continuous influence of artificial light. In addition, prolonged disruption of the circadian rhythm can lead to consequences on people's physical and psychophysical health. Not to mention the ongoing debate on the consequential effects of 'blue light', considered a valuable tool to combat winter depression and insomnia, but also causes permanent damage to the human eye. In low light conditions, it switches from sensitivity to green to sensitivity to the high-energy spectrum of blue. As a result, blue light is perceived more intensely and thus induces a more glaring sensation.

Another much-neglected detail of our relationship with light is the unconscious loss of background brightness. Tablets, smartphones, and other digital devices with displays have changed the light spectrum we are exposed to with a substantial increase in blue light and our visual habits. It is essential to recognise that we spend much time looking 'up close' compared to viewing from a distance. As a result, the eye gets less brightness from the background and becomes accustomed to the excess light in the field of vision. The eyesight of the technological human is familiar and accustomed to light that only arrives concentrated and is little stressed by diffuse light. This does not lead to a loss of focus in perception from a distance but does make the vision of backlit electronic colours, such as those presented to us by LEDs on screens, require more effort. Often when reading many devices, it is not difficult to notice the more significant fatigue in keeping graphics containing red, green, and blue lines in focus, compared to identical or similar lines with a different colour stamp. The reason is that the brightness of the background is often excessively reduced in the adaptability of the eye (Walerczyk 2020).

Examples of practical applications in designing the intangible can be found in the potential of innovation in lighting technology.

Such innovations are now so sophisticated that they can specify the right light for the required variety of performances and modulate it for what is needed with ample flexibility. What is innovative and unthinkable until recently is the capacity for evolution in this sector, directing the possibilities of using lighting towards much more than just the input of making light. Certain technologies in the lighting sector are revolutionising the design approach to ecological benefits by intervening in both formal and structural performance with little intrusiveness. Innovations that are capable of significant energy savings compared to previous consumption conditions but also promote even unprecedented results (Forcolini 2016).

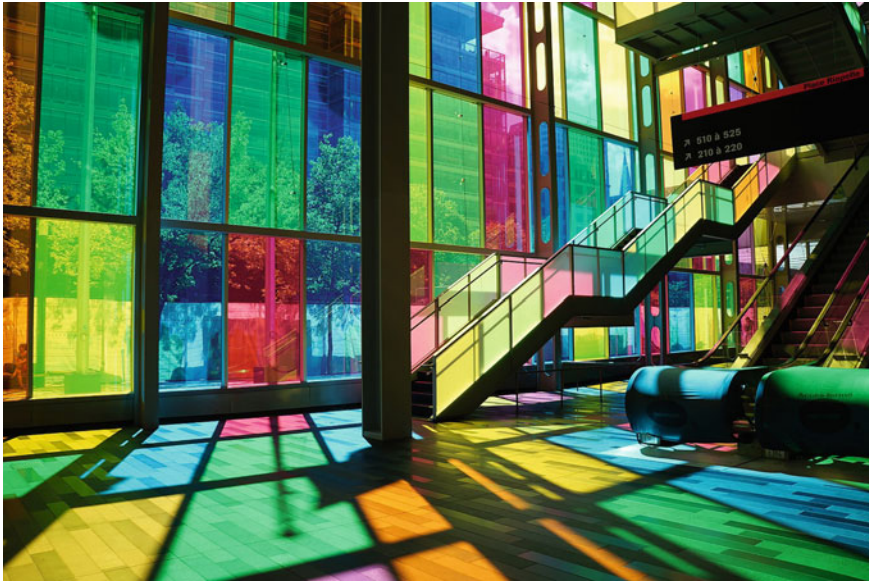
## 5 The Light that Does More Than Meets the Eye

One of these is Li-Fi technology. A lighting apparatus capable of transmitting data with the same beam of light built to illuminate (Baronchelli 2019) is a technology that works on a principle already widely used. Think of smoke signals, navigational



beacons, and SOS via flashing lights. Only it has long been confined to a non-applicable state due to the excessive functional latency of the optical sources in use until recently: incandescent bulbs, fluorescent, and neon. Thanks to the development of artificial lighting sources based on LED technology that emits light in the visible spectrum capable of withstanding current modulation with intermittencies undetectable to the human eye, the transmission of information identifiable in VLC technology is an indisputable fact with enormous signal quality and considerable energy savings (Balocco et al. 2018). After all, artificial lighting is everywhere, indoors, where its use is essential; outdoors (street lighting, illuminated signs, vehicle headlights, traffic lights), and even on mobile devices (smartphones, tablets). Exploiting the visible radiation emitted by LEDs in a bivalent manner, both for illumination and for connection in the transmission of data using only one source, is undoubtedly innovative and, above all, efficient in many conditions of use. Electromagnetic radiation in the visible is efficiently safer regarding the safety of the person exposed to the radiation and safeguarding information from possible malicious attackers. This technology is already being standardised and ready for commercialisation under Li-Fi Technology. It is up to the design to give it the formal dignity of a recognisable object both for its technological advantages and the substantial energy savings in performance.

Another technology related to lighting equipment is Ultraviolet Germicidal Irradiation (UVGI). This disinfection method uses ultraviolet light to prevent the reproduction of viruses and bacteria and their ability to be harmful. Since the Pandemic, disinfection using UVGI technology is no longer an issue exclusively in the medical field but extends almost everywhere: industrial areas, offices, transport, public spaces, and homes. When considering the entire electromagnetic spectrum, what is considered by UVGI technology is the segment of ultraviolet radiation, which is further subdivided into UVA, UVB and UVC. According to recent studies (Kowalski 2009), complete disinfection occurs at a wavelength ranging from 250 to 265 nm and thus falls within the UVC portion of the electromagnetic spectrum. Consequently, different types of lamps have been developed to achieve these specific wavelengths, which are now more easily achieved with LED lamp devices. Furthermore, it should be noted that each bacterium or virus requires an appropriate ultraviolet dose to inhibit its ability to reproduce and be harmful. This ultraviolet dose is calculated according to the exposure time and the intensity of the radiation to which the bacterium or virus must be exposed, and the new generations of LEDs respond very efficiently to this duration. Purifying the air, absorbing harmful substances, and combating electromagnetic pollution in the home, in workspaces, and collective living spaces, certain types of material and even certain paints, as well as certain surface finishing treatments, whether of walls, floors, ceilings, or worktops, are also able to do so (Grandin and Textor 2012). Therefore, there is a need for continuous updating on the performance of new materials and devices. However, above all, there is a need for a new culture of the performance and interacting capabilities of finishes. A culture that wonders and knows how to decide how much is enough. A culture that knows how to take advantage of alternative sources of energy supply to the conventional. Even from the surfaces of objects, of building facades painted with special pigments, the



**Fig. 3** Luminescent Solar Concentrators (LSC). Photo by Jiaqian AirplaneFan, CC BY 3.0, via Wikimedia Commons

technological capacity to store energy is already a reality. At the same time, the research by MIT and the FRSC Department of Pisa, together with researchers from the University of Groningen, is concrete experiments that have led to the creation of special photovoltaic cells on transparent photochromic films capable of selecting and capturing a specific part of the electromagnetic radiation of light (ultraviolet and infrared) without preventing introspection by the human eye (Carlotti et al. 2016) (Figs. 3 and 4).

Another emerging technology that is showing great potential is based on photocatalytic oxidation and was launched by Akira Fujishima and Kenichi Honda in 1972 as a unique technique to oxidise certain volatile substances in the air, today, the refinement of this process exploits the photochemical properties of specific semiconductor nanomaterials to reduce through oxidation, the pollution of certain highly harmful compounds when irradiated by a specific wavelength of light. Thanks also to the use of new ‘mixtures’ that ‘eat’ carbon dioxide, the walls of buildings are transformed into ‘purifiers’ of bad air quality. It is the latest generation of paints that help combat harmful agents or energy waste or generate energy. Among the paints designed to combat energy waste, studies focus on how to retain them. One component that has proven to be crucial in this is graphene. In combination with lime, this element, characterised by its high electrical and thermal conduction capacity, allows the temperature of buildings or surfaces on which they are applied to be kept constant, enabling thermal regulation, and thus avoiding waste.

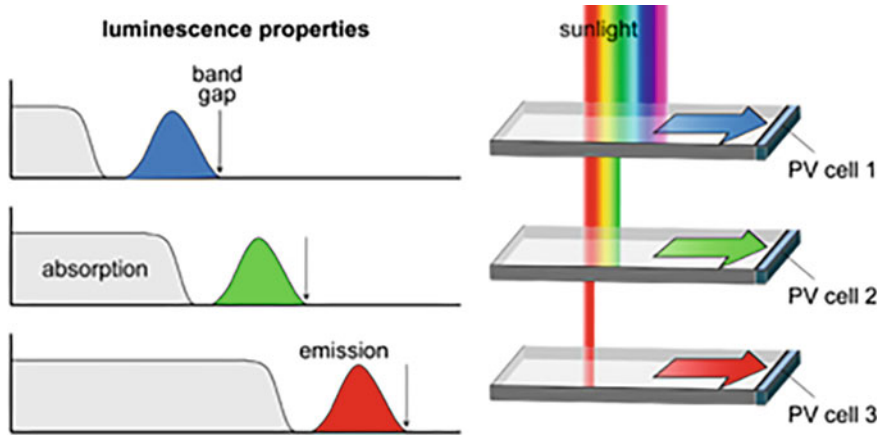


Fig. 4 Luminescent solar concentrators, structure and operation. Source <http://www.fotovoltaiico.sulweb.it/guida/lsc-e-quantum-dot-per-rendere-fotovoltaiica-ogni-superficie.html>

## 6 Energy-Producing Surfaces

Other examples of intangibility design consist of applying the reactivity of energy-capturing surfaces. Among energy-producing coatings, research is focused on the interaction of surfaces with solar energy and atmospheric elements. At the Royal Melbourne Institute of Technology, they have experimented with the possibility of producing hydrogen using energy from the sun and moisture in the air by reacting a mixture of molybdenum sulphide with it. Once the paint absorbs the water and releases it into the air, it produces titanium dioxide, known for its ability to interact with light. According to scientists, the ‘electrolytic’ paint would then be able to break down the elements of the water molecule, hydrogen, and oxygen, upon exposure to the sun to produce electricity. Regarding producing energy from the sun, the University of Toronto has developed an exciting research project involving the design of photosensitive paints and sprays. These paints could turn any surface into a small energy production plant. Experts at the university have developed a new technique for ‘spraying’ solar cells on flexible surfaces using tiny photosensitive materials that would act as absorbent elements. Much attention must be paid to the changing performance of surfaces in a future that is already transforming, prompted by the dematerialisation of some hitherto irreplaceable structures. Photovoltaic panels have also gone the way of the spray version. Technicians from the Catholic University of Notre Dame, Indiana, have designed Sun-believable: a solar paint consisting of titanium dioxide nanoparticles that, with water and an alcohol solution, form a sort of ‘paste’ to be applied to transparent conducting materials to generate energy. It must also be said that nanotechnology and superconductors have taken on highly advanced challenges towards the possibility of extending human senses to machines. Thanks to state-of-the-art sensor technology, it is now possible to ask not only to acquire ‘standard’ physical quantities such as pressure, temperature, voltage and the like

but also to extend man's sensory faculties to machines with technologies that have the function of seeing, such as those for image acquisition, feeling, such as increasingly sensitive membranes, communicating, such as with epithelial apparatuses, and moving, such as with bionic micro-prostheses. MEMS (Micro Electro Mechanical Systems) (Huang 2018) proposes a whole new world to invent and experiment with enormous unexplored potential even though inertial sensors in our smartphones, strain gauges for industrial machines and other everyday components are already made with MEMS technology. We must consider that almost all our devices are installed without our knowledge.

## 7 Change with Subtlety

As a result of these new performance characteristics of materials and especially of the performance of the new variable-performance surfaces, a culture needs to be founded that favours their characteristics. Spread its use. Make it a design culture. A design culture that, by taking an interest in detail, gives scalar benefit to the differentiation of energy production and consumption. This type of planning, hitherto considered only to support the criterion of choice, now needs more study and appropriate adaptation to technological knowledge to be coherent with the meaning it intends to express and the advantages it can bring to the ecological footprint. There is a growing need for this kind of design as much as a growing interest in it (Wackernagel and Beyers 2020).

The demand is for sensitivity. First, to be sensitive in perceiving and exercise sensitivity in the proposals to be offered. Pay attention, urge, and induce sensitivity to environmental problems while intervening with and on sensitive elements.

To be attentive to small details that can, on the macro-scale, favour and implement the awareness of the various actors that, from design to production, from distribution to fruition, act in the community of artefacts activating new virtuous human behaviour (Cicerchia 2016).

In the Smart Lighting Lab at the University of Florence that I direct, some design experiences are configuring objects and new performances aimed at containing and soliciting new sensitivities starting from neglected details or phenomena. Interestingly, in studying lighting conditions to seek advantages in both savings and visual well-being, the Tyndall effect has led some research to find new applications for a phenomenon neglected for its comfort properties and modulation of artificial light to natural light conditions. The Tyndall effect describes the dispersion of light in a substance by particles dispersed in it. The phenomena we all love, such as sunsets and sunrises, where part of the sky is painted in vibrant colours from yellow to orange, red, pink, and indigo, while the rest of the sky is still blue, are caused by effects like the Tyndall effect (Immirzi and Tedesco 2017) (Fig. 5).

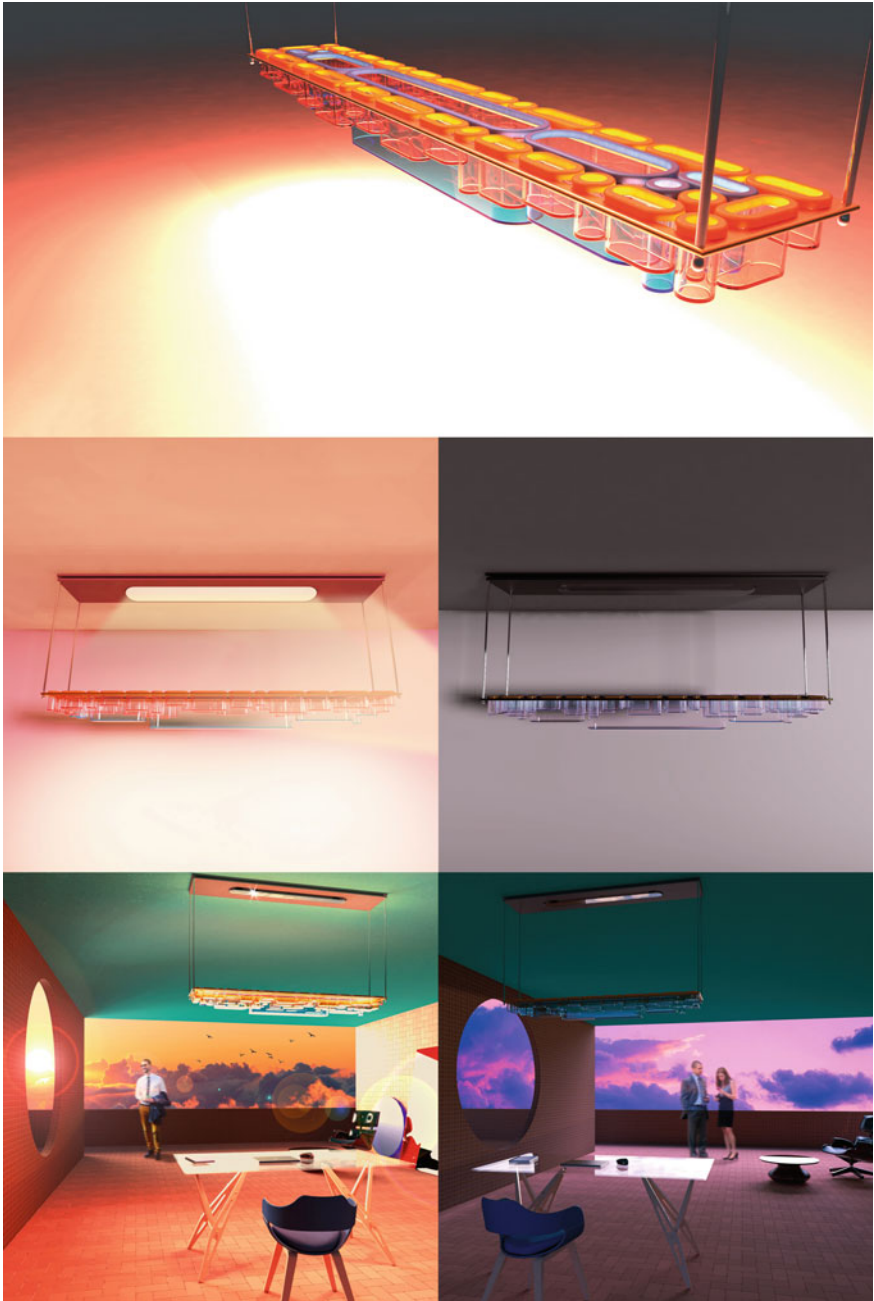
The everyday use of lamps considers them to be used in low ambient light conditions to allow the user to perform complex actions in sub-optimal daylight conditions. Commercially available lighting solutions include lamps with reflective surfaces that

**Fig. 5** Tyndall effect. Photo by Gianpiero Alfarano



can expand or channel the light beam generated by an artificial light source. In laboratory experiments, we also asked ourselves whether exploiting these reflective surfaces for daylight would be possible. The answer was expressed in creating a lamp that uses these surfaces to direct natural light into a dimly lit corner of a room or even onto a desk with the user's back to the light source. By directing natural light or polarising the room's residual light towards the poorly lit portion of the space, the lamp modulates the light colour through the Tyndall effect. That is, external light is concentrated through the internal refraction of the glass elements, reproducing warm or bluish colours on the outside about the inclination of the light beam. The glass made opal by particles with a diameter between 40 and 900 nm filters the light and changes its colour (Fig. 6).

This solution is also expected to positively impact daily energy expenditure because it would avoid switching on artificial light sources in particular environmental conditions. A further advantage of this lamp is the Tyndall phenomenon's impact on the user's circadian rhythm, as it could reduce the harmful effects of prolonged exposure to artificial light. In addition to putting into practice what has already been described, this lamp has also been proposed to experiment with the recovery of glass production with polarising microparticles that date back to antiquity and is now out of practice. With the stimulus of the beneficial effects of the Tyndall effect, it could be regenerated again. It is not a matter of adopting hyper-performance materials or advanced technology systems but of bringing back neglected techniques, knowing how to express new purposes realised with small expedients and new sensibilities towards their use. A subtle way of designing with choices and attention to finesse that can open new practical and low-cost benefits.



**Fig. 6** Lamp with Tyndall effect. Experimentation smart lighting design lab—UNIFI. Design and rendering by Davide Uricchio

## 8 New Sensitivities

The contextual conditions described so far, starting from the responsibilities in which the culture of the project is placed in the emergencies and availabilities of the contemporary, refer to and demarcate, among the numerous responsibilities to be assumed, above all, the need to acquire greater awareness in the tacit and at times even insidious passage from the Economy of Services, considered the most advanced front of the project of immaterial values, to the Economy of Experiences. A new hemisphere of sensitivity thus presents itself completely unexplored. From the implications of cultural status just described above, of an eroded future (Papanek 1985) and existential implications at the very root of design (see Introduction), there emerges the consideration of how much design needs to equip itself with motivations and decisions based on factors of new relations between humans and Nature that are effective in putting into action all kinds of interventions essential to anti-waste processes. Among those mentioned above, we can highlight two fundamental ones: attention to waste even of creative energy and attention to the ecological footprint neglected by human incidence and prevarication over Nature. Blinding is the principle of dominance through which the method of exploitation of every resource element is practised. What eludes the criterion of choice is precisely the recognisability of the principle of belonging, which due to blindness, even in some respects consequential and unpremeditated, only produces catastrophic scenarios if not put about reciprocity with Nature itself. As a result of this largely cascading trend and little tackled in global terms, as in many cases throughout history, the issues are more accessible if addressed through cultural rather than technological avenues, even though there are ample possibilities such as those available today from the plethora of innovations. The transition that cannot be postponed becomes concrete if adopted culturally. It is already a kinetic implementer of structural behaviours capable of affecting the actual realisation of the ecological transition.

Today, the criterion of choices is overlaid with other possibilities, new skills, and newly conceived methodologies. Negligible elements, even if not wholly, but considered implicit as happens to colours, scents, sounds, flavours, materials and performance, surfaces, and finishes, in a new scenario of technological potential and new cultural sensitivities are no longer chosen, they are designed (Bisson and Boeri 2006) contrary to what has been understood until now as being intensely concentrated only on taste that selects what is proposed. This requires questioning old strategies and conventional empirical observations in favour of new scientific acquisitions provided by nanotechnology for intelligent materials and neuroscience to benefit a more appropriate sensory perception (Bengisu and Ferrara 2018).

There is a need to refine new criteria based on sensible and practised factors with a strong involvement of intangible values.

The body's senses are the doors through which we have access to relationships with the context in which we live. The many external stimuli allow us reactions that involve the body and mind. Design, having always been dedicated to this reciprocity, now can do more: to engage the 'emotional system' with new attitudes (Fina 2015).

Acting on what, starting from a simple sensation, one can determine others gradually more conscious, advancing beyond simple instinctiveness. To determine quickly, easily, and recognisably the possibility of stimulating a part of the system by obtaining changes in the entire reactive response.

In the advancing innovations, there are tools, techniques, and technologies, also of a digital structure, that allow, with more excellent contact, a direct dialogue with emotional resonance phenomena. Not to be confused with the increasingly marked progress and development of disciplines aimed at scientifically constructing emotion.

It is suspended between the biological and cultural dimensions, and emotion seems intrinsically to escape due to its spurious Nature, any rigid attempt at regimentation. For this reason, the idea of designing emotion is probably destined to remain an ideal and, simultaneously, an ambition that is as inalienable as it is unrealisable and perhaps even presumptuous. In some ways, proposing the design of emotion still leads back to a method that is as obsolete as it is reprehensible towards ecological sensitivity. The shift from the consumerism of tangible goods and material possessions to the consumerism of emotions, considering the latter to be interesting enough to include intangible things, is all too obvious. While principles and ideals need constancy and durability, with an investment directed at the desire for long-term benefit, emotions expire quickly and change immediately. So: more consumerism than that! This trend indicates how the willingness to invest in the pursuit of excitement has become so rampant that it fuels the so-called experience economy. The consumption is no longer of a single emotion but of a collective experience of several possible emotions. However, this is undoubtedly not the sensibility required to include intangible and intangible aspects in design.

Rather than designing emotions, design has a vocation for generating sensations, which a today is a new approach and participatory immersion. In practice, there are new conditions to bring the senses into play and design for them in unison without the sole privilege of sight or aesthetic immanence.

It is feasible and highly desirable to set the project towards a future vision in which the technological world, with which we have established a relationship of instrumental exploitation, ceases to be so, and gains an emotional connotation, with attention therefore not only to our physical needs but also to our psychological and relational sphere.

This can help us move away from the idea that it is the object or the environment that triggers emotions and instead explore a process of knowledge of the increasingly delicate and fragile subtleties that foster and determine affection towards an artefact or a space. In other words, it means paying delicate attention to how people construct things and how things construct people.

With each innovation and new technology, we encounter, our perception of the world changes: we experience it. Differently, we acquire a sensitivity that was not there before, which has existential and psychological implications, influencing the repercussions of our behaviour in the context and human relationships. Refining the assumptions described so far, the trajectory that design can increasingly follow in the reception of ecological instances and the relationship with Nature is evident in the management of new design attitudes and sensitivities that, starting from sensorial



perception, lead to greater attention to detail. One of the main design sensitivities to be developed consists in the constant inclusion of the time factor both in the conception phase, in the choices and decisions to be made, and in the materialisation with every possible expression of the motivations that have generated the new and that from them can generate virtuous behavioural benefits on the relapses. The time factor that uses the details to make the difference, and the finishing touches and the finesse in paying attention and care make the substance. It is precisely the exercise of attention and the practice of care that is desirable that are widespread. Possible yet broadly feasible expressions of design but neglected in favour of the general concept of profit and the marked adherence to the logic of profit. Much of what can contribute ecologically can pass from the assumption of keen sensibilities and the no less negligible time factor capable of offering recognisability to the authentic that goes beyond the spasmodic search for identity.

Highlighting the dynamic character of objects and environments means including the time factor that oscillates between obsolescence and evolution, making the designed work dynamic, changeable, and more truthful of what it can bring at the end of its mission. The skill lies in the construction of a reading with which the “visuality” is no longer to be considered only of the object but also very much of the representation of it in which one can recognise the motivations that generated it and appreciate the consequential effects in it right from the start.

A new condition for a design that, if encouraged and valorised in its role as the primary vehicle of formal communication and in its capacity to solicit awareness, will succeed in constructing paths and practical tools to collaborate in reducing the harmful footprint of artefacts on the planet, and give more excellent quality to life.

It will be desirable that the conviction prevails that effective design thinking today involves much more than just applying design methods. To achieve substantial results, new design sensitivities need to be developed with new visions that foster new attitudes above all the osmotic reciprocity with the biological aspects of which we are made and of exchangeable inclusions of the rhythms and phenomena of Nature.

This approach supports a holistic practice of Design (Manétrey and Szerman 2016). It promotes an interchangeable relationship between variable conditions and sensory properties by enabling them to change how we design objects and spaces. In these sensitivities lie many of the hopes of imagining our futures that we are with Nature like our being as well as being for it our respect.

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