

FROM HUMAN-CENTERED TO MORE-THAN-HUMAN DESIGN

Exploring the transition

edited by Barbara Camocini and Francesco Vergani



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DESIGN INTERNATIONAL

Cover image by Sara Sciannamè

ISBN e-book Open Access: 9788835132585

Date of first publication: December 2021

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Introduction

*Barbara Camocini**, *Francesco Vergani**

The environmental emergency of the last century, highlighted by the pandemic (Morin and Abouessalam, 2020), has led to an urgent need to reformulate the predominant role of human beings on the planet by undertaking a less anthropocentric design approach (Díaz et al., 2019; Fry, 2017; Laybourn-Langton et al., 2019). This urgency has been especially outlined by a re-evaluation of the concept of the Anthropocene, which can be defined as a geological era characterized by the significant human impact on the geology and ecosystems of the Earth (Braidotti and Hlavajova, 2018; Edwards, 2015; Ellis, 2018).

Within this theoretical framework, the book explores the role of Design as multifaceted discipline capable of exploring the complexity of a changing world, and reconsiders the human being's position in a pervasive relationship with the contemporary environments (physical and abstract) through a more-than-human approach. In this volume that illustrates reflections, analyses, and interventions guided by or intersected with the concept of the post-Anthropocene, two different scales of observation can be traced. The first, explored in the two starting chapters, highlights how the complexity of the topic requires a large-scale analysis perspective in order to be fully understood. The concept of the post-Anthropocene does not exclude the human being as a fundamental component but takes the latter as a

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departing point to frame wider contemporary needs and issues and to support a call for action to envision and shape the future. The second part of the book instead explores the possibility to include, within this broad discussion, the theme of More-than-Human applied to specific disciplines – linked to the culture of Design – analyzing different aspects that move from taxonomy, application, and creativity.

The first chapter by Biamonti, titled ‘The Political and Social need for a New Design Culture’, describes the pandemic as a phenomenon that brought to light the fragility of our system of values on different scales. Even if the diffused overprotection and recent restrictions has affected human relationships, the Covid-19 emergency has injected new energies to revise old paradigms and to assign new meanings to our actions. The pandemic has opened new opportunities at different levels of contemporary life, fostering designers (professionals, companies, schools, and other institutions?) to see projects not as isolated phenomena but as part of the dynamics of contemporary times. The author argues that the real objective of designers and the ecosystem of which they are part is the production of scenarios – often clearly different from everyday life – built on the objectives, themes and conditions of the present.

The contribution goes on to develop an analysis centered on the following topics: inclusion, sustainability, respect, designing with/for, beauty and meaning. The topics selected by the author confirm the analysis perspective that invite a transition from the central position of the human being to more-than-human perspective, where, for instance, *inclusion* means *boundaries* open to all, allowing any difference to be assimilated whereas *respect* is to be addressed to both users and framework. The last two topics are particularly interesting as they are not directly traceable among the core concepts of More-than-Human Design. The author defines *beauty* as an anthropological tension, a dimension of human existence, which assumes a new level of *meaning*. In fact, *meaning* follows *beauty* as a key factor, referring to the initial interpretation of reading a new vision of contemporaneity.

The second contribution by Di Prete and other authors is about ‘Design for urban regeneration’ and expresses the previous synergistic perspective even more clearly by placing actions-research be-

tween Design and Anthropology in a multispecies world. If in the previous contribution the author refers to the development of future scenarios starting from the conditions of the present, the second chapter suggests the assumption of a projective perspective, *moving the edge* where the anthropology of the future is promoting the uncertainty and the fragility as vectors of innovation. The contribution focuses on peripheral areas, where marginals and diversities show a *residual authenticity* that has to be preserved. Exploring this *residual authenticity* – a concept that embrace different components – requires a new point of view to interpret urban regeneration from the perspective of the post-anthropocentric era. The authors suggest that Anthropology and Design can effectively co-operate in studying the existing, exploring the future and co-designing a positive change.

The first part of the chapter presents the concept of regeneration as an opportunity for innovation to be gained through a consolidated cooperation where the anthropological view has guided the design work, experimenting tools and practices. Four case studies involving the Municipalities 8 and 9 of Milan experimented a high participatory approach in diverse modalities. The common goals shared by the case studies are about the requalification of anonymous urban interstitial areas which remain largely unrecognized. The strategy here promoted has been to involve the community – with a particular emphasis on the voiceless community – involving them in prototyping solutions, managing their contribution in the different phases of the design process and with different modalities.

The second part of the chapter focuses on possible future scenarios – already hidden in the present – that require new design experiences to be developed. These include the *built environment*, and the integration with the animal and plant world as a major challenge, reimagined as a potentially *augmented* ecosystem, sustainable, hospitable and rich in biodiversity.

Searching for *residual authenticity* in complex networks and ecosystems requires new ways to envision relationships in the post-Anthropocene. Old paradigms are no longer effective to face the multifaced dimension of the contemporary world and Design must find new practices to face the complexity of conducting research. As described by Gatto in the third chapter, Multispecies Design emerges

as a possible way to move beyond the ethnographic boundaries of the past and the present. Looking into the future with a post-anthropocentric approach means considering more speculative stances leading to world-making processes, embracing agents from the natural world to develop new storytelling and scenarios. The author highlights the issue of communication in a more-than-human world wondering about the need to frame participation between human beings and plants. As a long-standing issue, Gatto explores new ways to trigger encounters within the plant world by presenting two projects that follow plants' metabolic processes. *Geomerge* and *Vegetal Rescuers*, intertwines plant research with a series of ethnographies focusing on the theme of vegetal agency in contaminated landscapes. The contribution highlights how Design Research – supported by new tools and practices – can open infinite and unexpected possibilities for participation in the post-Anthropocene.

As previously stated in the first contribution of the volume, the urgent environmental and social conditions have triggered new paradigms to go beyond the Anthropocene. Designers can and must play a role in this journey, updating their methods and approaches to anticipate the forthcoming and unclear future.

In this framework, the fourth chapter by Piccinno focuses on the need to develop a new Taxonomy of contemporary Spatial Design in order to respond ethically to the global emergency conditions by using a holistic vision of the world. By assuming that human beings are part of a *whole* – and not the center of the *whole* – the author states that spatial designers should be able to develop a new taxonomy built on Design Tactics as strategies to envision post-anthropocentric scenarios that are primarily conceptual experiments and visions and subsequently formal aesthetic outcomes. These Tactics may be useful to cross borders between different disciplines – such as humanistic logic, scientific knowledge, transdisciplinary attitudes – and to observe the complex relationship between *nature* and *artifice* with new experimental approaches such as Technonatures (i. e. a continuous renewal of its capacity for genesis, creation, and adaptation, capable of absorbing the artificial as its component).

Spatial designers must be involved in cross-disciplinary teams, which operates within a design scale of variable intervention, from

micro to macro, for a concrete ecological vision of the project towards the post-Anthropocene Era. The urgent environmental and social conditions, therefore, require serious reflections on the role that Design and designers can and must play in modifying the consumerist dimension and the unsustainability of human action over the last hundred years, in order to shift the axis towards a non-anthropocentric vision that considers equilibrium as a basis for any (human) impactful action in the Earth environment, up to and including the Cosmic dimension.

Shifting in the post-Anthropocene means focusing on the envisioning of new Design practices but also requiring the search of new ways to apply concretely design researches. In an ever-changing world where finding resources is becoming harder, Design has to find new ways to imagine, develop and create new solutions. In this framework, the fifth chapter focuses on materials as the first and fundamental design component that contribute to a sustainable transition. If yesterday designers were focused on selecting the available materials, today they are called to find more suitable and sustainable solutions. Rognoli and the other authors highlight the need to focus on organic waste, circular and bio-manufactured materials from living organisms as emerging trends to support the transition to the post-Anthropocene Era.

Biocompatible organisms, such as mycelium, bacteria, algae and yeasts – as well as organic waste – are considered as an alternative source in producing new bio-based materials, improving sustainable development and promoting effective waste management. Nowadays it seems no longer possible to distinguish if materials derive from natural resources and those from waste and the boundary between natural and artificial is becoming increasingly blurred. The fifth chapter frames the need to focus on the innovative potential of organic waste as a valuable way to support bioeconomy, strengthening the concept of a symbiotic human-nature perspective that can be prompt at any level, from Politics to bottom-up and DIY initiatives. Design and designers, as previously highlighted, are expressing a high social impact in fostering awareness towards the issues of the Anthropocene and more than others are positively supporting new forms of bioeconomy. In the same way as the contributor of the third chapter,

the authors effectively make a point in showing the ways in which Design Research is implementing new ways to produce sustainable products, describing emerging trends for the transition to a post-Anthropocene Era.

The last contribution by Canina and other authors focuses on creativity and the way in which the digital evolution can support new forms of creativity in a more-than-human world. Stating that creativity is mainly a human-based skill, the authors wonder how it could be possible to shift from a Human-Centered approach to a More-than-Human one, framing Design tools, methods and approaches to support the transition to the post-Anthropocene. In this chapter, digital transformation is described as the main stream to support any kind of creative and intellectual process (both human and non-human) as well as green and sustainable transition. The authors underline the emerging technological advancement and digital transformation as essential tools to sort the complexity of the contemporary era. More specifically, they declare that Design must be a guiding light to achieve the Digital Maturity – intended as a “continuous and ongoing process of adaptation to a changing digital landscapes” (Kane, 2017). The conclusive chapter explores the topic through 3 main dimensions: Regenerative Creativity that unfolds a new perspective of creativity as a result of an assemblage of human and non-human agency, Digital Creativity that defines how both humans and digital technologies can be creative and Future Thinking which generates a more exhaustive, innovative and forward-looking approach to the topic. The second and conclusive part of the volume highlights the potential and the great impact that Design has in the post-anthropocentric perspective. Its culture and practices have always played a prominent role in binding different disciplines, and now more than ever they can lead the path to envision the richness of the still-unexpressed future which is ready to be explored and designed.

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1. The Political and Social need for a New Design Culture

*Alessandro Biamonti**

Abstract

The pandemic that we are facing worldwide has highlighted some fragilities of a system of values that we took for granted and, at the same time, has brought out new paradigms and new energies, both unknown and known yet unattempted beforehand. Still, we did not dare to put them into practice. For both those strategies involving large organizations and companies and the private daily life of individuals, it has become of pivotal importance to deal with the new meanings that the pandemic has made us attribute to our actions and relationships.

The city's spaces have been changing and so have the times, with their own social interactions. The economic leverage (as it previously happened with the myth of the function) has proven ineffective in guiding urban transformations. *Inclusion, sustainability, respect, sharing* – without forgetting *beauty* and *meaning* – are key concepts for the development of contemporary projects.

Within the tradition of Design in our own Country, it might be worth mentioning the peculiarity of what we call Design Culture (Cultura del Progetto), an approach which has always preferred the generation of meaning over the search for solutions.

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In this framework, the world of Design faces the great opportunity to redefine the foundations of a new Design Culture for the third Millennium, which reaffirms the political and social contribution of this discipline. Indeed, a political and social design culture, rather than relying on an ideological paradigm to defend, connects better with the events of public life as well as to those strategic choices to be made for the future of a community.

1.1 Premise

In the early 2020s, an unprecedented period that could only have been thought of by visionary either screenwriters or novelists began: the world came to a stop because of a “flu”. A virus (from the Latin “virus”, meaning a poisonous secretion), a microscopic biological entity – a parasite – started to proliferate among humans, causing such terrible damages that unprecedented precautionary measures such as social isolation and lockdown were necessary. All forms of interaction between human beings, whether related to physical contact or merely proximal, were reduced to an absolute minimum.

In spite of the many reflections published in record time, there is still room for better elaborating how much this pandemic condition has affected our dimension as human beings, our relationships, the construction of a system of values, both social and individual. What has already emerged quite clearly is that this new condition of deprivation of certain possibilities previously taken for granted has also opened up new chances.

At first, the winning strategy was undergoing over-protection. Individuals closed themselves inside their small private sphere, shielded from the outside world. Be that as it may, whilst technically effective against contagion, isolation unfortunately raised a sense of diffidence towards any “other”. However, in the long run this enclosed scenario, isolated from a potentially dangerous outside world, brings out how the condition of “other” is represented by everyone, therefore at the same time by no one. Because, as they say, “we are all in the same boat”. It is therefore desirable to adopt an approach that aims to break down the diffidence that has been generated, through

an adequate quantity (and quality) of information, practices and useful methods to develop a sense of belonging between the members of the same community.

Indeed, the ultimate scope is to create a community that can be trusted and that trusts itself. For the Design Ecosystem (professionals, companies, schools, etc.) we are clearly facing the most important challenge and opportunity since the first industrial revolution: the need to collaborate in the formulation of paradigms for a new balance in society. This new balance entails, first of all, that we attribute the due value to those issues that had previously been neglected within the strict economic and political program of the “running locomotive”. This leads us to the question of environmental sustainability, which stems from a desire to reconsider as vital those solutions to problems that are currently jeopardizing the future of the planet. Accordingly, a new conceptualization of balance, in which growth and economic well-being become the driving force behind the search for solutions instead of the cause or consequence of the planet’s inequalities. Indeed, this virus, which has made us all feel more fragile, imperfect and human, may also have taught us to understand how it is precisely in that fragility, that imperfection and humanity are the foundations for a new energy, a new strength. This period has also reminded us that the ultimate goal of designers – and indeed of companies – is not just to make money on furniture, objects and services, but rather to help build a better world in which we can spend our own lives and those of future generations in the happiest way possible.

The Italian tradition of the “Design Culture” (Cultura del Progetto) finds its roots in this approach and represents a double possibility of interpretation. On the one hand, that of the designer’s individual point of view, in which a project is approached not only with the scope of providing a functional answer to a specific need, but also in terms of elaborating the issue within a wider socio-cultural dimension. On the other hand, from a broader point of view inherent to society, it represents the result of an eco-systemic phenomenon, which does not only concern the “design community”, but is also inserted within a specific local context. In this way, each project not consti-

tute an isolated phenomenon but is part of the contemporary dynamics of its day and age.

The current pandemic situation, which, as previously outlined, can be perceived a starting point towards a new condition, also represents an important standpoint. This is indeed because the approach of the “Design Culture” does not refer to distant possible futures, but rather to an evolution of the present. The real objective of the designers and the ecosystem of which they are part becomes the production of scenarios. These scenarios, often clearly different from everyday life, sometimes even utopian and disruptive, all arise on the basis of solutions, dynamics and technologies that can be applied and used today. Thus, they work as scenarios and visions of an alternative present. Therefore, as we have experienced in recent years, the future can reserve us the surprise of technological, political and social events that may cause sudden changes of direction, opening (or unfortunately closing, in some cases) possibilities for our lives.

It is therefore desirable to keep on producing visionary scenarios, while also avoiding holding tight to the *alibi* for which any element or condition required for their actuation may depend on a future we cannot control. Finally, we should always remind ourselves of the importance of focusing on certain precise objectives, themes and conditions, arising from both the opportunities and the challenges of the present.

1.2 Topics

1.2.1 Inclusion

There is a general misunderstanding between the concepts of inclusion and integration. Integration, which has been at the centre of many social and political battles in recent decades, is a concept akin to the idea of normalization (i.e., smoothing out differences in order to achieve a condition of normality). In this view, differences are seen as something to be removed, in such a way that are invited, helped (or sometimes pushed) to change themselves and adapt to

normal conditions. Inclusion, as cited by Gaspari (2020), who himself draws from the sociologist Habermas:

Does not mean assimilatory grabbing, nor it does not mean closing oneself off from the different. Rather, inclusion of the other means that the boundaries of the community are open to all: also, and especially, to those who are mutual strangers or who want to remain strangers.

As far as its philosophical framework, while integration represents an added value to the results of a service, inclusion is a fundamental right of every human being. Therefore, if integration can be understood as a linear process, with rules aimed at a goal to be verified, social inclusion is presented as a dynamic process, unstable and in continuous definition, because it constantly brings into play the rules and balances between the individualities of a community (Trabucchi, 2020). From a design perspective, the concept of integration can be brought back to the practice whereby differences must be eliminated in order to make all the elements cohere with the parameters of a pre-established “normality”. On the other hand, within the concept of inclusion, the context must possess those characteristics that will allow any differences to be assimilated. In this way, inclusion also emerges as a concept capable of overcoming the era of the “standard”.

1.2.2 Sustainability

The issue of sustainability has been a topic in the field of design for decades, thanks to scholars of the likes of Thomas Maldonado or Ezio Manzini, who have strongly contributed to raising awareness among generations of designers, researchers and even organizations and companies. In the face of the most recent forms of commitment to protecting the planet, it is necessary to remember that this sensitivity in the world of design can flaunt a long-established tradition. Such a tradition has changed over time, taking on a more complex form, in an attempt to include issues that, whilst not strictly related to environmental debate, have emerged over time as important for a global condition of sustainability.

The definition of sustainability has, in fact, expanded over time to include, on the one hand, economic-social issues in which there is a relationship of reciprocal influence, and on the other, some more vertical, in-depth studies of supply chain issues relating to materials, processes, etc. Today, a reflection on sustainability is to be considered essential in any projects, and for each project it requires a specific declension.

1.2.3 Respect

Respect, in its most classic definition, is the act of “admiring (someone or something) deeply, as a result of their abilities, qualities, or achievements” or a “due regard for the feelings, wishes, or rights of others”, thus, a feeling embracing both esteem and regard. In fact, the term “respect” derives from the Latin *respēctus* (esteem), which in turn comes from *respicere* “to look back”, in other words, to look a second time. You look at something a second time when you have either not understood it, or when you want to appreciate it again. In any case, one does so when something is worthy of interest. When it therefore deserves respect.

In the context of Design discipline, the term is important on two somewhat related levels. Firstly, there must be adequate “respect” for the users of projects, their needs, their expectations. Secondly, it is important to note that projects which arise within the framework of “respect for people” deserve respect themselves. The work of the designer, or rather the action of designing, fits into that territory that lies between Technique and Culture (Maldonado, 1991). This is an important position which underlines that what concerns either only Culture or only Technique is not Design but it is something else. Yet this condition of being “between” two poles does not indicate a fixed position in a third dimension, but rather the temporary and ever-changing condition of a balance that includes both technical and cultural elements. A delicate balance between these two sides that should also take into account their characteristics, needs, and expectations with great respect.

1.2.4 Designing With/For

Arguably, the times we recently experienced has forced us to reflect on how unavoidable *sharing* is. As a community of human beings, whether we want it or not, whether we seek it or not, it should be clear today that we share the same fate.

History has shown over time the fragility of borders, walls and barriers: both those physically constructed and defended in the past, as well as the more contemporary ones, often less tangible but erected with the same inner logic of “keeping something out”. That “something” which, when conditions become critical, when entropy collapses, can never be contained. The reason beneath this change lays in the belief that humanity has more to do with communicating vessels than with clusters. It has become once again evident that we would take advantage from visualizing ourselves as a single complex community. Within the cultural debate of Design discipline, scholars have started to veer towards this direction. In fact, today we are witnessing a growing number of experiences based on sharing and collaborative inclusion, so much so as to make them one of the defining factors of our times. In addition, a significant sign of change is also coming from international competitions (one such example is the Italian Compasso d’Oro), which reflect the emergence of a growing sensitivity towards projects with a strong social impact, oriented towards a system-wide exploration rather than the definition of a circumscribed object. Such projects often developed in the framework of a broad multidisciplinary participation, involving also end users. This new scenario can help the development of new models of reference, new narratives for our dynamic, vital and cosmopolitan society, on which the various experiences based on sharing are inserted and find fertile ground.

In recent years, many authors have explored the role played by design in the “big picture” of our complex society, highlighting how in recent decades we have increasingly moved from designing objects to designing systems and services supporting society, and how this has necessarily led to working *with* society (Manzini, 2018; Thackara, 2005; Norman, 2011).

Moreover, a further change is represented by the passage from times in which designers, albeit with good will, were finding new so-

lutions from the top of their profession, to a more effective condition in which such solutions are developed in collaboration with other people from outside the design community and yet provided with complimentary skills and a direct involvement in the issues to be tackled (Mulgan, 2013). Indeed, if on the one hand good design has always brought unexpected results, on the other the most attentive and sensitive people (non-designers) have always welcomed these new results in a very natural and intuitive way, as something they have been waiting for in their daily lives.

So, in the words of Don Norman (2011):

When you go out into the society, and you try to do things for the society, you've to work with the society.

1.2.5 Beauty

Although the question is a decidedly uncertain one, it is not possible to conceive a design action that does not include an aesthetic intention, or that does not produce beauty. The history of humanity shows us that beauty is an unavoidable question. Indeed, beyond the parameters by which it is measured, beauty is a psychophysical sensation that human beings have always strived for, ever since they first sketched the world around them. Without considering phenomena related to the purely artistic dimension, the history of human material culture – with the first graffiti, drawings, decorations, shapes and materials – is a sequence of demonstrations of how the creation of “useful” objects has always been accompanied by the search for beauty.

Beauty can also be interpreted as a social construction as well as a cultural phenomenon. Indeed, the aesthetic experience may consist of universal evidences, often linked to natural phenomena, which come to be perceived, almost physiologically, by the senses without the need for cultural interpretations. Instead, it can be found in the result of different socio-cultural declensions, whose understanding requires a sharing of information, history and values, as typically occurs within a given society.

Design has an important role in the construction of beauty, above all by acting in the combination of the two aforementioned dimensions, the natural-instinctive and the socio-cultural, through the construction of meaning. Since beauty is a complex issue, and in order to avoid the trivialisation produced by the search for a simplified dimension, it is necessary to train ourselves in understanding and perceiving the complexity of beauty. We need to learn how to recognise its nuances, its limits, which lead us to find beauty in tragedy. As an example, we may think about the works of extraordinary beauty that, like Michelangelo's *Pietà*, depict scenes of heartrending tragedy, flowing into the sublime. The desire for beauty has no gender, no race, no age. Beauty is in fact an anthropological tension, an energy that runs through the history of human beings, both in the dimension of individual existence and in the shared values of a social context. For a designer, beauty is an essential, intrinsic component of his or her work of building a new world that, if uglier, can never be better.

1.2.6 Meaning

Contemporary Design appears to be a territory whose perimeter does not seem to be defined by a clear line, but rather by a blurred zone, which is in fact typical of those disciplines characterised by a wide margin of hybridisation and unpredictability.

Design is certainly not a science, and consequently its results are not certain and unambiguous. Such a condition leaves a wide margin of action and interpretation for the human element, and therefore also room for the emotional component, which, whilst being difficult to manage and assess, is becoming increasingly important over time. This is inevitable if we consider the impact that Design can have on people's daily lives. We are therefore referring to a discipline characterised by contrasting elements, which can be held together by what represents the true focus, the true goal towards which every design activity should tend: the creation of meaning. The production of meaning represents the overcoming of the typically early-20th-century limit, that pertains to the centrality attributed to the concept of "function". Often seen in opposition to

the presumed superficiality of a purely aesthetic dimension, the *functionalist* approach has deep roots in the history, and in the relative system of social and religious values of European society. To put it bluntly, nobody wants to surround themselves with objects and services that do not work. But just as today we no longer ask Art to reassure us with beautiful landscapes, but rather to provide us with a reading, a meaning, a vision of contemporaneity on which to meditate, in the very same way with regard to Design, today we do not ask a product/service simply to *work*, but rather to help us interpret the spirit of the times through a new meaning. This can be achieved, for example, through the introduction of new gestures, new habits, new aesthetics that can contribute to improving our experience of the world.

1.2.7 Dynamic Balance

Balance in theoretical physics is defined as a condition in which the actions of different forces cancel each other out, generating a situation of harmony. But in moving from theoretical physics to life experience, it is often necessary to introduce altering variables such as time, friction, etc. So, to begin with, we can think of the various forces involved as changing over time and precisely because of this harmony of balance, as the result of these forces, will change over time. Therefore, there is a dynamic dimension to balance.

The closest personal experience to the dimension of balance is probably riding a bicycle, an activity in which opposing forces, allowing you to go forward, are at work. In fact, it is precisely by moving forward that one avoids falling. Some more skilled or more fortunate people may have the same experience surfing over a wave or fighting the wind in a sailing boat. In any case, these are experiences where conflicting forces are managed and organised to generate a favorable condition for the person involved in the activity, even though such a condition changes every moment and therefore requires constant attention and an immediate ability to react.

From the design point of view, within a society-world that is becoming more and more complex, it is important to consider the di-

mension of harmony as a dynamic, ever-changing condition requiring constant tests (in virtue of its constant, unexpected developments).

1.3 Conclusions

Our country, and specifically the city of Milan, is a particularly fertile and dynamic context for Design. In fact, the city is easily associated with events of the Design Week, thanks also to the presence of various professional and cultural realities, as well as a strong tradition linked to what is defined as Design Culture (*Cultura del Progetto*). According to Ettore Sottsass (2002):

In Italy design is not a profession, it is a way of life.

I think this statement reiterates the importance of Design when viewed beyond the strictly professional dimension and in connection with the society in which we live. Sottsass's verdict also came to my mind when I came into contact with the Japanese term *Ikigai*. More than a term, *Ikigai* is a concept, as it represents a situation of existential balance in which four conditions occur simultaneously. The first one is "you do what you love". According to it, your work and your actions correspond to your desire or passion, and that putting it into practice is a kind of existential mission. The second one is "what you do is what you're good at". The idea here is that your job allows you to put your professional and personal skills into practice. The third condition, then, is that "you do what you can be paid for". So that the results of one's work can be professionally verified, which is usually also based on an economic dimension.

These first three conditions have mainly to do with the subject, apart from the last one where an external value dimension also comes into play. The fourth one instead reverses the point of view, because it requires doing *what the world needs*. Therefore, by widening the horizon of reference, one's work must be useful to the world, to others, to society.

It must be said that this interpretation of the term, whereby *Ikigai* expresses the complex situation of balance in which the four

conditions occur, has been proposed by an American researcher, Dan Buettner, who has “translated” the term into an almost diagrammatic form, in order to make it easier for Westerners to understand, while for the Japanese the meaning probably appears less complex and more intuitive.

It was very natural for me to superimpose the aforementioned Sottsass’s statement on this diagram (Fig 1.1) and certain characteristics, such as *responsibility*, *meaning*, *character* and *beauty*, which I believe should be part of the set, professional and personal, of a designer, particularly nowadays. Such characteristics can hardly be expected from a traditional training course, but rely on personal qualities that can be developed, supported, helped by an experiential training that must, in some way, involve life, passions, interests, to reach a relationship between the designer and society (Biamonti, 2020).

The outlined connection and involvement therefore imply the existence of a social role for Design. Such a social role that cannot be separated from taking a position towards the choices and the visions that concern the society in the context of a political dimension. Today, the idea of doing politics through projects is no longer a slogan, but can actually boast a tradition of projects and practices that in recent decades have gradually become the tools of a form of innovation capable of generating *added values*, both in economic terms and in terms of social integration. A still blurred idea of projects and practices, sometimes at the “prototype” stage, which help to visualize the scenario of future community structures.

Therefore, we are not talking about a purely ideological individual political identification. But rather the assumption, supported by the growing need to produce meaning, of a role within politics. A Design involved within the government of the *polis*, and therefore Design as a key-element in the development of visions, choices and, indeed, policies of society.

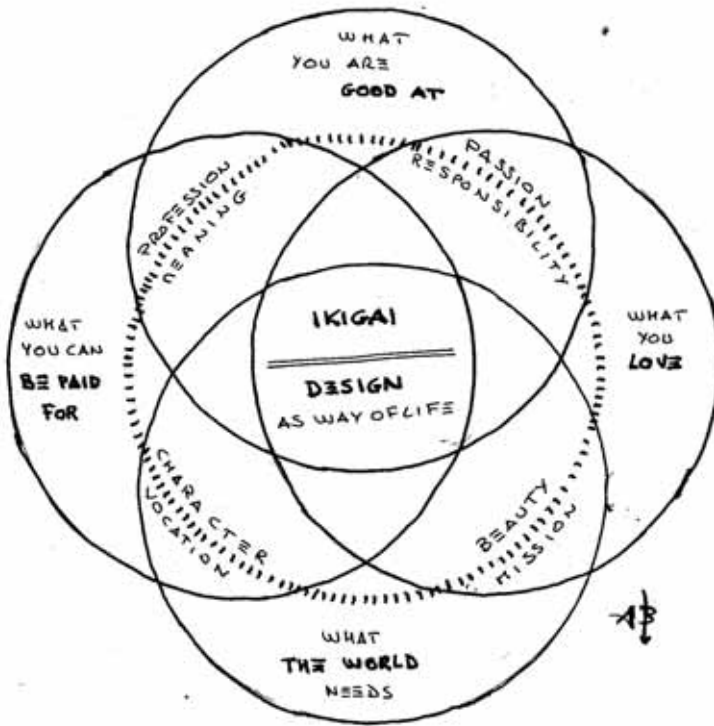


Fig. 1.1 – Ikigai diagrammatic representation

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2. Design for urban regeneration: future scenarios and common challenges in a multispecies world for synergistic action-research between design and anthropology

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Abstract

Design and anthropology represent two intertwined disciplines, which historically have found fruitful opportunities for comparison and elements of contact; in light of the social changes that are strongly influencing also the design field, today more than ever these two disciplines are called to question themselves again, with a critical and future-oriented approach, to renew their fields of investigation by enhancing each other's interferences, strategies of collaboration and possible common challenges.

In particular, the paper aims to adopt a projective perspective, investigating the present as a time open to the future, a moving "edge". In fact, more and more frequently we wonder what the perspective is for "the anthropology of the future" (Bryant and Knight, 2019), taking a position similar to those design-oriented approaches promoting "the uncertain and the possibility" (Akama et al., 2018) as well as "fragilisms" as vectors of innovation.

The analysis will focus on the role of public anthropology as a privileged interlocutor to those engaged in design; on the enhancement of suburbs as a territory of "residual authenticity" and creative

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“indiscipline” (Vattimo, 1988, p. XI); on the centrality of a micro approach to urban regeneration, as well as on the examples of widespread and inclusive regeneration that see the inhabitants as co-authors, where individuals are not mere bearers of culture and values, but also creators of new culture and projects.

The goal is to outline a synergy that looks to the future of action-research on the peripheries starting from margins, diversities, hybrids, creativity and the informal. Furthermore, we will analyze the prospects of urban regeneration in a post-anthropocentric era.

The paper, starting from some recent case studies that mainly involved the Milan area, thus intends to underline and enhance the disciplinary links between anthropology and design, but also their “exchanges, entanglements and frictions” (Bargna and Santanera, 2020), and, in a proactive perspective still to be validated, some possible opportunities of implementation – of tools, practices, policies – for a renewed dialogue between these two disciplines.

2.1 Introduction

The essay analyzes the topic of urban regeneration, and more specifically the regeneration of the peripheral territory as an opportunity for innovation, including social innovation, pursuing an approach sensitive to the “micro”, to fragile and marginalized living contexts, to hybrids and the informal. In the following paragraphs – developed as a two-way dialogue on the relationship between anthropology and design, on their synergies and on the still unexpressed potential that could be pursued thanks to a closer collaboration between these two disciplines – the attention is focused, first of all, on the so-called “bottom-up” planning that sees citizens become active interlocutors in the different phases of the design process (first of analysis, then of project and finally of realization and management of the common good). This view is extremely emblematic of contemporary life, that already sees many projects moving in this direction; each best practice obviously has its own characteristics, but for a summary reading we will try to frame the phenomenon through some macro-categories of interpretation.

In the second part of the essay, the analysis moves instead from reading the current situation to framing possible dynamics that will be typical of the near future, debating between *emerging*, *possible* and *preferable* futures.

Therefore, while maintaining this two-voice approach, capable of making us read the disciplinary perspectives of design and anthropology as a system applied to the same field of interest, the essay's structure shifts from an analysis of the dynamics of participation and co-creation by the inhabitants of their living environment, to a broader one, where instead the latter are only one element – one of many, not the only one nor necessarily the main one – that contributes to the well-being and quality of urban space. From a purely anthropocentric perspective, then, the focus shifts to a post-anthropocene era, one that according to many is already underway, in the form of a “Neoanthropocene” (Carta, 2021).

2.2 The contemporary scenario: design and anthropology in dialogue

Design and anthropology now have a consolidated common history, having in recent years increasingly become a tool and action of one another, with a reciprocal use more and more recurring. Many are the fields of shared interest: both pursue a design approach that puts *living* before *building*, through the understanding of its practices and imaginaries. This determines the centrality of the socio-cultural dimension in urban regeneration, as the transformation of *spaces* into *places*, of *built* into *lived*, cannot leave out an active listening, especially of what is often considered marginal, fragile, eccentric or invisible. That is, “peripheral”.

It is, therefore, precisely in the periphery that the challenge of contemporaneity is played out, which must overcome the notion of “peripherality” as an attribute of “peripheralization” (Pezzi and Urso, 2016, p. 2). The periphery is always accompanied by an insulting adjective: far away, abandoned, sad; in reality, 80% of people in a city live in the periphery and it is there that the energy lies. [The periph-

eries] are full of life, they are places of the future, all it needs is for cities to grow to include, not exclude them (Piano, 2015).

The recognition and enhancement of cultural and social diversity, for a widespread regeneration that accepts the inhabitants as co-authors, is the basis of all those now consolidated design practices that act on the place triggering participation, spontaneous appropriation, aggregation and sense of community. It is precisely the awareness that individuals are not simply bearers of culture and values influencing their behavior, but also continuous creators of new culture, what constitutes a fundamental creative lever in urban regeneration projects.

A micro approach that is attentive to the way in which “locality” is (re)built, the deep knowledge of contexts, the building of trusting relationships, the sharing of experiences, the engagement and empowerment of inhabitants in the making of a common environment are, therefore, fundamental traits representing the basis of both an anthropological and a design approach that is not self-referential; they allow to increase the degree of inclusiveness of urban regeneration projects, rooting them better in local contexts and making them, in a longer-term perspective, recognized, shared and cared for. The “in-the-field” ethnographic dimension of design is thus the hinge between these two disciplines, the area able to combine quantitative and qualitative research to catch, address and then meet the needs and aspirations of the territory.

2.2.1 Multispecies ethnography and the anthropology of things for urban regeneration

In the context of urban regeneration projects, the ethnographic method is one of the main areas of dialogue and exchange between anthropology and design. Designers have long practiced ethnography to comprehend the recipients of their projects and the socio-cultural context in which their projects are implemented. However, design ethnography differs from “classical” anthropological ethnography, due to the marginal role played by participant observation, compared to other research tools, such as video recording, scenarios, mock-ups,

props, opportunity maps, and games (Bargna and Santanera, 2020, p. 28; Gunn and Donovan, 2012; C. Miller, 2018, p. 53). On the other hand, anthropological ethnographic research must rely on some form of “taking part” in the people’s lives, to understand explicit and tacit aspects of culture and social life (Dewalt and Dewalt, 2011). As a consequence, anthropological ethnography takes longer and is less structured than design ethnography.

In urban regeneration projects, this “slow method” requires taking a close look, unlike the panoramic and distant vision, which has often been typical of urban planning. The goal is to discern what city dwellers do, say and feel, and to grasp the “internal point of view”, trying to give an “interpretation of the interpretations” (Geertz, 1973) that the inhabitants give of themselves and of the practices they implement. Thus, very general themes and issues, which other disciplines embrace on a larger scale, are rethought based on everyday interactions. To give a few examples, in green regeneration projects, people’s mobility can be analyzed by starting from people’s paths, motivations and purposes. Meanwhile waste management can be related to the cultural notions of *clean* and *dirty*, *purity* and *contamination*. These affect belief systems and ways of feeling deeply embedded and irreducible to a cost-benefit calculation, to medical and health hygiene or to the “good intentions” of the circular economy. More generally, this approach implies the analysis of the networks of relationships, as societies and cultures gain coherence through the accumulation of these relational activities, which are stabilized in routines and take shape in frames (Hannez, 1998). What is called *culture* and *city* emerges within a multiplicity of situations, though often divergent and contradictory, of which no one has a complete overview. Networks and communities of practices, be them stable or ephemeral, converging or conflicting, design the city as a taskscape, i.e. a set of activities that are at least partly interconnected (Ingold, 1993).

Within this general framework, the possibility of reaching the “hidden population” is particularly relevant for urban regeneration projects. This is possible thanks to the deep knowledge of the local context, the building of trust relationships and the sharing of experiences typical of anthropological fieldwork. The so-called “hidden

population” is made of people who do not participate in formal and organized groups and who are therefore difficult to intercept. They are a “silent” majority of inhabitants who seldom participate in associations, as well as those who live on the margins of society, such as homeless people or undocumented migrants. Including their points of view in the design and implementation of projects is essential to better ground the intervention, thus increasing its chance of success. Yet this does not necessarily lead to the narrowing of the gap between how spaces, services, and infrastructures are imagined by designers and how they are actually used by people. As the design anthropologists Dourish and Bell (2011, p. 73) remind us,

Seeking to close the gap through the application of the ethnographic methods is a contradiction in terms; the gap is where all the interesting stuff happens, as a natural consequence of human experience.

On the other hand, in the Anthropocene age, the hidden population to be taken into account is not only the human one. To design for the post Anthropocene age it is also necessary to take into account the agency of all the other inhabitants of the city, such as animals, plants and microbes, in an ecological perspective capable of imagining new interrelationships and common futures (cf. Haraway, 2008; Ingold, 2011; Tsing, 1995). It is not so much a question of designing spaces of *nature* within the city, but of recognizing the indissoluble mix of “natureculture” (Viveiros de Castro, 1998; Descola, 2014; Latour, 1993), where the human being is entangled with non-humans, in an “interspecies relationship” (Tsing, 2012). The anthropological approach, therefore, goes beyond anthropocentrism (Kohn, 2013) towards a multispecies ethnography that studies how humans and other beings are connected and mutually enmeshed, in the human body living non-human organisms, such as microbes (Kirksey and Helmreich, 2010).

In this process of decentralization of the human perspective, it is also essential to recognize the power of things, which remains “invisible” (D. Miller, 2010) when things are seen as mere tools at the disposal of humans. Instead, they have a certain degree of autonomy and are entangled with humans (and other non-humans) in multiple and unexpected ways, beyond instrumentality (Appadurai, 2013;

Gell, 1998; Ingold, 2013; Latour, 2005). For example, houses do not allow themselves to be inhabited freely, but through their materiality, they “suggest” certain behaviours and lifestyles while inhibiting others (D. Miller, 2010). In a similar way, streets, sidewalks, buildings and parks, through their conformation, allow, prevent or encourage specific possibilities of utilization. They incorporate the stories of previous generations and manifest, within the limits they set, their autonomy with respect to our intentions.

The anthropology of things (cf. Appadurai, 1986; D. Miller, 1998; 2010) addresses these complex interactions. It recognizes a certain agency in the inanimate world and explores how objects and human beings are bound in relational networks.

2.3 The regeneration of the periphery: from latent potential to a new “center” of interests, values and experimentation of design practices

In this paragraph we intend to present some emblematic projects, possible translations in the field of what has been stated above, and particularly representative of a highly participatory approach, where participation is not only listening or sharing, not only mapping or building common platforms of expressed and unexpressed needs but is implemented each time in different operational modalities.

Particularly, in the following section we will report some interpretative categories typical of these widespread methodological approaches, where the anthropological view – implicitly or explicitly – has guided the work of designers. These are macro-categories, therefore necessarily wide ones that can have a summary nature and a value applicable to different contexts. Each one is illustrated using a reference best practice, all of which are extremely recent (one in progress, two just completed and a fourth dating back to 2016) and all selected in the same area – the areas of North-West Milan, belonging to Municipalities 8 and 9 – to facilitate comparison. These are peripheral areas with a non-homogeneous urban fabric; for example, the Bovisa district is characterized by a recent industrial past, whose traces are still strongly visible in the urban voids left by old factories

now abandoned; vice versa, the area that leads from Portello to Ghisolfa shows a dense and distinctive building fabric, that makes the area a potentially attractive pole for different expressions of social life.

As previously mentioned, participation has been a consolidated practice for years, but today it has rediscovered new tools, practices and policies, also attributing multiple roles to “social players”. It is precisely with respect to this role that we intend to propose the following interpretative framework.

2.3.1 UNPark: when participation takes place in the process

This planning dimension, on which the sociologist and economist Saskia Sassen, among others, has long focused its analysis, is at the basis of a “horizontal urbanism” founded on a system of individual actions that manage to flow into collective practices of “urban democracy”, assuming the city as an adaptive and open system (Sassen, 2011).

Here – by way of example – we intend to report specifically the case of a pilot project proposed by Politecnico di Milano, developed thanks to the “Polisocial Award 2019” call for proposals and currently in its final phase. This is “UNPark - Urban Nudging Park”, a project carried out in synergy by the Departments of Architecture and Urban Studies (DAStU), Design, Architecture, Construction Engineering and Built Environment (ABC), the Department of Electronics, Information and Bioengineering (DEIB) and the Department of *Chemistry, Materials and Chemical Engineering* “Giulio Natta” (CMIC); the object of the applied research proposal is in this case the redevelopment of a portion of the Serra-Monte Ceneri underpass, designed by Eng. Silvano Zorzi and Giorgio Macchi and built between 1950s and 1960s.

The topic is considered of undoubted interest for the city of Milan both because of the peculiar context of intervention and because the problem of the areas adjacent to (and specifically underneath) large road infrastructures is a widespread issue; its solution would therefore be replicable and virtuously scalable also in other urban con-

texts. Now in the final phase of experimental application, the pilot project that will be installed on site for a week, following Milan Design Week 2021, will therefore be an important test, especially useful for testing the spontaneous dynamics of “presuming” of urban space that will be activated and for verifying the response of the population to the proposed activities.

The project is wide-ranging (starting with the redevelopment of a portion of the underpass, it is hoped to trigger a broader urban and social regeneration), but because of the peculiar perspective characterizing this essay we intend to illustrate this project here underlining the possible short-circuits with the anthropological approach.

a. First, the “photographic look” with which the analysis of the area was conducted in the first instance appears to be interesting: the involvement of photographer Matteo Di Giovanni has in fact made it possible to capture details of the place, bringing out its hidden features and making its “invisible soul” visible. Particularly, some of the shots certainly revealed the barrier nature of the infrastructure, but also the strength of the buildings behind it, which constitute an essential backdrop to the context. Similarly, the most neglected and abandoned areas, those of potential spontaneous aggregation have emerged, as well as the different ways of use and appropriation of space of the two prevailing flows, that of car traffic and that of pedestrians. Thus, transit and parking, speed and slowness, density and voids tell every time about different cities, depending on the time and day of the survey.

b. Second, another key element of the analysis of the area and of the creation of a “common feeling” were the co-design tables, where both interested citizens and stakeholders were invited to offer their contribution both in analytical terms (what is missing in the area, what would be needed, what problems there are, what constraints and what potential could be seized) and in propositional ones (what can be actively – and personally – done to improve the context). These tables, which were repeated on three different occasions to ensure the widest engagement and were conducted virtually to facilitate participation even in the pandemic phase, allowed to collect the wishes of the inhabitants, to encourage knowledge and discussion among them, and to activate the latent potential of the place’s intrinsic resources.

Some design “guidelines” emerged, aimed at creating a multifunctional “square” for easily accessible street sports, also equipped for spontaneous aggregation activities and able to constantly enliven the underpass. With the declared aim of nurturing the centrality of the impact of infrastructures in the city's agenda, these co-design tables have therefore pursued urban regeneration on various levels: fighting social marginalization, fostering intergenerational and intercultural cohesion, promoting active citizenship, promoting physical and social wellbeing and strengthening environmental awareness.

c. The third tool that was proposed, and that can also be considered useful in terms of anthropological analysis, was again a participatory occasion: a “situationist walk” through the neighborhood carried out on 25th April 2020 that represented a further opportunity for discovery and sharing. Thanks to its playful force and its aggregation capacity, this “urban drift” was extremely useful to build a common ground of reading first and intentions later.

After these three moments of listening and collection of the dreams, ambitions and fears of the inhabitants – moments that also made the physical place with its inanimate artifacts “speak” (fundamental elements of the environmental ecosystem in the above-mentioned perspective of “anthropology of things”) – the phase of transformation of all the data collected into a practical application, or rather into a real project capable of entering the local context, was delegated to the team of designers. This group of interdisciplinary experts, who followed all the previous phases step by step, now has almost the sole task of “physically translating” the set of expectations identified.

A first fallout on site was already implemented from 4th to 6th December 2020 with a pop-up event linked to the European call “Furnish” whose aim was testing the effectiveness of some prototypes of urban furniture and their impact on the lives of the inhabitants, particularly on their ability to appropriate the public space. “MUE:SLI - Mobile Urban Elements Sport Leisure and Inclusion”, a modular system of furniture that, thanks to different plug-ins, adapts to multiple functions related to sport, leisure and socialization, while respecting the procedures and rules for physical distancing due to the pandemic, has raised interest and curiosity and in the underpass has been used

by different “urban populations” – even those previously defined as “hidden populations” – without suffering any specific acts of vandalism. It will therefore be repropose in the pilot project to be installed in September 2021, within a more structured program of activities and a more defined design ascribable to the so-called “urban interiors” (A.a.V.v., 2016). This term refers to spaces that are welcoming and hospitable, sustainable, resilient due to their adaptability and socially inclusive. These are places with wide recognizability that intercept passers-by, welcome them, “reassure” them and represent them:

interventions that aim to recover that dimension of the relationship between man, object and space that is proper to the culture of interior design (Crespi, 2018).

In addition, the project envisaged an air monitoring system and the modelling of the data collected by means of control units positioned on the balconies of private homes, to raise citizens’ awareness on Nature Based Solutions environmental protection issues. In conclusion, the implementation and management phases of the pilot project will once again see a strong element of direct participation by the inhabitants, called to “build” and then take care of their living environment as the first co-artisans.



Fig. 2.1 - Work in progress phases of the redevelopment works of the Serra-Monte Ceneri underpass on the pop-up event realized for the call “Furnish”: application of stencils and floor painting. Milan, 4-6 dec. 2020. Ph Barbara Di Prete.



Fig. 2.2 - Redevelopment project of the Serra-Monte Ceneri underpass on the occasion of the pop-up event realized for the “Furnish” call for proposals: in the foreground the graphic area on the floor, in the background the MUE:SLI prototypes. Milan, 4-6 dec. 2020. Ph Paolo Carli.



Fig. 2.3 - On-site installation of the MUE:SLI prototypes, funded by the European call for proposals “Furnish”. Milan, 4-6 dec. 2020. Ph Davide Crippa.

2.3.2 The P.A.A.I.: when participation is expressed in the project

The project we intend to recall here is the most dated one, in fact it dates back to 2015-2016, but still today – for its complexity and for the important recognitions it has received (including the Compasso d’Oro ADI in the “Design for Social” category in 2018) – it seems of great interest for this dissertation. This is the “PAAI - Padiglione Adattabile Autogestito Itinerante” (Adattabile Self-Managed Traveling Pavilion), a project once again proposed and developed by a group of university researchers (Department of Design, of Architecture and Urban Studies, of Management Engineering) within the broader research project called “CampUS - incubation and staging of social practices”, financed thanks to the call “Polisocial - the program of commitment and social responsibility of Politecnico di Milano”. The pavilion, “adattabile” with respect to the different contexts and modes of use, “self-managed” by the partner associations and freely used by citizens, “travelling” in the north-west area of Milan, was primarily designed for what were previously called “hidden populations”, with the aim of improving their inclusion, engagement in the processes of use of the city and mutual understanding with other urban “populations”.

The pavilion particularly addresses those considered to be the most vulnerable, often at the margins of urban life, excluded from the world of work and from the active social fabric: the NEETs, children and the elderly are too often only considered in terms of welfare, and their resources, knowledge and time are not valued. In contrast to this approach where they are regarded as passive participants in the life of the community, the *PAAI* project acts to satisfy their needs at the same time as welcoming their availability and harnessing their potential (Di Prete, 2019, p. 240).

For a complete analysis of this case study, please refer to the monographic text dedicated to “CampUS” (Fassi et al., 2019); here we will instead describe it in brief, again trying to illustrate the tools put in place and that could pertain to what was previously called “design ethnography”.

a. Among the most effective tools used, we must certainly include those used by the inhabitants to “vote” for their favorite proposal among the ideas displayed in an illustrative exhibition of potential projects for the travelling Pavilion. The students of the course of “Scenography and Representation Spaces” of Politecnico di Milano, in fact, had developed some early project options, still to be verified in terms of technical feasibility, financial cost, realization times and durability. On the final exhibition of the course, while not claiming to solve the design phase at the same time, it was however important to present the results of the work carried out and - through “palettes” available to citizens for an open vote, interviews and questionnaires - to collect the first suggestions and feedback from the territory. Following this both informative and operational step, that used some tools typical of the anthropological field, the actual co-design phase began.

b. As in the previous case study the co-design tables had constituted an essential moment of exchange, knowledge and collection of the inhabitants’ desires, so for the planning of the Travelling Pavilion (thought to be installed “temporarily” in some public areas of the Affori, Dergano and Isola districts) the co-design tables played a crucial role. In this case they represented the occasion to implement, “correct” and integrate the initial, most voted meta-project, giving it a more and more executive setup. This effort was carried out in meetings with progressive monthly appointments, so as to gradually guide the planning towards more detailed levels of formal, material and structural definition; this task - having involved people often without any technical-design expertise - was carried out thanks to a scale model of the pavilion itself and thanks to the role played by the university’s researchers, “mediators” of skills, “collectors” of needs and proposals, “synthesis” and “translation” of often imaginative visions. On the study pattern, the citizens were thus able to “write” their own project starting from a non-white sheet of paper, that would have got them in trouble and would not have allowed for the research to progress.

c. Finally, the third tool of “design ethnography” used had the purpose of facilitating the structuring of a calendar for the pavilion’s use and management. Conceived to host events, exhibitions, debates,

games, recreational, sport or cultural activities, this space had to represent an informal place at the disposal of citizens and local associations, that had to organize its management and agree on the services offered. To manage this complex phase, considering the significant number of participants in the tables and stakeholders interested in the use of the pavilion (with over 45 subjects for 87 proposed events), we used a tool now consolidated in co-design practices: an empty calendar, a sequence of customizable post-it notes, a debate mediated by graphical diagrams to represent each potential mode of use. Thanks to these tools and to the audience's large participation, in just one afternoon it was possible to satisfy most of the requests presented by the associations and to build a calendar for shared use, conceived almost seamlessly from May to October 2016. When not in use, the pavilion would have been a free space available to citizens, a place to rest and shade, a scenic device for informal uses, a "gift" to the neighborhood that could then take advantage of an additional public space.

Through these various shared moments, people's participation has led to a well-defined result both in terms of planning and of the service offered; at the same time, it has contributed to raising the interest of the community, to making the players of the territory responsible and, in short, to making this apparently neutral "space" feel like a "place" for everyone.

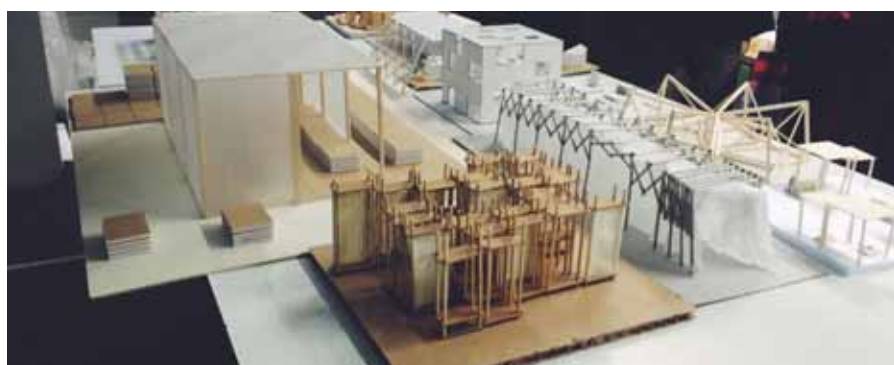


Fig. 2.4 - Final exhibition of the course in "Scenografia e Spazi della Rappresentazione" (Scenography and Representation Spaces) at Politecnico di Milano, that exhibited the first design ideas for PAAI. Responsible prof. Pierluigi Salvadeo. Ph Barbara Di Prete.



Fig. 2.5 - Study maquettes for the PAAL, representing the different project advancements, presented at the co-design tables on November 28th and December 10th, 2015. Ph Barbara Di Prete.



Fig. 2.6 - The Adaptable Self-Managed Travelling Pavilion in its final configuration, during the opening on May 8th, 2016 in Savarino Park. Ph Barbara Di Prete.

2.3.3 Via Toce: when participation takes the form of implementation

In both the previous best practices, citizens' participation was also translated into their direct action in the implementation and management phases, but this action represented almost an inevitable consequence, seeing the involvement of citizens as key players in the analytical-process phase or in the more specific planning phase. On the other hand, in this interpretation category we intend to recall some projects promoted by groups of creative people or local associations that in the implementation phase availed themselves of the contribution of much larger segments of the population. These are actions of urban regeneration that could be framed into the broader phenomenon of the so-called "Tactical urbanism" (Garcia and Lydonm, 2015), a redevelopment strategy that acts both in terms of social reactivation and territorial animation, connecting the physical space of living and the symbolic one of experience. These are practices that convey the value of the ephemeral and the intangible as tools for urban regeneration; in this sense, they are actions that express a transient image of the city but build a long-lasting imaginary in the memory of the community.

In particular, to make these projects possible – generically included in the "Piazze Aperte"¹ system – the City Hall of Milan set up the so-called "cooperation agreements". They are the operational tool of a policy aimed at pragmatically and easily giving concrete form to the several proposals that constantly reach the municipal tables "from below": in exchange for the commitment of a group of citizens signing the deal to create, give life and oversee the project, the City Hall offers free use of racks, playful devices such as ping-pong tables or paint to graphically decorate the urban area. Paint is a fundamental material for these projects, since all the "open squares" have a necessarily temporary, ephemeral, prototypical character, designed to test in the short-term different uses of public space with cheap and strongly graphic solutions. Indeed, in most of these cases the strategy is to subject the project "to a trial-and-error dynamic" (Zappulla, 2015, p.105) and experimentation is useful to assess its impact on a

¹ Available at: www.comune.milano.it/piazzeaperte

physical-perception level, but also to verify its ability to integrate into the local value and symbolic fabric. This is a kind of “guerrilla urbanism”, sometimes also called “pop up” urbanism or “urban hacking”, that is:

actions able to interfere with the consolidated organization of spaces and times of the city and thus suggest, trigger or guide unprecedented paths of transformation (Arras et al., 2017, p. 56).

Among all the many initiatives launched in recent years and framed in the phenomenon of “tactical urbanism”, we will mention here only one of the last finished in chronological order in Milan: the redevelopment of a road section of Via Toce, located between the Bruno Munari Garden and the gardens of Via Cusio/via Toce in the Isola-Lancetti area (Municipality 9), inaugurated in October 2020.

The street divided the two parks, but following a collection of signatures, the City of Milan included in the project “Open Squares” the request for applications to temporarily make pedestrian and redevelop that part of road, reconnecting the two gardens with a sort of equipped square, an environment designed specifically for recreational use and aimed primarily at children. The project of tactical urbanism in this case intended to test the new dynamics of use in the idea of making the green space of that urban portion a single one. The Isola Association and the Repubblica del Design Association responded to the City Hall’s call with two different expressions of interest. They then signed the “collaboration agreement” and worked on a unified proposal that should have been, in the original plans, the result of a participatory process conducted with workshops in the area, but that, due to the pandemic, was finally translated into a project signed by the Ghigos studio.

The project obviously reflects on the issue of green as an occasion of urban mending, even if metaphorical, and pays tribute to Munari, thus further enhancing the character of the surrounding area. For this reason, the protagonists of the design, organized in a sort of “urban fairy tale”, are some symbols taken from Munari’s experience that invade the public space making it a big “page” of an open book, to “flip through” step by step. As you walk through the square, you will come across a human silhouette taken from the text “Da cosa nasce

cosa” (One thing leads to another), Munari’s own face, an amusing “Little Green Riding Hood”, the ever-present wolf at the entrance to the gardens in Via Cusio/Via Toce, some frogs, the “Falkland” lamps interpreted here as trees, and the drawing of a rich vegetation that evokes the workshop “Disegnare un albero” (Drawing a tree) to recall the dimension of the garden and the forest. Among these graphic elements, acting as a narrative background, the usual urban devices made available by the City Hall of Milan have been installed: ping-pong tables, picnic areas and seats aimed at encouraging sociability, playful enjoyment and opportunities for aggregation.

The realization, despite the difficulties of the pandemic context, was carried out thanks to the crucial contribution of the inhabitants, including many children of the neighborhood. Such a massive participation of young children can be explained both by the presence of the neighboring Bruno Munari Garden, already very lively and attractive for the presence of several children’s games and by the engagement of the nearby Toce Municipal School, and by the specific theme of the project, as this “tactical square” is conceived as a narrative park, almost an “urban fairy tale” that inevitably caught the interest of children. Furthermore, it should be considered that, prior to the construction phase, Isola Association had started an on-site preliminary phase communicating to teachers, to its members and then to curious passers-by the meaning of the initiative thanks to a constant presence during the works. This moment of knowledge and “engagement of the population” gave rise to a spontaneous word of mouth that contributed to the success of the operation and to the strong participation of children in the implementation phase.

The outcome of the urban prototyping appeared immediately very good; it was verified through the usual “design ethnography” tools, namely direct interviews and questionnaires carried out by Isola Association to people intercepted on site and to inhabitants registered with the association itself. Even the institutional steps conducted in Municipality 9 have given positive feedback, further demonstrating the satisfaction of the citizens for this urban transformation and in general the effectiveness of the intervention, so much so that the City Hall now intends – exceptionally with respect to the practice of “Open Squares” – to maintain the project, that will no longer have a

temporary and prototype dimension, but will become a “permanent” element of the urban image.

Additionally, we intend to implement the proposal shortly by also including some urban devices that could fully belong to that post-anthropocentric vision that was already mentioned above. The neighborhood, in fact, has decided to focus on biodiversity, starting with the “biodiversity of the small”: that of small urban green spaces like gardens, vegetable gardens, but also terraces and balconies; on the other hand, it should not be forgotten that Isola is an area full of parks and has long developed a very strong sensitivity on the issue (think for example of the successful project of the “Library of Trees”). In line with this vision, bug-hotels, shelters for useful insects, kits for urban beekeeping and tools that can encourage this ecosystem approach will be installed in Via Toce to complete the urban furniture that will be provided in the two gardens. The aim is to protect and encourage the variety of living forms and urban environments, enhancing diversity within species, between species and of ecosystems and – again acting on the minute, residual and “peripheral” – committing to the general maintenance of the ecological balance.



Fig. 2.7 - The new “tactical square” of via Toce during the inauguration, with games and readings with the children of the neighborhood. Ph Davide Crippa (picture on the left) and Davide Stanga (picture on the right).



Fig. 2.8 - Overall view of the part of Via Toce between the Bruno Munari Gardens and the small gardens of Via Cusio, redeveloped with a strong graphic-narrative imprint. In the foreground, the wolf from “Little Green Riding Hood”. Ph Davide Stanga.

2.3.4 Illumina-Mi: when participation takes the form of representation

This last interpretation category is probably the most elusive, being certainly the least codified in formal practices and policies. It is, in fact, a participation that becomes a work itself, that turns into communication and representation of an entire community.

An emblematic case, in this sense, is the project “Illumina-Mi”, promoted and implemented by Astronove and La Repubblica del Design, two associations operating in Municipality 9 of Milan, thanks to the contribution of the City Hall itself under “Bando Quartieri 2019”. “Illumina-Mi” started with a call aimed at collecting “words” donated by the citizens themselves, called to tell their stories and reflect on

the issues of #Future and #Hope, two particularly delicate topics in a difficult period like the one experienced in lockdown.

The contents of two site-specific urban installations were thus built, two dynamic luminous devices that became a community storytelling, a self-representation of the “dreams” and “hopes” of the neighborhood, a nocturnal multi-voiced tale developed thanks to a collective participation; the collection of everyone’s words served, in fact, to build the story of all and the luminous installations were designed as an authentic expression of the community. The result is a collective message addressed to unaware passers-by that has transformed the streets into social spaces with a high ritual potential, in a continuous metaphorical dialogue between the “inhabitants-writers” and the “inhabitants-readers”. The city, avoiding the risk of falling into self-celebration, has thus found in the sum of the narratives of everyone the opportunity to become the representation of a collective imaginary.

These two installations were staged, respectively, on the terrace of La Ribalta brewery in December 2020 and at the Headquarters of Municipality 9 in via Guerzoni 38 in January 2021; operationally the words were collected using a dedicated website², a subscription form, and a collective engagement pursued through newsletters addressed to members and wider-dissemination press releases.

Before these two installations, the “Illumina-Mi” project had its first operational fallout on the territory at Nuova Armenia in September 2020. In this case, children from four schools in the area were involved, who had described the neighborhood through their personal photographs; then the photos were turned into 8 bits and made “luminous images” projected onto the installation. Once again, it is the city as a physical urban artifact that here has allowed for different interpretations, that is discovered and finally enters its own storytelling, in a sign and semantic short-circuit that belongs both to visual anthropology (for the ethnographic use of photographic investigation) and to the anthropology of things (for its ability to trigger actions, thoughts, behaviors).

² Available at: www.illumina-mi.it



Fig. 2.9 - The “Illumina-Mi” lighting installation installed in Milan at La Ribalta brewery and at the Headquarters of Municipality 9, between December 2020 and January 2021. Ph Repubblica del Design.

All the cases mentioned here, despite the heterogeneity of the approaches and results achieved, ultimately pursued a common goal:

Requalifying anonymous urban fragments, poorly recognized and often excluded from the inhabitants’ daily paths, “occupying” them with prototypical solutions that aim at physically and socially redeeming the environment, even in the finiteness of the temporal horizons and in the temporariness of the physical means put in place (Crippa and Di Prete, 2020)

The challenge is to redeem precisely the “residual”, because as Stefano Boeri also highlights in the conference “The new urban peripheries: the challenge of global cities” (Boeri, 2019), peripheral areas are certainly marked by contradictory dynamics, but they are also full of exchanges and “urban intensity”, offering an intrinsic “social capital” (Putnam, 1993) and favorable conditions on which to start any policy of urban redemption.

2.4 From “emerging futures” to “preferable futures”

As can be seen from the previous chapter, anthropology and design interpret the idea of the present in a dynamic way, considering it not a static time, but one projected into the future, almost a moving “edge”. The ridge between the reading of the contemporary and that of the near future is, therefore, particularly indefinite, also because the future is not a time completely unrelated to the present, but in

some way is contained in it, already existing in people's dreams, hopes and ambitions.

Design creates culture, culture shapes values, values determine the future (Peters, 2021).

In this framework anthropology and design can be used not only to know the existing, but also to explore the coming tomorrow, to co-design a positive change together with local communities and to integrate in the project all those non-human components of our ecosystem that are increasingly recognized as active and essential parts of it. Indeed, as will be shown below the pandemic, also the result of the environmental emergency, has made this awareness more urgent and has imposed a speedup towards a not merely anthropocentric design of the city and its suburbs.

In times of Covid-19 taking its toll on almost every industry on this planet, we all must finally embrace the lesson on what's at risk if we continue to overstep Earth's environmental boundaries. Or, to use terms originating from human-centered design: what's at risk for all living beings if we, humans, continue not to address Earth's needs, limitations and preferences (Sznal, 2020).

Although it is now clear that the simplification of habitats and the reduction of the variety of living forms populating them constitute an imminent threat to the survival of our planet, man – who is both cause and victim of this simplification – still struggles to find different scenarios of life.

For this reason, one of the first and priority challenges for anthropology and the design of tomorrow is to consider the animal and plant world, but also the built environment, as parts of a single ecosystem with which to interact and to “use” in design to improve the overall structure of cities, making them more hospitable, welcoming, inclusive, but also sustainable and rich in biodiversity.

Many cities hold the keys to open the doors of the different present to enter the possible, sustainable, creative, fair and solidarity-based future. I call them “Augmented Cities” of Neoanthropocene, a new era in which humanity returns to taking care of urban space, returns to generating beauty, returns to being an ally of nature (Carta, 2020).

2.4.1 Anthropology of the future, peripheries and the Anthropocene

The intersections between design and cultural anthropology have contributed to shift the focus from space to time, from past and ethnographic present to future (Bargna and Santanera, 2020, p. 31). The future can become an integral part of the research field even if it has remained a foreign time to anthropology for many years: “an allochrony” excluded from the domain of History and of “the cultural” as well as the exoticist atemporality to which “primitive” societies were confined (Fabian, 2000). It is precisely on the basis of the “anthropology of the future” (Appadurai, 2013; Smith et al., 2016; Salazar et al., 2017; Bryant and Knight, 2019) that it is possible to outline trajectories of collaboration between anthropology and design for action-research in the peripheries.

Studying the future as an object of inquiry does not mean trying to predict and to control possible scenarios, but rather looking at the future as a plural time extending into the present. “Futures” already exist, *hic et nunc*, as expectations, ideas, phantasies and projections embodied by individuals and social groups. The future affects the contemporary world by shaping human actions according to individual and collective aspirations and goals: it is a “cultural fact” (Appadurai, 2013) constantly re-produced in different ways in the very act of living in the world. The present, likewise, can be conceived as an open flow on the future, a constantly changing reality; a time of “uncertainty” (Akama et al., 2018) in which different, multiple and divergent ways of imagining and building futures emerge and conflict. Insofar as “there is no script for social and cultural life”, the everyday becomes the field of a continuous work of “cultural improvisation” (Hallam and Ingold, 2007, p. 1), of an uncertain, relational and future-oriented designing of life in which cultural and dwelling forms are ceaselessly reinvented.

Cultural anthropology thus makes it possible to grasp the complexity of social reality, which goes beyond any form of reduction and planning, and to consider alternatives from the inhabitants of the periphery point of view, questioning a linear and one-dimensional vision of the present and the future of the city. First

and foremost, it is about understanding expectations, fears, hopes and ideas that local communities share towards their neighborhood and the metamorphoses of urban scape, in order to actively involve them in the processes of transformation even before they occur.

Different futures can be negotiated and discussed to act in the present. Making “anthropology of the future” in the context of urban regeneration means, moreover, considering the margins not as fragile and deprived environments, but as places that create culture, where practices of resistance, resilience and re-appropriation take place. The insights and experiences that anthropology is able to explore allow, with the aim of designing urban settings together with communities, to work by intercepting and developing the capacities to aspire. As Arjun Appadurai (2013) points out discussing the concept of “aspiration”, the possibility to aspire to alternative and better futures is a “cultural capacity” that is not equally distributed among human beings and that can be reduced, if not annihilated, by poverty and by an uncertain and precarious living on the margins. Only through active participation, as much in urban planning as in imagining different ways of living in the periphery, could we achieve a culture of dwelling able to give voice to “the right to the city” (Brenner, Marcuse and Mayer, 2012), i.e. the freedom to participate with full rights in the urban. The task of an “anthropology by means of design”, as defined by Caroline Gatt and Tim Ingold (2013), is not reduced to ethnographically representing reality and intercepting voices and needs of territories but is embedded in a transformative perspective. Exploring “emerging futures” (Smith et al., 2016) through long-term fieldwork gives the opportunity to work by identifying and building, together with inhabitants and planners, scenarios of change and “preferable futures” (Dunne and Raby, 2013) towards which to target transformations and actions in the periphery.

At the same time investigating alternative futures signifies framing the action in the contemporary “anthropo-scene” (Lorimer, 2017) and in the Anthropocene debate by moving the focus from an anthropology *in the city* and *in the design*, to an anthropology *of the city* and *of the design* (Low, 1996). The recent pandemic resulting from the unprecedented impact that humankind has on the Earth has

highlighted the need to rethink building, designing and dwelling in the city in a post-anthropocentric way. Even considering that, in the light of the increasing urbanization, it seems appropriate to speak of an “urban Anthropocene” (Swilling and Hajer, 2016).

The Anthropocene represents not only a problem but also an “opportunity” to reshape human beings’ relationships with the natural habitat and with other life forms (Tsing, 2015; Latour, 2017). The fact that human agency has become the main force shaping the entire ecosystem suggests, in fact, an overcoming of the classical categories that have dominated the thought of modernity, making a clear break between Nature and Culture, Human and Non-human and removing the existing interrelations between cities, natural environment and humans (Descola, 2014).

Instead, in an anthropological perspective, the environment is not simply the material background of human action, but the dynamic result of a work of co-production and mutual shaping between human and non-human agents. Consequently, new ethics and practices are required in order to think about animals, plants and natural elements not as entities existing “outside the space of the city” (Van Dooren and Rose, 2012) but as life forms that actively participate in the urban social life. They have to be included in the multi-species cohabitation needed to build the future of dwelling on a damaged planet (Tsing et al., 2017).

2.4.2 Design in a “more-than-human” scenario

With respect to these “possible futures” it is interesting to analyze the way design can establish a dialogue: with which “actors”, what tools, what policies and taking what role, in a design and cultural context that increasingly investigates the scenario of “more than human” (A.a.V.V., 2021). From this perspective, a worth-reading book is the one recently published by Maurizio Carta (2021), who talking about “Augmented Cities” and “Neoanthropocene” has identified ten “barrier gestures” – an expression derived from Bruno Latour (2020) – useful to face with planning awareness the social, urban and environmental challenges that await us.

The Neanthropocene for me is an era in which humanity becomes aware of being responsible for climate change and accepts the challenge of being responsible for its solution, acting in an active and collaborative way to the mitigation of ecological impacts, but above all to the design of new spaces, forms and modes of living able to reactivate the powerful generative energy of the urban environment: an environment of care, justice, rights, coexistence, plural and fluid space and never again a segregated space in perpetual conflict with nature (Carta, 2020).

In light of these “barrier gestures”, identifying models and practices that every designer should adopt during the work phase, setting them down every time in the relevant local context, we can reinterpret the best practices analyzed in this essay. Here below are seven of the ten proposed “gestures”, the most representative for this dissertation:

1. Towards a city that “feels and reacts”, making intelligent use of data and sensors. “Unpark” in this sense appears paradigmatic, having chosen to install sensors to monitor air pollution directly in private homes, to also increase the direct engagement and awareness of citizens on a critical environmental issue.

2. Towards a “more open and collaborative” city, that establishes a synergy and collaboration between the civic and technological dimensions. From this point of view, the case of “Illumina-Mi” is particularly emblematic: a call open to the city, an installation in an institutional civil seat, a sum of stories that becomes itself “civic sense” and finally a dynamic luminous LED installation. Here the graphic-communication element is not only a visual representation of the desires of a community, but also a system of signs that triggers value short-circuits (building a “long-distance” dialogue between the designers, the “authors” of the words displayed and the passers-by who receive them and make them their own).

3. Towards a “smart and innovative” city, that combines the “hardware” of spaces, infrastructures and services with the “software” of an active citizenship, added to a renewed institutional capacity. With respect to this dimension, all the four cases analyzed are consistent, all the more so because the City Hall of Milan has been able to “listen” to the demand and planning approach coming from the territory, channelling it through the tool of the “collaboration agreements”, through demonstrative interventions and

accompanying placemaking processes, in an innovative model based on multi-authority and co-responsibility of the proposed actions.

4. Towards a city that “creates and communicates”, to facilitate the structuring of new cultural and creative districts. This fourth “barrier-gesture” can be interpreted as a direct consequence of all those interventions – like those described here – that arise from below and activate local resources; in particular, however, it is interesting to notice that “La Repubblica del Design” association was founded with this very purpose, also reported as a mission in its charter.

5. Towards a “resilient and ecological” city, capable of combating the climate crisis and placing ecological sensitivity at the heart of the project. This is an ambition that all projects, in this post-anthropocene era, should now implicitly consider. Among the cases described, this focus emerges as a priority, especially in the via Toce initiative (that provides for the installation of hotel-bugs and, in general, of devices to host bees and other insects useful for the biodiversity of the environmental ecosystem) and in UNPark (that implies the application of textile systems to reduce the impact of pollution in a particularly challenging context due to heavy car traffic).

[The project UNPark pursues] the development of multi-purpose textile systems for the collection of fog/humidity – with collection of natural grey water from the air, reduction of noise pollution and filtration of air pollution particles – that represent an example of a circular approach to the use of resources (Crippa et al., 2020).

6. Towards a “circular and recycling” city, that gives opportunities for reusing materials, spaces and knowledge. In the project realized in Via Toce this aspect is considered essential, so much so that the above-mentioned equipment for the reception of insects will be made entirely with recycled plastic, according to an innovative die-casting technique allowing to reuse even residues of different materials (aluminum, tetrapak) without the need for prior selection. The process, developed by Design Differente, is the result of the project “One thing leads to another”, based on the idea that a given number kilograms of plastic waste collected in the

neighborhood will be transformed into as many kilograms of street furniture for the community, in a virtuous process of territorial recycling.

7. Towards a “reticular and polycentric” city, able to enhance neighborhoods, metropolitan areas, urban and suburban portions welcoming their diversities. In all the cases we have mentioned, the regeneration of the suburbs started from the resources of the territory, systematizing the skills of local players. Particularly, for example, the university has taken a proactive role on several occasions (in UNPark, in P.A.A.I., but indirectly also in the regeneration of Bovisa and in the foundation of La Repubblica del Design), becoming the engine and collector of many actions of urban regeneration and social reactivation.

In view of this reading, therefore, we discover that “the future” is really already written in the present, and in some way, it influences and shapes it, bearing witness to what was observed in the previous paragraph: in fact, the sensitivity to the ecosystem element is already part of the actuality of the project, sometimes in a more implicit, sometimes – more and more – in a conscious way.

The challenge, now, is precisely that of awareness: to consider all the players (human and non-human) in the design phase, codifying new tools, practices, policies that make them non-accessory parts of the process and of the outcome.

2.5 Conclusions

The dialogue between anthropology and design can thus develop in two directions. On the one hand, by focusing through the anthropology of the future on the capacity to aspire of those living in the periphery, one can engage in an urban regeneration that examines different, inclusive and alternative futures for the city. On the other hand, by addressing the issue of cohabitation in the age of the Anthropocene, the foundations can be laid for a non-anthropocentric approach to urban surroundings that extends the “right to the city” to non-humans. The aim is to establish practices which can avoid the dominant logic of exploitation and which can operate in a context,

that of the suburbs and urban margins, where the impact of climate changes is experienced most violently. The climatic, economic and social damages caused by the Anthropocene are unequally distributed, feeding the geographies of inequality between centers and peripheries. Urban regeneration, then, has to work within the framework of “environmental justice”, analyzing how the exposure to Anthropocene’s consequences is not fairly spread across space and human populations (Nixon, 2017).

Some tools for a so-called “Environment-centered design” (ECD) approach have already been codified, such as the actant mapping canvas, that help to map all the human and non-human stakeholders (“actants”), but there is still a long way to go to make these tools widespread, commonly used in the design phase and recognized also at the regulatory-institutional level.

If the goal of human-centered design is to maximize empathy felt towards the people we design with or for, then the goal of environment-centered design is to extend this empathy towards both the human and non-human stakeholders of our designs (Sznel, 2020).

Ultimately, environment-centered design requires that the tools commonly used in a user-centered design framework (i.e. in a strictly anthropocentric perspective) are paired – not necessarily replaced – with new tools and new holistic exercises, that promote greater empathy towards the “other” (species, landscapes, water, air, soil, viruses) and eventually towards ourselves.

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3. Within the Metabolic Network: studies in Multi-species Design

*Gionata Gatto**

Abstract

Doing Multispecies research asks us to learn to comprehend the entities we are about to work with. Not only their biological identity but first and foremost their ways of weaving relationships, the power relations that link them to others (human and otherwise), and the factors that regulate the network in which they operate. Being Design oriented towards the future, the practice of Multispecies Design moves beyond the ethnographic boundaries of the past and present, considering more speculative stances leading to world-making processes, future scenarios, and storytelling.

This chapter addresses one fundamental aspect in Multispecies Design Research, that is, asking what kind network the design is designed to explore, who participates in it and how participation is achieved. By theoretically drawing from traditions of Multispecies theory, the work considers the projects Geomerge and Vegetal Rescuers, two design installations that intertwine plant research with a series of ethnographies focused on the theme of vegetal agency in contaminated landscapes. By following the plants' metabolic processes, it was possible to navigate across the growing sites of hyper-accumulating flora, exploring their interweaving of relationships from within, and understanding how those species – often understood

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as weeds to eradicate – can manage to configure unexpected more-than-human worlds.

3.1 Doing Multispecies Design Research

In recent years, the concept of Multispecies started to travel across the practice of artists (see, for instance, Kirksey, 2014; Korsbaek, 2016) and designers (see, for instance, Gatto, 2019; Gatto and McCardle, 2019), providing inputs for re-thinking the role and position of nonhuman participants within design and its processes. In design, “participation” can be read as a conversation between users (Lawson, 2005); however, concerns and questions arise when participants are biologically different others or simply do not communicate through normative human methods. How does participation occur, through what means and how does that affect the design process? Hence, the need to find modes of engagement that can led us to explore and acknowledge other species’ ways of being and acting in the world. Multispecies design involves experimenting with environmental methods and tactics that can led us to listening those other ‘voices’ and letting them permeate the design process.

One approach previously investigated suggests to focus on relational narratives in complex ecosystems (Gatto and McCardle, 2019), such as polluted areas and degraded sites. Those territories, rather than being explored through conventional dystopic lenses, can actually provide important opportunities of encounter with other-than-humans. This echoes Anna Tsing’s argument, according to which at the heart of our encounter experiences does not proliferate the theme of “purity” (Tsing, 2015) but that of contamination, the only one capable of changing world-making processes and leading to mutual worlds and new directions. The idea here is to use ethnographic methods involving following nonhuman others across what Tsing calls “blasted landscapes” (Tsing, 2014). In the case of plants, the tactic of “following” (Deleuze and Guattari, 1980, p. 11; Marder, 2015; Gatto and McCardle, 2019), can be seen as one way of entering into their social life, encountering the actors and forces that populate their existence and simultaneously acknowledging the re-

reciprocal affordances of people and plants as they encounter each another. The encounters that emerge from such practice are the result of relational agencies through which different human subjects (the researcher and those who became involved in his/her work) choreograph intimate processes of meaning-making with (and about) other species.

3.2 Other-Than-Human Plants as Agents

In the discussion of multispecies networks, the notion of agency plays a crucial role. In its simplest form, the concept indicates the capacity of acting and transforming creatively and autonomously. For long, the concept centralized humans as exclusive agency holders, thus attributing

action to a small number of powers [and] leaving the rest of the world with nothing but simple mute forces (Latour, 1993).

Callon and Law suggest this to be a problem rooted on western societies, which tend to attribute action and will only when two classes of conditions are met, that is, “intention” and “language use” (Callon and Law, 1997, p. 491). Since the last century, post-humanist scholars have been drawing attention on the idea that autonomous and creative action is not a prerogative limited to the mankind but should also account for biologically different others. Here, agency does not equate with intentionality but is rather seen as a relational achievement, involving the creative presence of organic beings, technological devices, and discursive codes.

When venturing beyond the human, the issue of agency gets more intricate, particularly when we talk about flora. First, the ways in which we understand plants is determined from biological and physiological differences that inherently exist between us and them, which result in entirely different ways of perceiving and acting. To the human eye, for instance, plants cannot move, sense, think and therefore act. And this, if we consider what Giorgio Agamben calls “*cécité réciproque*” (Agamben, 2002), might be even reciprocal. Second, plants act in their place according to their own vegetal times,

which are different from ours. And yet, just like humans, they are involved in processes of construction of reality, in which they are anything but passive beings.

At those days, both, popular and scholarly accounts of plants' secret life got us to accept the idea that trees might be involved in significant agentic forces. Considering the physiological impossibility of plants to change their growing place, American author Michael Pollan borrows four vegetal species to introduce their "eye views of the world" (Pollan, 2002). Before him, Francis Hallé argued that precisely because plants lack of mobility, they embody biochemical differences compared to other living beings, which could even motivate animals to work for them (Hallé, 1999, p. 15). In "The Botany of Desire" (Pollan, 2002), Pollan's premises move even further, suggesting that plants successfully managed to "use" humans for serving their own survival and reproductive needs, and not the opposite.

Most of the scholarly work on the agency of flora focused on plants as adult trees. Those plants wield a specific symbolic power, which often derives from their age and degree of importance within the landscape (Cloke and Pawson, 2008; Jones and Cloke, 2002; Rival, 1998). The agencies of adult trees are distributed across distant times and spaces and involve encounters that affect (and are affected by) a multiplicity of political agendas. Human geography scholar Jamie Lorimer (2007) suggests that practices of environmental governance for the conservation of biodiversity are influenced by the "charisma" (Lorimer, 2007) of nonhuman species, including trees. The concept entails that nonhumans, by changing their forms across time, have the capacity of drawing affective responses from us. Charisma, he claims, should not be seen as a list of innate properties, but as a relational achievement that is regulated by the corporeal and perceptual skills (the *Umwelt*) of the entities involved in the encounter. Those forms of nonhuman response act as a motivating force on humans, contributing to form "ethical sensibilities" (Lorimer, 2007; citing Bennett, 2001) capable of leading to practices of environmental conservation.

Jones and Cloke (2008), in their attempt to explore plants as agents in the co-constitution of places, propose four ways in which

trees can be regarded as having significant forms of agency (Jones and Cloke, 2008; citing Thrift, 1996, p. 26):

- 1) routine actions consist of a plant's biological processes of growth, reproduction, fructification, spread and colonization;
- 2) transformative actions involve the ways in which a plant creates new directions and fields of relations, which are linked to the transformation of a place. Self-seeding and spontaneous growth are transformative actions: when remixed with the social, they create transformative effects;
- 3) purposive actions consist of the capacity of influencing future courses of action (e.g. the DNA of a plant embeds specific instructions. A purposive action is the capacity of the plant to enact them);
- 4) non-reflexive actions consist of a plant's capacity to engender affective or emotional responses from those who dwell amongst it (e.g. see Lorimer's notion of charisma).

Those features, according to Jones and Cloke (2008), can be used to account for creative agencies that are usually assumed to just belong to humans, and to explore how plants can become part of large multispecies networks.

3.3 Unblack-boxing soil pollution: Geomerce

Conceived as an itinerant installation, Geomerce (Figure 3.1) is a design project investigating how the physiology of hyperaccumulating flora can help to geographically situate issues of soil pollution and imagine alternative agricultural practices to be developed on contaminated sites. Hyperaccumulators are a particular kind of plant species, known within the natural sciences for their efficiency at absorbing heavy metals from polluted soil, and accumulating those metal particles within tissues and leaves. The mineral absorbed by those plants can then be extracted, by harvesting the leaves and burning the biomass, a process known as phytomining (Rascio and Navari-Izzo, 2011).



Fig. 3.1 - The design installation Geomerce, which was used as part of the methodological construct.

As these species' ability to colonize contaminated sites depends on their capacity to evolve metal-tolerant ecotypes, natural scientists began to study their behaviors as a form of self-defense from external actors (Boyd and Jhee, 2005; Kazemi-Dinan et al., 2014). Sociological readings of this process would further position the mechanism of metal uptake as a mode of vegetal agency. This includes aspects such as those plants' ability to "witness" histories of human transitions on their territory and facilitate cross-species evolution in multispecies environments (Gatto, 2017).

As many of the metals absorbed from those plants are also listed on international financial markets, Geomerce attempts to re-interpret the contaminated site as a living financial asset. With the support of hyperaccumulating flora, the installation draws a speculative scenario where agriculture blurs with finance and farming decisions result from the collaborative effort of people and plants, thus suggesting more-than-human readings of "contamination" that account for both biological and economic factors. The installation's main element is a series of three extraction units that accommodate different species of

hyperaccumulating plants, whose roots are immersed in a hydroponic solution made of water and specific concentrations of heavy metals. Each unit also embeds sensors that monitors the quantity of metal absorbed by each plants' group. The data are subsequently crossed with the value of the extracted metal in the financial market, using information provided from the London Metal Exchange (LME). The resulting data is then transmitted to a series of plotting units, which draws infographics reflecting three interrelated figures: the amount of metal absorbed from the plants, the real-time value of the specific metal in the market, and a digit that assembles the two figures (Figure 3.2).

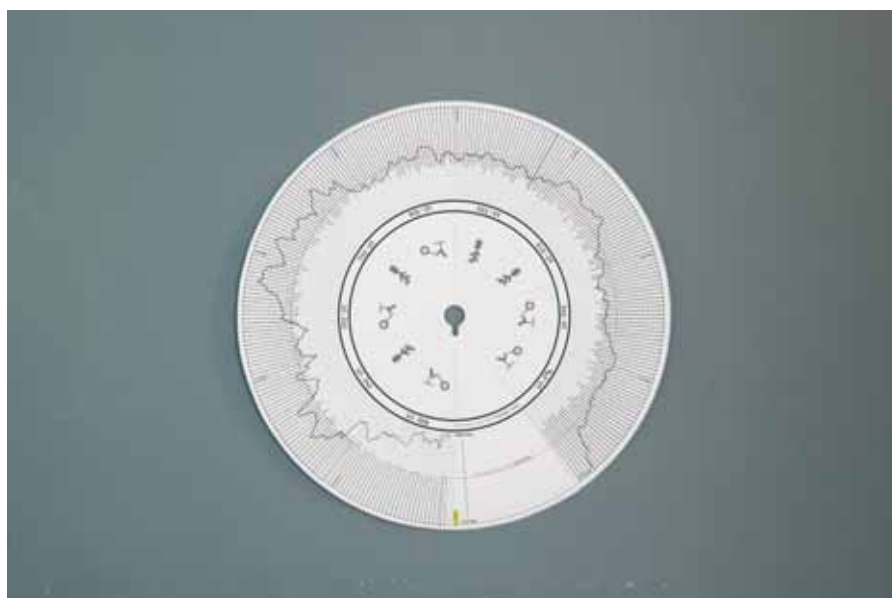


Fig. 3.2 - Example of one print, produced in 9 hours from one of the three plotting units. The vertical lines represent the quantity of heavy metals absorbed by the plants every two minutes; the fragmented line represents the trend of the absorbed metal in financial market; the numerical figures describe the hourly value-per-year of a hectare of contaminated soil, assuming it was cultivated with hyperaccumulators.

The latter, drawn hourly, portrays the value-per-year of a hectare of contaminated soil, assuming it was cultivated with hyperaccumulating flora and according to the real-time extraction activity moni-

tored during the performance. Being designed to be publicly exhibited, Geomerce is then circulated as a research object, finalized to explore multispecies networks in given geographical contexts.

In 2017, the installation was exhibited during the twenty-fifth edition of BIO, the Ljubljana Design Biennial, inside a gallery located within the city center. The process saw the engagement of the Plant Biology department of the University of Ljubljana, which provided information concerning possible plants to install within the exhibition and their growing sites (Figure 3.3).



Fig. 3.3 - Research settings of Geomerce's landing at BIO25. The three red dots indicate the position of three different sites (one lab, one field and one exhibition venue) around which the research took place.

Focus of the scientists at the lab is the hyperaccumulator *Thlaspi praecox* (Figure 3.4), a species they first identified in proximity of a former Slovenian mine. With scientist, we formed a research team and planned an excursion to the site in the Mežica valley, in view of finding, observing, and sampling some specimens of *Thlaspi* to include in the installation. On May 2017, three days before the opening of BIO25, we visited the site, with a team including six scientists and myself. The walk provided information about the ecology of that

place, the way in which the ecological succession in the valley began, through what species and how those could survive over several decades. By digging the soil, I could observe the alliances that those plants formed with the underground mycorrhizal network. In exchange for nutrients, the fungus facilitates the growth of those plants, protecting them from heavy contaminants such as cadmium, considered toxic even for resilient species. Walking the site and doing fieldwork on it led us to a population of *Thlaspi praecox*, where we collected the samples later installed in Geomerce.



Fig. 3.4 - White inflorescence of a Thlaspi praecox, found on the site of Zerjav (courtesy of the plant biology lab of the University of Biotechnology of Ljubljana).

Inside the gallery, the project was displayed as a solo exhibition for 4 days. To explore how the *Thlaspi praecox* participated in Geomerce's performance, two public activities were organized in collaboration with one plant scientist: a presentation and a debate. The events mobilized and aggregated different audiences inside the exhibit space, shedding light on the ways in which visitors, through their interactions, engaged with issues of soil pollution. For instance,

some inhabitants from the Mežica valley who visited the installation gathered around the project, to discuss with the biologist the ecological functions of the plant for their territory. In an interview, one of them claimed to have an emotional bond with those plants, as they shared with her an entire life in that territory. Rather than becoming a cause of concern, aspects of geographic territorialization leveraged on that visitor's sense of belonging to the land and the urgency to plan a better future for its inhabitants. Experiencing Geomercé's performances brought others to think about alternative agricultural futures for the valley, which could remediate the soil and at the same time provide opportunities for generations to come. Some visitors were more interested instead in the performative dimension of hyper-accumulators. One environmental consultant explained that Geomercé suggested a re-thinking of contamination through the perspective of those plants. This brought him to consider the implications of phytomining on a larger, more-than-human scale, reflecting upon factors that he would have otherwise left aside.

The format used to exhibit Geomercé and the following debate brought people to engage in multiple encounter experiences with the performing plants and reframe their understanding of soil contamination. Those activities did not simply involve the biologist and the designer in quality of experts, but rather assembled a network of heterogeneous participants, including environmentalists, social scientists, and engineers, who could exchange ideas, opinions, inform each other, and discuss the issues raised by the project.

3.4 From Plant Participation to Multispecies Engagement: Vegetal Rescuers

Vegetal Rescuers is an ongoing design research project, initiated on occasion of the "Art Meets Science" residency, a trans-disciplinary initiative promoted from the University of Wageningen (WUR). For the event, which took place in October 2018, I was invited with designer and researcher Alessia Cadamuro to collaborate for two months with scientists from WUR, to explore opportunities of cross-contamination and mutually enrich our fields of expertise.

Vegetal Rescuers involved a collaboration with biologists from the Environmental Sciences group and social scientists from WUR Sociology department; together, we worked on a theme of evolutionary sciences, exploring how evolutionary processes could increase resilience in the face of accelerating global change (Wageningen University and Research, 2018)

The topic was approached from the team through unconventional exploratory lenses, posing questions related to evolutionary processes, yet moving beyond just scientific readings of “resilience”, and towards a more-than-human understanding of its ramifications. The project explores the theme of metal contamination through the lens of hyperaccumulators’ metabolic processes, thus continuing the work initiated with Geomerge, yet shifting the focus on those plants as actors capable of mediating alternative modes of interaction with brownfields. Particularly, *Vegetal Rescuers* asks in what ways plant metabolism in contaminated sites could open to alternative modes of human/plant encounter, and whether this could lead to multispecies forms of resilience and dwelling.

Building on Guattari’s notion of “Ecosophy” (Guattari, 2000), the work entails that resilience to contamination (and its material by-products) can only occur if we merge together three main registers of ecological thinking: the environmental, the social, and the mental. The contaminated site exemplifies one between the many consequences of capitalism: it is a socially constructed place, with processes and materialities that are directly tied to the public perception of risk. As toxic contaminants are visually untraceable to the naked eye, those areas often become matter of concern for the population (Grasmück and Scholz, 2005), generating fear and neglected spaces, which prevents those territories from becoming socially actionable. Furthermore, the high cost of mechanical soil remediation usually leads to economically impractical investment projections, unless in presence of real estate development plans. As a result, most of existing contaminated brownfields remain unused, unless designated to the construction industry (Haninger et al., 2012).

The project revolves around two main design elements. The first is the database vegetalrescuers.org, whose aim is to connect situated scientific and environmental knowledges about hyperaccumulators,

providing at the same time opportunities to understand what plants grow and prosper within different ecosystems, according to criteria of endemism. The database was conceived as a trigger for environmental and social engagement, in that it represents a way for human communities to engage with the ecology of contaminated sites. One section, for instance, features a function of “Plant Finding”. This allows to input data concerning the location of specific sites and run a search within a growing database of plants, suggesting the three that can better grow on that soil, considering its composition and contaminants (Figure 3.5).

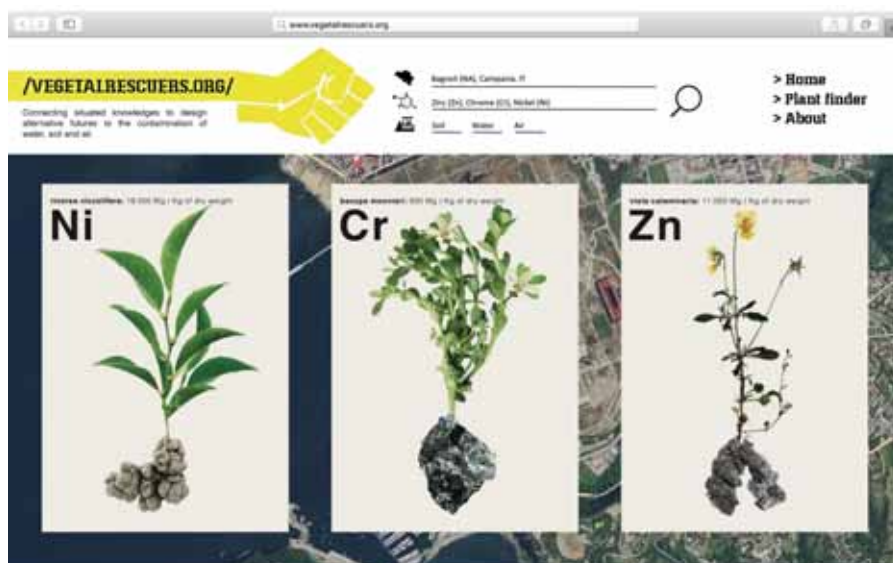


Fig. 3.5 - Plant Finder representation of plants that grows on a specific site, considering its environmental conditions (e.g. climate, soil composition, etc), extracted from the website *VegetalRescuers.org*.

From the database, we draw the second element of the project, consisting of proposals for site-specific interventions on polluted sites. The concept entails that hyperaccumulators, by flourishing on contaminated land, might guide human communities to reconsider the ecological significance of those places, thus supporting potential requalification processes. The project involves the employment of

drones, equipped with a special sowing module, capable of converting the devices into seeds printers. As contaminated sites are often extended, abandoned places, whose access to the public is usually restricted, we chosen drones as they can fluidly cover the vastness and unevenness of such territories, compared to unmanned ground vehicles. By programming those devices to follow a specific air path, we foresaw seeds to be evenly sprinkled on the ground, even in areas that would otherwise remain inaccessible.

The drone's paths follow the graphic outline of a raised fist, the logo of the project (Figure 3.6), however the actual growth of the artwork depends on the agency of the seeds: their way of interacting with the ground on which they fall, the climate, the type of flora and fauna living in the area. Most of the seeds might or might not grow, some of them might get dispersed by the wind or change their original location. This experiment of drone-sowing wanted to account for the hyperaccumulators' metabolism as a performative design process, changing over time and dependent on pre-designed aerial routes as well as on the routine, purposive and transformative actions (Jones and Cloke, 2008) of the seeds. Our purpose was to grant plants extensive ownership over the artwork and its aesthetic appearance, according to their own metabolic processes. In doing so, at each stage of the project, they would perform their actions independently, liberating both, the process from human control and the contaminated land from socially constructed biases.

Although the project is not yet fully implemented, one question that motivates it concerns what futures we could expect for those sites, assuming they would become a theatre for multispecies acts. As suggested by Cloke and Pawson, the contaminated landscape might work a site for the co-construction of intra-species relations, that is, a place for experiencing the agency of hyperaccumulators through new modes of affect and human-plant relationships. But it might also lead to human-seed alliances oriented to legitimize access to those sites, thanks to their re-qualification as milieux of environmental, cultural, and artistic interest for the community.



Fig. 3.6 - Series of speculative representation of a multispecies design, taking into account the Italian site of Bagnoli. Full videoclip available at: www.vegetalrescuers.org/sites/Bagnoli.

The question of whether this could -or not, become a viable route remains still open, however, recent events remind us that it might be possible. In New Zealand, for instance, the Whanganui river has recently become an actual “legal person” (Evans, 2020), obtaining the same rights as a human being. No need to say, the New Zealand government nowadays treats “crimes against the river as crimes against the tribe” (Ibid).

3.5 Encounters in the metabolic network

The work involved in designing and circulating the two projects came about as multispecies, multi-sited and multi-disciplinary practices. While “following” hyperaccumulator plants (Gatto and McCardle, 2019), I was able to navigate in person the places associated with their existence, moving between different sites, places and

locus of knowledge production. The heart of my work, however, started right from field work done on (and about) the contaminated site. This allowed me to explore those plants' interweaving of social relationships from within, trying to comprehend how these plants, often so small and even understood as weeds to eradicate, manage to prosper due to the settings of their land, configuring entirely new ecosystems. To get to the core of the discussion on multispecies networks and encounters, I suggest beginning by posing two questions. First, what sort of network does the project explore?

The two presented projects situate hyperaccumulating flora at the core of the design process; in particular, they are motivated by those plants' capacity of metabolizing heavy metals. Yet, both projects attempt to interpret metabolism through more-than-biological lenses. If, on the one hand, we are used to think of metabolism as biochemical activities that permit life in living organisms (e.g. allowing the conversion of food into energy, proteins, lipids, and elimination of waste), the term can also be used as a metaphor and paradigm to account for socially enacted mechanisms. Social metabolism, for instance, refers to the biophysical transformation and distribution processes in human societies, "constituting the self-reproduction and evolution of their biophysical structures" (Pauliuk and Hertwich, 2015). Urban metabolism looks instead at the flows of material and energy in cities and urban settings.

One interesting aspects of metabolism is linked to its reading as a series of intra-species, performative processes. Monika Bakke introduced the concept of "Metabolic Network" (Bakke, 2017), as a way to discuss the links existing between plants and minerals. In doing so, her purpose is to provide a geological rather than biological reading of vegetal metabolism, which serves her as a lens to analyze vegetal agency from a relational stance transcending time and space.

Geomerge and Vegetal Rescuers show that a multispecies reading of metabolism allows considering hyperaccumulating plants as living probes for exploring blasted territories, helping us to identify what agentic forces are at play within those places. Furthermore, being the designer positioned in a dialectical space that gestures towards the future, it also allows to carry out research across the times and places that define a plant's life, performing narrative bridges that can bring

these times and places in relation to each other. In the instance of Geomerce, the original metabolic network of hyperaccumulators initially included minerals, former mines, plant scholars and other actors with which these plants interacted from their natural habitat. While inhabiting the research process, however, that network was extended to a constellation of different sites (e.g. the lab and the showroom), and cut across different temporal setting. The plants who uptake minerals from a polluted sites are the same plants that nourished the work of the labs involved in the design process; the very plants that were also brought into the exhibition venue, to process Geomerce's solutions, suggesting its possible transformation into financial value.

The second question concerns the forms of agency exerted by the network's participants, and how to experience them. During my lab and field work on occasion of Geomerce's landing in Ljubliana, I observed that endemic hyperaccumulators are engaged in multiple relationships and forces. For instance, they do act politically, within metabolic networks involving post-industrial sites, national environmental policies, biologists and even laboratory things such as academic publications and lab equipment. Such mode of agency emerges relationally, as a result of the reciprocal affordances of these actors/actants. In growing on territories of political disputation (such as brownfields or former industrial sites), often subjected to the scrutiny of national environmental policies, each metallophyte species manage to engender responses from national research institutions, which then aggregate biologists and lab equipment to identify opportunities for the remediation of dirty land. The relationship between those actors resulted in relational processes that transformed the territory: some of these sites were later cleaned up, although often without the employment of phytoremediation processes.

Hyperaccumulators also act as witnesses of their environmental disturbances, both historical and contemporary. My field encounters with these plants revealed the geo-historical dimension of their presence on particular sites, linking stories of contamination otherwise temporally distant. This was partly possible as a result of the transformative actions in which those plants are involved, that is, their capability of forging relations determining a transformation of the terri-

tory. To encounter that agentic dimension, I had to assemble objects and practices that helped me to make sense of it.

Tsing's notions of Assemblage and Bodily Forms (Tsing, 2013, p. 32) were used as ethnographic concepts to approach those species as participants in multispecies networks. The plants collected from the former mines were chosen while paying attention to their geographical position, bodily form, color and vitality, through a tacit mode of interaction that I attempted to establish with them, in quality of witnesses of past environmental events.

This way of reading participation in the metabolic network had important implications for me and for the project. Most importantly, it brought me in direct touch with unexpected, other-than-human perspectives concerning the future of some territories, alternative to those proposed by current techno-industrial models of environmental restoration. Understanding that plant metabolism is not only entangled with our social life but can also emerge as an unplanned consequence of it, does reposition us as human beings, and at the same time helps imagining scenarios of environmental collaboration and rehabilitation, as opposed to logics of accumulation and resources exploitation. Given the current ecological crisis, now more than ever we need to familiarize with these viewpoints, as not only they can help us overcome the fatigue and distress of "living in the ruins" (Tsing, 2005), but can also provide us a means to re-negotiate our existence in a broken nature, paving the way to an inversion of thought towards the environment.

Acknowledgements

I would like to thank: Stimuleringsfonds Creative Industries; Giovanni Innella; the Plant Sciences and Environmental Sciences group of the University of Wageningen. This book chapter partially builds on work previously presented at conference: The Ecological Turn, January 2021. Another version was presented at conference: Safe Harbors, October 2021.

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4. A New Taxonomy for Spatial Design in the post-Anthropocene Era

*Giovanna Piccinno**

Abstract

In this chapter, an observation lens is placed on the themes of ethics and on the sustainable approach of those project that operates around the pivotal themes of contemporaneity with an interdisciplinary and transdisciplinary perspective. The focus is to generate a new Taxonomy of contemporary spatial design in order to respond ethically to the global ecologic and humanitarian emergency, thanks to a new vision and design-driven approaches.

The balance or unbalance between *Nature* and *Artifice* (biologic and technologic) is used as an interpretative key to identify the prefigurative actions of the design for the spaces in a researched, conscious and experimental ethical, and sustainable vision. The condition of the continuous need for transformation, adaptation, and metamorphosis of contemporary living and environmental systems arises as a central question. As observed by the philosopher Coccia (2020), all living species operate in a conscious way to transform the world around them and adapt it to their own existence. Every natural space is an artificial space. In this sense, in an anti-dialectical ecological perspective, the Technonatures experimental approach understands Nature as a continuous renewal of its capacity for genesis, creation, and adaptation, capable of absorbing the artificial as its component.

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The notion of Technonatures may provide a fruitful metaphor/myth to ignite discussion and reflection about changing relations between our ecologies, bodies, technologies, and urban worlds.

Different Spatial Design Tactics can be studied and activated to achieve new goals for a different Taxonomy in a post-anthropocentric scenario. Tactics that observe the border disciplines and draw useful lessons for the design between humanistic logic, scientific knowledge, transdisciplinary attitudes, observation of nature, and use of the most advanced technologies. In such tactics, the space designer is part of a cross-disciplinary team, which operates within a design scale of variable intervention, from micro to macro, for a concrete ecological vision of the project towards the post-Anthropocene Era.

4.1 Periscope Research Hub

The exploratory activity on Spatial Design¹ – which I am currently pursuing at the School of Design and the Design Department of the Politecnico di Milano – becomes, as a sort of Periscope in search of new horizons for the future, both a lens of observation and a methodological perspective of the project on the new complex spatial calligraphy of the Earth. The Periscope team's research, teaching, and design activities are opportunities to generate different logics, all of which aim at finding a new Taxonomy of contemporary Spatial Design. Such a Taxonomy draws its rationale from the increasingly current urgent ethical and global conditions, which replace the world of design in a new orientation of responsibility towards undeferrable ecological and humanitarian emergencies.

The research aims to experiment with disciplinary renewal, a new concept of a Spatial Design role that work primarily as a conceptual experiment and vision, and subsequently as a formal aesthetic outcome, concretely sustainable. Therefore, a new cognitive process is

¹ Piccinno, G. (2012), *Spatial Design: Design activity for the project of urbanised spaces [interior | exterior | in-between | landscape] and its related urban equipment system, through innovative sustainable, environmental, relational and logical configuration strategies – both progressive and regressive – even systemic, towards real sustainability*, in: Piccinno, G. and Lega, E., 'Spatial Design for in-between urban spaces', Maggioli, p. 77.

required, capable of both changing and even overturning our common approach to the project and representing and designing new ethics and new geographies for the Earth.

The group of scholars, experts, designers, researchers, and teachers² who have been collaborating with me in these first years of Periscope activity, highlighted the need for a change of pace. They all experimented – both the students and me – the vision and the realisation of project proposals aimed at provoking, imagining, suggesting solutions for spaces whose scope is to define a new taxonomy for an ethical and sustainable project.

4.2 Anthropocene and Capitalocene Era

In 2002, 1995 Chemistry Nobel Prize winner (for his groundbreaking studies on the chemical composition of the atmosphere as well as the formation and decomposition of ozone) Paul. J. Crutzen³ defined the current geological Era as *Anthropocene*⁴. Such a label was proposed on the grounds of the activities of industrial and post-industrial development of humankind, which have led to the so-called *global change*. Daniel Tanuro⁵, agricultural engineer and ecological scholar, persuasively explained the dynamics linked to the scale of the contemporary ecological crisis that have led to this global dimension.

From the 1950s onwards, the surge in the consumption of primary energy (essentially fossil), water, the use of fertilisers, the transporta-

² Markus Jatsch, Diego Pacheco, Cristina Morbi (MSP_Martha Schwartz Partners, London-UK+ New York-USA); Elisa Cattaneo, Alice Zingales (Politecnico di Milano-IT); Camillo Boano (University College London_UCL, London-UK); Alexandros Tsamis (Rensselaer Polytechnic Institute, Center for Architecture, Science and Ecology_CASE, New York-USA), Emanuele Coccia (EHESS_École des Hautes Etudes en Sciences Sociales, Paris-FR); Vincenzo Napolano (INFN_Istituto Nazionale di Fisica Nucleare); Stavros Katsanevas (Director of EGO_European Gravitational Observatory); Bruno Zamborlin (Hypersurface), Marco Barsottini (camerAnebbia); QuitEnsamble.

³ Crutzen, P. (2002), 'Geology of mankind', in "Nature", no. 415, p.23.

⁴ The Anthropocene is a proposed geological epoch dating from the commencement of significant human impact on Earth's geology and ecosystems, including, but not limited to anthropogenic climate change.

⁵ Tanuro, D. (2020), 'È troppo tardi per essere pessimisti. Come fermare la catastrofe ecologica imminente', Alegre.

tion of goods, and the size of the world's population – a consequence of the extremely fast industrial development, with exponential growth rates – has led to the now-no-longer sustainable escalation of the development of anthropogenic activities, which are closely related to the capitalistic economic system. Indeed, others have spoken critically of *Capitalocene*⁶ rather than *Anthropocene*. This objection arose by observing that it was not so much the activities of *Homo sapiens* per se, but the activities of the *capitalist man* that caused the acceleration of geological transformation, leading in very short geological times (only in just over two hundred years, usually calculable in millions of years), to the passage from the *Edenic garden* of the *Holocene*, to the contemporary and much-discussed new geological dimension, in which the indelible human activity has had a greater impact on the natural balance of the Earth than natural accidents.

Very briefly, in order to define the extent of the problem of the global ecological crisis, I report some of the criteria that various study groups and international entities, including the United Nations – in charge of controlling natural balances – have identified and pursued over the years (with first alarm bells ringing already in the 1960s). In 1987, the “International Council of Science” with the “Igbp - *International Geosphere-Biosphere Programme*” – an interdisciplinary study programme on *global change* – identified nine key parameters in order to evaluate their maximum sustainable values:

1. the alteration of nitrogen and phosphorus cycles;
2. the alteration of the carbon cycle;
3. the availability of fresh water;
4. the decrease in biodiversity;
5. the acidification of the oceans;
6. chemical pollution;
7. the concentration of atmospheric gases;
8. the use of the land;
9. the ozone layer in the stratosphere.

⁶ Angus, I. (2017), *Facing The Anthropocene: Fossil Capitalism and the Crisis of the Earth System*, Monthly Review Press.

This analysis, which concluded in 2015, highlighted four areas in which the ceilings had been exceeded: the concentration of CO₂ in the atmosphere, the decrease in biodiversity, the alteration of the nitrogen cycle and the use of the land. Other values such as the maximum limit for airborne particulate matter and chemical pollution were not determined at the time. The development of the research then also highlighted – thanks to the intervention of the British economist Kate Raworth⁷ – the threshold values of social development not to be surpassed. The diagram that represented this evaluation, between social minimum thresholds and environmental ceilings, was called *doughnut economics*⁸.

Increasingly comprehensive and precise important scientific studies have subsequently followed, highlighting the ever-higher risks for the survival of living beings, human and otherwise. The “Rio de Janeiro Earth Summit in 1992” activated three resolutions to address the situation under the leadership of the United Nations: the *United Nations Framework Convention on Climate Change* (Unfccc); the *Convention on Biological Diversity* (CBD); the *United Nations Convention against Desertification* (Unccd). Unfortunately, in occasion of the subsequent international and national government programmes and commitments very little has been done to date, and the consequences for the environment can be summarised in an alarming list of natural hardships and imbalances, all of which are interconnected and several of which, regrettably, cannot be solved anymore.

- Anthropocene warming (*Hothouse Earth*) causing climate change with consequences such as: increase in the number and intensity of fires, cyclones, storms, exceptional rainfall, droughts, cold waves, heat waves, melting of polar ice and sea level rise, etc.
- Decline in biodiversity, mainly caused by climate change, changes in the use of land and sea, the direct exploitation of living organisms (e.g., fishing), chemical pollution – a direct consequence of the processing of oil (plastic in the seas, air, and water pollution) – from the invasion of non-native spe-

⁷ Raworth, K. (2018), ‘Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist’, Cornerstone, ISBN 9781847941398; <https://www.kateraworth.com/doughnut/>

⁸ Available at: <https://doughnuteconomics.org/about-doughnut-economics>

cies on one fifth of the earth's surface (also linked to the massive agri-food industry). Most of the major ecosystems and biomes of planet Earth appear to have deteriorated.

The current extinction rate is at least ten to one hundred times higher than the average of the ten million years prior to the current period and, without intervention, will accelerate further. (Ipbes, 2019)⁹

- Residual carbon balance remains uncertain (in terms of consumption) and a very short time left to take actions against it. At the pace of current consumption, experts have established a maximum time frame of two to six years. What today can, in fact, be considered a temporary overshoot of 1.5 degrees with respect to the threshold value, can ultimately cause permanent effects (think of the large glaciers that are melting such as the Thwaites in West Antarctica or the Totten, whose melting process has been accelerated by the warmer ocean water that comes up against it traversing two valleys on the seabed).
- Epidemics of the Anthropocene. The Sars-CoV-2 has made it clear that other pandemics related to human activities will occur with consequences for the environment. The cause is the reduction in the distance between wild animals and *Homo sapiens* – as a result of practices that eliminate natural ecosystems, such as mineral extraction, the meat industry, deforestation, single-crop farming, etc. – and the facilitation of the spread of the virus due to the extensive movement of humans using mass mobility systems (especially air transport) and the growth of megacities.

The Climate Conference held at the end of 2015 in Paris¹⁰ stipulated a climate agreement for the period after 2020 that, for the first time, committed all countries to reducing their greenhouse gas emis-

⁹ Ipbes (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services), *Summary for policymakers of the global assessment report on biodiversity and ecosystem services*, 2019. Available at: <https://ipbes.net>

¹⁰ *Paris Agreement: the EU's road to climate neutrality*, <https://www.consilium.europa.eu/it/infographics/paris-agreement-eu/>

sions. In this way, the preliminary distinction between industrialised and developing countries was effectively abolished. At the moment, not all countries have fulfilled their commitments. The data is provided by Climate Action Tracker (CAT)¹¹ and draws a picture last updated on 10th December 2020. Under the “Paris Agreement” in 2015, governments formally acknowledged that their national climate targets collectively would not meet the purpose of limiting warming to 1.5 degrees Celsius, which led them to pledge to make the first update of their targets for 2030.

Tanuro concluded that ecological planning is urgently needed to produce less, transport less, work less and share more. Such a project that aims at a complete paradigm shift, breaking with the perverse logic of capitalistic accumulation towards a degrowth which has already been proposed, in the early 2000s by Latouche¹² and Fournier, as follows:

[...] degrowth is not only an issue of quantity, doing without it, but it is, above all, a paradigmatic re-ordering of values, especially the (re)affirmation of social and ecological values and the (re)politicisation of the economy. (Fournier, 2008)

This definition reflects what has been outlined in the guidelines of the United Nations Conference of the Parties on Climate Change (COP26)¹³ to be held in Glasgow, in partnership with Italy, in November 2021.

4.3 The EU Taxonomy for sustainable activities

To meet the EU’s climate and energy targets for 2030 and reach the objectives of the European Green Deal, the EU defined vital to direct investments towards sustainable projects and activities. The Covid-19 pandemic has effectively reinforced the need to redirect money towards sustainable projects to make the economies, businesses, and societies more resilient against climate and environmen-

¹¹ Available at: <https://climateactiontracker.org/climate-target-update-tracker/>

¹² Latouche, S. (2004), ‘Degrowth Economics: Why less should be so much more’. In *Le Monde Diplomatique*; Latouche, S. (2004) *La scommessa della decrescita*. Feltrinelli.

¹³ Available at: <https://ukcop26.org/it/iniziale/>

tal shocks¹⁴. Rethinking the logic of global development involves quickly adapting policies to contain consumption, using alternative energies, and profoundly modifying the system's economies. To begin achieving this goal, EU has committed to defining the EU Taxonomy classification system.

The EU taxonomy would provide companies, investors, and policymakers with appropriate definitions for which economic activities can be considered environmentally sustainable. Through this more precise definition, the taxonomy should create security for investors, protect private investors from greenwashing, help companies to become more climate-friendly, mitigate market fragmentation and help shift investments where they are most needed¹⁵.

The EU Taxonomy Regulation establishes six environmental objectives:

1. Climate change mitigation
2. Climate change adaptation
3. The sustainable use and protection of water and marine resources
4. The transition to a circular economy
5. Pollution prevention and control
6. The protection and restoration of biodiversity and ecosystems.

4.4 Neo-Holistic Design Approach

The current emergency, therefore, require serious reflections on the role that design can and must play in modifying the consumerist dimension and the unsustainability of human action over the last

¹⁴ Available at: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

¹⁵ The Taxonomy Regulation was published in the Official Journal of the European Union on 22 June 2020 and entered into force on 12 July 2020. It establishes the basis for the EU taxonomy that an economic activity has to meet in order to qualify as environmentally sustainable; https://ec.europa.eu/info/law/sustainable-finance-taxonomy-regulation-eu-2020-852_en

hundred years, in order to shift the axis towards a non-anthropocentric vision that considers equilibrium as a basis for any (human) impactful actions in the Earth environment. Yet, we should also include the Cosmic dimension. Indeed, we have already left the boundaries of the Earth and are colonising the cosmos with probes, satellites, international aerospace bases and installations on Mars and polluting it with cosmic refuse.

Until the advent of industrialisation and the productive principle linked to the economic dimension of the exploitation of resources, *Homo sapiens* – during the long history of the Earth – had managed to maintain an effective and balanced dialogue with Nature. There is evidence of this, for example, the magnificent transformation of the territories, moulded to create unique, local, and geographically specific landscapes, non-massive agriculture and physical structures – urban, sub-urban and infrastructural – designed to defend humans and nature itself.

The *philosophia naturalis*¹⁶ in its various currents of thought that have spanned the centuries – from Aristotle to Giordano Bruno, from Galileo Galilei to Goethe and Schopenhauer, up to the present day with a resumption of reflections on the ontology of nature – has outlined a very articulated reflective path, to which we can refer in search of enlightenment. The relationship between Macrocosm and Microcosm, in its inseparable duality, over the centuries clarified, on the philosophical level, the type of relationship between the *one* and the *many*, which is not to be considered simple otherness or diversity – namely, a quantitative difference – but rather a substantial identity, since a qualitative analogy exists between the macrocosm, containing in itself every part, and the microcosm, which in turn contains the whole in a small way. The universe was represented as being concentric, according to the Aristotelian-Ptolemaic model, the Greek man was inserted in a harmony existing between the *polis* and its inhabitants (likened to that existing in nature between the whole and its individual parts), the Vitruvian man of Leonardo represented this inseparable relationship and became a symbol of the mathematical correspondence between microcosm and macrocosm, through the relationship with the golden ratio.

¹⁶ *Philosophia Naturalis* (Philosophy of Nature).

We must recover the contemporary meaning that the part, even tiny, reflects the whole, towards an unprecedented holistic vision of balance. Holism¹⁷ (from Greek ὅλος *holos* “all, whole, entire”) is the idea that various systems (e.g., physical, biological, social) should be viewed as wholes, not merely as a collection of parts.

The Neo-Holistic Design Approach¹⁸ prefigures, in my opinion, a new “Whole”, of the different systems that compose our environments:

- the Natural Systems = Systems that exist in nature (e.g., man);
- the Artificial Systems = Man-made systems (e.g., car);
- the Mixed Systems = Man-made systems that contain natural subsystems and vice versa (e.g., city).

Therefore, the actuation of this principle provides for an enormous change in values, by subtracting resources from nature, and restoring resources and values, including social ones, to the environment. Clement (2014) celebrates in that sense *the symbiotic man* that

[...] should ideally return the energy he removes to the environment, like the tree whose leaves are produced from solar energy and restored to the soil as nourishment.

Re-echoing the eco-philosopher Henryk Skolimowski (1992) that prophesied the birth of what he called the *homo oecologicus*.

Today, on the macro scale, we must shift the axis of signification from the concept of territory to that of Earth. In particular, the guidelines of large projects today must also respond to the question of complex landscapes and spaces (neglected, residual, hyper-built, mining, etc.) and seek a new idea of space that combines the smallest (Spatial Design and equipment) with the infinitely large (planetary geographies) towards different ethics of the project. We should move towards an interpretative rethinking of these complex physical and social spaces, often linked to migratory phenomena. Landscapes of migration, extraction, and abandoned spaces are, in fact, holograms

¹⁷ The term “holism” was coined by Jan Smuts in his book *Holism and Evolution*, 1926.

¹⁸ Piccinno, G. (2020) ‘*Neo-Holistic Design Approach*’, Speech at ICDF 2020. International Conference on Design Future; Tsinghua University-Carnegie Mellon University- Politecnico di Milano, November 2020.

of the controversial processes of planetary urbanization, often linked to social and environmental exploitation.

Consequently, on the largest scale, the different taxonomy of the Spatial Landscape project must be investigated as a substitute for the urban one by modifying the design tools. In this sense, as Cattaneo (2008) wrote, the *patterns* become skilled in specifying the landscape's representational instruments and its general concept, which nowadays is still understood as an empty and relational space to the architectural one. A shift of interests must be activated, coinciding with a total redefinition of the values linked to the current main economies.

A movement of substitution, and not of violence, which presupposes slowness and progressiveness and the awareness of the masses. (Clement, 2014)

4.5 A new Taxonomy for Spatial Design

A new taxonomy for Spatial Design must, therefore, be put in place. This brand-new taxonomy must be generated by the understanding and application of some fundamental principles and by the implementation of control actions. There are very different aspects regarding complexity, that is the dimensional scale of the intervention, scope and contextualisation, technological development and experimentation, the balance between the natural and artificial dimension, the systematic nature of the production and construction principle, and the definition of new languages, and much more.

An articulated system of logic that must predict the *ecological impact* and *effectiveness* of the project as a whole – which must be sustainable – considering both the energy and ecological aspects, the cultural and social aspects, the poetic and language dimension, the economic and investment aspects. From micro to macro scale, projects can be answers to everyday reality and users, or placed in the large dimension of mending, between urban infrastructures and landscape, to merge the indiscriminate urban sprawl of postmodernity. An important series of characteristics and requirements can lead to the generation of an innovative, creative process for the Taxonomy of Spatial Design for the future of humanity.

Spatial Design Agile Approach. The definition of a renewed Taxonomy for Spatial Design must consider a series of objectives and aspects that can be selected by adopting a lean approach, depending on the scope and scale of the project intervention. Translating the concept of the *Agile Approach* from the world of programming to the realm of Spatial Design, the development of a new Taxonomy includes support for *adaptive planning*. It means promoting evolutionary development and continuous improvement, encouraging flexible responses to changing needs, checking the availability of resources, and understanding the different design levels to be solved. Using the *Agile Approach* in Spatial Design mainly means avoid waste: ecological waste (waste of resources), economic waste (waste of effort), social waste (necessity: how much, how big, etc.). To reach more flexibility, efficiency and less effort (capital, time, mistakes), we must follow some main principles:

- reject
- reduce
- reuse
- recycle
- rot

Less production means, in fact, less waste. Reusing older, still usable products saves resources, effort, and energy for a new production process. Using recycled and recyclable materials for new products decreases waste in the future by avoiding long garbage storage and no need to repeat burning processes. Also using materials, which rot after disposal minimizes effort and energy in the future.

Even introducing the innovative bio-design processes or materials and components can explore a new frontier for a more sustainable project.

Spatial Design Sustainable Innovative Traits. The extremely complex current condition makes it necessary and profitable to adopt an interdisciplinary approach to the design of spaces, which means recognizing the value of the various disciplines involved acting in synergy. Requests for the development and adaptability of the con-

temporary spaces seem to be particularly consistent with a canonical design process. More specifically, multilevel exploration and the information feedback stage – typical of the step-by-step development of Design method – create the opportunity, for Spatial Design, to plan actions in progress, to employ measures for the adaptation of interventions, which include their future regression within the design.

Furthermore, attention to the issue of degrowth is already consistent with the innovative systemic characteristics of Spatial Design¹⁹. These approaches are implemented with a forecast of the life cycle of the interventions until their conclusion. This means:

- being flexible
- being reversible
- low consumption of space
- being transportable
- being modular
- being adaptable
- being multi-performative
- being multifunctional
- being systemic
- being replaceable

In this way, it is also possible to favour the decolonization of spaces, useful for effectively contributing to reducing overall environmental loads.

Life Cycle Assessment and Life Cycle Design. The product (and the spatial device is defined by many products) has a complex life, expressed by its various parts, synthetically divisible into successive phases: it is born (extraction of materials), it is transformed (its processing), it is packaged and travels (transport), lives (use phase) and dies (disposal). For each of these phases, the impact of the object on the environment must be monitored and, based on the results obtained, the environmental performance of the critical phases must be improved. The environmental analysis of all these phases defines the

¹⁹ Piccinno, G. (2008) ‘Spatial Design’, in: Piccinno, G. and Lega, E., ‘*Spatial Design for in-between urban spaces*’, Maggioli, p. 79.

life cycle assessment (LCA) of the spatial device. Therefore, Design must be based on the analysis of these phases, defining its Life Cycle Design (LCD) upstream.

Evaluating the Product or Organisation Carbon Footprint (the amount of greenhouse gas emissions generated along the life cycle of a product/service/organisation) allows them to be controlled and managed, through the reduction and compensation phases.

Nature and Artifice balance in Spatial Design. As the philosopher Coccia (2020) recently argued, *Nature* itself is a great technological laboratory. All living species work in a conscious way to transform the world around them and re-adjust it to their own existence. Any natural space is an artificial space. Even the air we breathe is not natural but produced by millions of plants and cyanobacteria (Coccia, 2020). The current objective of the Spatial Design project actions – and the services connected to them – should be to design, for each different condition, a coherent balance between *Nature* and *Artifice*, thus overcoming both dichotomous and conciliatory relationships.

Different visions, theories, and fields of application are tested and pursued to discover the new boundaries of this delicate natural/artificial balance between art, biology, bioengineering, design, philosophy, ethics, with a strongly multi-trans-disciplinary approach.

- **Technonatures**

In this sense, in an anti-dialectical ecological perspective, the *Technonatures* experimental approach understands *Nature* as a continuous renewal of its capacity for genesis, creation, and adaptation, capable of absorbing the artificial as its component. The notion of *Technonatures* may provide a fruitful metaphor/myth for motivating discussion and reflection about changing relations between our ecologies, bodies, technologies, and urban worlds (Cattaneo, 2018)²⁰.

In contemporary culture, technonatural sensibilities also seem to be hovering in dystopian cinematic visions like *The Matrix*

²⁰ Cattaneo, E. (2018) '*Sensorial Landscape. Natural pattern/Ecological taxonomy*', Maggioli.

and more hopeful gestures such as the ecological-technological art installations of Olafur Eliasson²¹ and the performative installations of Tomás Saraceno, a visionary artist whose multidisciplinary practice encompasses art, social, and life sciences, creating immersive works and participatory experiences.²²

Furthermore, one could also think of the rather more controversial new aesthetic interventions in biotechnology debates as provoked by Eduardo Kac²³ with *Biotelematics* and *Transgenic-Art* and *Bio-Art*:

Bio-Art challenges the boundaries between the human and the non-human, the living and the non-living, the natural and the artificial (Kac, 2017).²⁴

In this scenario, we increasingly negotiate technonatural spaces/times that affect the definition of different behaviours in the global context.

- **Neo-bio-logical civilization**

Kevin Kelly²⁵, one of the supporters of the most radical stance, describes his theory of future *Neo-bio-logical civilization* in a striking and visionary manner: a civilisation that is still being born from the integration of the *Kingdom of the Born* (Natural), with the *Kingdom of the Produced* (Artificial), thanks to the morphogenetic engineering that integrates the Natural and the Artificial (Kelly, 1995). Machines are becoming biological, and the biological is becoming engineered. In other words, we can now control biology with engineering techniques (e.g., genetic engineering or artificial

²¹ Available at: <https://www.olafureliasson.net/>

²² Available at: <https://studiotomassaraceno.org/>

²³ White, D. F., Wilbert, C. (2006) 'Introduction: Technonatural time space', Article in *Science as Culture*. Available at: <https://www.researchgate.net/publication/233351163>

²⁴ Available at: http://www.ekac.org/manifesto_whatbioartis.html

²⁵ Kevin Kelly (born 1952) is the founding executive editor of *Wired* magazine, and a former editor/publisher of the *Whole Earth Review*. He has also been a writer, photographer, conservationist, and student of Asian and digital culture.

ecologies) and we can borrow ideas from biology to create machines with life-like properties.

According to Kelly (2016), much of what will happen in the next thirty years is inevitable. The future will bring with it even more screens, tracking, and a lack of privacy.

His book, *The Inevitable*²⁶, outlines twelve trends that will forever change how we work, learn, and communicate:

1. *Becoming*. Moving from fixed products to always upgrading services and subscriptions.
2. *Cognifying*. Making much smarter using cheap, powerful Artificial Intelligence (AI) that we get from the cloud.
3. *Flowing*. Depending on in real-time for everything.
4. *Screening*. Turning all into screens.
5. *Accessing*. Shifting society from one where we own assets to one where instead we will have access to services at all times.
6. *Sharing*. Collaboration at a mass scale. Kelly comments “On my imaginary Sharing Meter Index we are still at 2 out of 10”.
7. *Filtering*. Harnessing intense personalization to anticipate our desires.
8. *Remixing*. Unbundling existing products into their most primitive parts and then recombining in all possible ways.
9. *Interacting*. Immersing ourselves inside our computers to maximize their engagement.
10. *Tracking*. Employing total surveillance for the benefit of citizens and consumers.
11. *Questioning*. Promoting good questions is far more valuable than good answers.
12. *Beginning*. Constructing a planetary system connecting all humans and machines into a global matrix.

²⁶ Kelly, K. (2016) ‘*The Inevitable. Understanding the 12 Technological Forces That Will Shape Our Future*’. Viking Press.

- **Bio Design. The Hybrid future, the Biomimicry lesson, and the Material ecology**

Biomimicry is the practice that learns and mimics the strategies found in nature to solve human design challenges and find solutions. When translating nature's strategies into the design, biomimicry involves three essential elements: Emulate, Ethos, and (Re)Connect.

- *Emulate.* The scientific, research-based practice of learning from and then replicating nature's forms, processes, and ecosystems to create more regenerative designs.
- *Ethos.* The philosophy of understanding how life works and creating designs that continuously support and create conditions conducive to life.
- *(Re)Connect.* The concept is that we are part of nature and find value in connecting to our place on Earth as part of life's interconnected systems. (Re)Connect as a practice encourages us to observe and spend time in nature to understand how life works to have a better ethos to emulate biological strategies in our designs.

Pioneering Bio Design representative Neri Oxman – as a designer, architect, and founding director of *The Mediated Matter Group at MIT Media Lab*²⁷ – has developed new ways of thinking about materials, objects, buildings, and construction methods as well as new structures for interdisciplinaries and even interspecies-collaborations. From tree bark and crustacean shells to silkworm webs and human breath, nature shapes Neri Oxman's innovative design and production processes.

Her approach, which she calls *Material ecology*, brings together materials science, digital manufacturing technologies, and organic design to create new possibilities for the future²⁸.

²⁷ Available at: <https://mediatedmattergroup.com/>

²⁸ Oxman, N. (2020), '*Material Ecology*', MoMA New York, May 14/Oct 18.

At MoMA²⁹ (2020) an exhibition, curated by Paola Antonelli, presented her original research.

Bio Design explores a not-so-far future that investigates the possibility of replacing industrial and mechanical processes with biological processes (both natural and engineering); of integrating Living Structures and New Ecological Integrations in urban, architectural, and spatial scales; of experimenting in speculative objects and tools; in creating experimental original Aesthetic Experiences in the realm of Art practice (not designed for any specific users or perform a clear function).

Bio Design thus goes beyond biomimicry towards integration, dissolving the boundaries between the natural and built environment and synthesizing new Hybrid typologies towards innovative frontiers of design.

4.6 Towards the Post-Anthropocene Era

As analyzed, life is characterized by uncertainty, unpredictability, genuine chaos, and continuous change, in the current mature Anthropocene Era. Capitalism's productive capacity has generated great human wealth for some, yet it has also produced global-scale pollution, negative climate change, and mass species extinction. At the same time, it has impoverished and corrupted many of the efforts that have been made to harmonize human enterprise with the life systems of the Earth.

The sovereignty of Nature, seen with ecology lenses, clearly shows the "Whole" of the natural world. Nature viewed in all its aspects, cycles and interrelationship, cancels the human claims of dominion over the planet: Nature is stronger than human beings.

Since we have previously evolved within a pre-existing ecological matrix as an intensely social species and lived in relative harmony with all other life forms - and given the alarming consequences on the survival of the human species and the balance of ecosystems, it should be possible, as well as necessary - to progress in a more ethic

²⁹ Available at: <https://www.moma.org/calendar/exhibitions/5090>

and sustainable direction, overcoming all the forms of political-economy that has been called “*corruptalism*” (Cohen, 1993).

Through the complex movement of progressive replacement of the principles of the capitalist economy with an economy linked to values such as the global socio-economic system that utilizes the most current technological and scientific advances to provide the highest possible living standard for all people on Earth, the Neo-Holistic Design Approach with the different Spatial Design Tactics, here proposed, could contribute to the development of new Paradigms and Taxonomy for the Spatial Design in a post-anthropocentric vision, thanks to an interpretation of human being as part of a “Whole”, and not as the center of the “Whole”.

The global scale of the necessary answers means that the design actions represent a part of the complex process for advancing collaboration among actors in science, governments, the private sector, and civil society in all regions of the world for identifying and realizing concrete pathways for transformation, driven by evidence and strategic vision, towards a Post-Anthropocene Era.

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5. Design materials for the transition towards post-Anthropocene

*Valentina Rognoli**, *Barbara Pollini**, *Luca Alessandrini**

Abstract

Materials are considered fundamental elements of the design process and influence the era we live in, the Anthropocene. The chapter provides an overview of the leading researches on materials for design contributing to a sustainable transition.

We will consider the main aspects of new materiality emerging from processes of experimentation and sustainable innovation, highlighting those materials scenarios opening up solutions for a post-Anthropocene epoch. Yesterday, designers were focused on selecting the available materials; today they can design them for its own needs, helping to find and develop more sustainable solutions.

This chapter will focus on materials from organic waste, circular materials, and those bio-manufactured from living organisms as an emerging trend that design proposes as a helpful tool for planning the transition to the post-Anthropocene. Organic waste can be considered an alternative source in producing new biobased materials, improving sustainable development and promoting effective waste management. Nowadays, professionals' goal evolves in the diffusion of the circular bioeconomy through design thinking disclosing how materials play an essential role in this ongoing process. By selecting design case studies, we will highlight how materials can contribute to a

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more symbiotic relationship among industries and circular materials flow, acting as a key player in this transition.

Today, the word *biomaterials* can have multiple but slightly different meanings, reflecting material's differences in technologies, complexity, and potential impacts. An emerging trend in material design is related also to those grown from living organisms, thanks to a radical approach that draws on biology, incorporating the use of living materials into structures or objects. The growing interest in these materials lies in the possibility to biofabricate materials and artifacts from fast renewable and biocompatible little organisms, such as mycelium, bacteria, algae and yeasts. These and other sustainable features trigger designers willing to advance the transition from an oil-based and linear economy to a bio-based and circular one, designing post-Anthropocene futures.

5.1 Introduction

As argued by several scholars from different disciplines (Morton, 2018; Torres, 2017), the world as we know it is already over. All the changes we are experiencing at multiple levels force us to rethink and redefine almost everything to find sustainable solutions and the right direction.

Even if today the International Commission of Stratigraphy still classifies the current epoch in which we live as Holocene, that is the last part of the Quaternary period of the Cenozoic era, in reality, the concept of Anthropocene emerged and settled down into the scientific and intellectual debate. Especially since the beginning of the new millennium.

The entire historical development of human civilization took place within the Holocene, which in common sense, begins with the discovery of agriculture about 10,000 years ago, but it is the concept of Anthropocene that better highlights the impact of humankind on the environment. The term was spread in the eighties by the naturalist biologist Eugene F. Stoermer and adopted at the IGPB conference in 2000 by the Nobel Prize for chemistry Paul Crutzen. He announced that as far as he was concerned, the Holocene was to be considered

concluded. The International Union of Geological Sciences and the International Stratigraphy Commission have not yet officially approved the term. The latter, however, established the Anthropocene Working Group (AWG) in 2009, a working group that, over the last decade, has worked to understand if there were the conditions for talking about a new geological era. The feedback was positive, and the AWG has decided that in 2021 it will formally propose to the International Commission of Stratigraphy to add the Anthropocene within the history of the Earth.

The new Era could begin with the mid-1900s, the moment from which, according to the AWG, it is possible to identify radionuclides in the rocks from the detonation of the first atomic bomb in history (Perasso, 2015). In the scientific community, there is still ambiguous agreement on the start date of the Anthropocene, but there is a point on which all scholars and theorists of the Anthropocene agree: the new Era started when humankind became a geological force capable of changing the systems of the planet. In fact, as written in the name, human beings reshaped the Earth in this new Era, modifying its entire systems and consequently obtaining a decisive influence on global ecology. The human being is the dominant force that influences the planet, creating all the now evident damage and perhaps irreversible. The detrimental impacts and degradation of human activities have accelerated and intensified in various areas. It includes the overuse of resources and overloading that is over the limits, which compromises the integrity of the fragile ecologies of planet Earth and its climate.

In addition to the well-documented environmental problems caused by this human domination, we can see how the world has also become more confused and with less certainty. Is it still possible to distinguish what is natural from what is artificial? What is the difference between products created from raw materials and those generated from waste? Between consumption and production? These dichotomies are evolving and dissolving, emphasizing at the same time the growing uncertainty of the blurred boundary between them.

Humanity is called to find and pursue new ways to interact differently with the environment, and design, as always, has the responsibility to facilitate the task. The Anthropocene, or rather the transition

towards the post-Anthropocene, requires planning commitments that can question human domination's social, economic, and political implications. In other words, rather than being interpreted as an affirmative discipline, design can serve as a process-oriented critical tool (Gatto and McCardle, 2019).

The Post-Anthropocene is a neologism that is perhaps a bit ambitious to connote the Era in which humanity will be able to reverse the process, to make all forms of pollution and perverse sedimentation disappear. There are several theories for what will happen after the Anthropocene. Perhaps we will experience James Lovelock's "Novacene"¹ (2019), or Geoffrey West's "Urbanocene"² (2016), or Rachel Armstrong's³ "Ecocene"⁴ or the Era of ecosystemic egalitarianism (2016). Possibly the European Green Deal will show the world the right way. Or none of this because we will not have reversed course and will have become the only species on this planet to have self-extinguished.

The Anthropocene is characterized by the highest level of imbalance between humans and nature that was reached with the industrial revolution that began in the second half of the eighteenth century with the transition from renewable energy to fossil sources. A revolution that has changed the way of living and producing, bringing significant benefits to the community, but at the same time also increas-

¹ The Novacene hypothesis is the new Era of digital "superintelligence" that gets rid of human intelligence because it is not intelligent enough to follow the very rapid evolution of the artificial one. Human beings will find themselves, for the first time, having to share the planet with other beings smarter than themselves. This is why the Novacene is seen as the first true post-human Era.

² Begun with the first industrial revolution, the rise of cities seems to configure a transition from the Anthropocene to a new era that Geoffrey West, theoretical physicist and one of the leading experts of complex systems, he called "Urbanocene". Cities are laboratories of ideas, innovation, social cooperation and wealth creation, but they are also primarily responsible for the constant increase in environmental pressure and the consequent impacts on bio-systems health.

³ Armstrong, R. (2015) 'Keynote Presentation', Urban Ecologies 2015: A conference examining the future design of our cities, 18-19 June 2015, Toronto, Ontario, Canada: OCAD, Ontario College of Art - <https://ecocene.wordpress.com/home/the-ecocene/>

⁴ The Ecocene refers to an epoch where humans and their design practices identify ecological frames of reference. An emergent Ecocene depends on creative transformations in all domains and on all levels from human subjectivities to political economies (Boehnert, 2018).

ing an excessive consumption of natural resources that had been accumulated on Earth for millions of years.

With the industrial revolution, materials have also become industrial materials, designed and developed to meet mass production needs (Bosoni and De Giorgi, 1983). If, for decades, designers have been fascinated by the continuous development of industrial materials that perform well on the application level and of inspiration on an expressive and experiential level, today, the situation has changed. In fact, in the last ten years, designers have returned to take care of the materials themselves, designing, developing and self-producing them. The term DIY-Materials (Rognoli et al., 2015; Rognoli and Ayala-Garcia, 2021) is now shared in the literature (Galentsios et al., 2017; Calinedo et al., 2019; Comino et al., 2021) to describe the phenomenon that sees the designers realize, thanks to experimentation and tinkering, material drafts and demonstrators (Rognoli and Parisi, 2021) that can be subsequently studied and further developed to meet the needs of contemporary production.

In particular, the experimental process with materials was referred to as “material tinkering” (Parisi et al., 2017). Material tinkering is linked to the Experiential Learning concept, which involves the creative exploration of the connections between experience, learning, and personal development. Going more into depth implies acquiring new knowledge through direct experience with phenomena observed: this can be applied to the development of materials. As suggested by Resnick and Rosenbaum (2013),

The tinkering approach is characterized by a playful, experimental, iterative style of engagement, in which makers are continually reassessing their goals, exploring new paths, and imagining new possibilities.

Thanks to the democratization of technologies and processes brought about by the spread of the maker culture and the authorization that tinkering has given designers to handle materials, exciting things are happening that can positively influence by providing sustainable material solutions for the post-Anthropocene Era. Observing

what is arising from these new practices towards design⁵, we could say that there are two emerging phenomena regarding materials in the Anthropocene (Panneels, 2019; Dijkstra et al., 2019; Davidova and Zavolea, 2020).

The first is the one that investigates the increasingly blurred boundary between natural and artificial. Since plastic and other materials belonging to discarded objects have become part of the Earth's crust, it is no longer possible to distinguish which materials derive from natural resources and those from waste. Creating materials using waste is a pervasive practice and can be considered a driving force towards the transition to the post-Anthropocene Era.

Given the growing interest in the circular economy, all waste should be recycled most cost-effectively and sustainably. This is particularly important given the intensification of climate change and the increase in world population and urbanization. Due to the depletion of fossil resources and pressing environmental issues, the general interest in waste as a raw material increases. In particular, the EU must accelerate the transition to a regenerative growth model that gives back to the planet more than it takes, working towards maintaining the consumption of resources within the limits of the planet and therefore must do everything possible to reduce its consumption footprint and double the percentage of use of circular materials in the next decade (EU, Circular Economy Action Plan 2020⁶).

The European Green Deal⁷, which consists of a wide variety of legislative initiatives to be pushed forward during the next few years to increase climate ambition and create a growth strategy for the EU, is also focused on the concept of circular bioeconomy.

⁵ Some interesting references available at: <https://www.designinfo.in/blog/fashion-design-revolution/2018/materials-of-anthropocene-era/900>
<https://www.cooperhewitt.org/2019/05/22/nature-salons-materials-of-the-anthropocene/>
<https://www.dezeen.com/tag/anthropocene/>

⁶ Available at: <https://eurex.europa.eu/legalcontent/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>

⁷ Available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

The circular bioeconomy is a circular economy based on renewable biological resources and sustainable biobased solutions. As defined by Stegmann, Londo and Junginger (2021):

The circular bioeconomy focuses on the sustainable, resource-efficient valorisation of biomass in integrated, multi-output production chains (e.g., biorefineries) while also making use of residues and wastes and optimizing the value of biomass overtime via cascading. Such optimization can focus on economic, environmental or social aspects and ideally considers all three pillars of sustainability. The cascading steps aim at retaining the resource quality by adhering to the bio-based value pyramid and the waste hierarchy where possible and adequate.

Furthermore, scholars believe that the development of the bioeconomy reduces emissions and mitigates climate change, mainly thanks to the use of biological resources, this can include also living organisms, such as bacteria, algae, fungi, and plants to develop new materials. In fact, it is generally believed that using these resources reduces emissions compared to highly emission-intensive fossil products (Kardung et al., 2021). The second emerging phenomenon regarding post-Anthropocene materials is characterized by the transition from anthropocentric to anthropo-decentric⁸, which sees the development of materials starting from living organisms, bringing the design closer to scientific laboratories and life science.

In the chapter, these two emerging phenomena will be explained and described in particular: we will focus on materials from organic waste, circular materials and materials from living organisms as an emerging trend in design for the transition to a post-Anthropocene Era.

5.1.1 The organic waste dual value for a new bioeconomy

The European Commission defines the bioeconomy above all by emphasizing the innovative potential it represents for the industry. In fact, he says that the bioeconomy is about

⁸ The term is proposed by Valentina Croci (2017) in an article on Interni, which also presents post-industrial projects focused on the use of exemplary materials of the transition towards the post-Anthropocene.

the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. Its sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge⁹.

A fully sustainable and symbiotic human-nature perspective finds a conceptual framework within a circular bioeconomy that manages and uses resources consciously. Nowadays organic resources are considered vital for the future of sustainable development (Vea et al., 2018). These play a central role in a circular bioeconomy because it aims to move towards a climate and nature positive economy not only through the replacement of fossil energy with renewable energy but also through the shift to fossil-free materials, substituting carbon-intensive products like plastics, concrete, steel and synthetic textiles for lower-carbon alternatives (Bracco et al., 2018).

This shift also represents an opportunity to modernize and make industries more circular: renewable biological resources are, if managed sustainably, circular by nature and often easier to remanufacture. Several important sectors like chemicals, textiles, plastics or construction now need new conceptual business models and innovations to become more circular and lower carbon industries. It is urgent to develop business models and design products and services in new ways to decouple business prosperity from the mere consumption of products (Zihare et al., 2019).

In this context, organic wastes can be considered alternative sources in producing new biobased materials improving sustainable development and promoting effective waste management (Lundie and Peters, 2005). Organic waste is the oldest waste stream arising from human communities. We can include in its food and green waste, forestry and agricultural residues, animal waste, biosolids and sludges, as well as paper, cardboard and natural textiles (Lasaridi and Stentiford, 2011). Italy produces 10.8 million tons of organic waste, consisting of food and green waste (Buratti et al., 2015), which of this 42% is transformed into compost being put back in the soil. In

⁹ Innovating for Sustainable Growth - A Bioeconomy for Europe (2012)
https://ec.europa.eu/research/bioeconomy/pdf/bioeconomycommunicationstrategy_b5_brochure_web.pdf

recent years, a significant amount of research has been done to convert organic waste into valuable materials and products; strategies for producing sustainable materials and manufacturing processes for various applications are vital for sustainable development, but still little is applied.

Furthermore, it is necessary to consider that biowaste valorisation has received significant attention in recent years as sustainable alternative raw materials, exploiting the biowaste for producing high-value biomaterials (Dahiya et al., 2018). Repurposing waste materials into valuable products will not only improve sustainable development but promote effective waste management. In this regard, it has been proven that organic waste has a dual value if used within a bioeconomy framework. The first is that once the organic waste is disposed of, during the decomposition phase, it naturally produces gasses accelerating the greenhouse effect, like methane (CH₄), able to trap heat within the atmosphere more effectively than CO₂ (Dilkes-Hoffman et al., 2018). The second advantage consists in the fact that upcycling organic waste avoids the extraction and use of new raw materials (Ghisellini et al., 2016).

For instance, a remarkable project done by a team of researchers from the Colorado School of Mines focused in extracting raw materials from organic waste taken from the local municipal site¹⁰. The lead researcher Ivan Cornjeo said that

there's no reason to continue mining, destroying the environment, when we can find many of the materials we need from waste.

In fact, they demonstrated that organic waste from food leftovers could be a great source of precious minerals, like silica. The research team extracted it from 38 organic wastes to realize fully usable clear glass components. The team hypothesized that seeing the food waste amounts worldwide it will be possible to produce up to 36 million tons of glass from it (Cornejo et al., 2014).

Another organic waste used to extract raw materials is the citrus peel. In 2006, researchers from Cornell University showed successful results in extracting a potential alternative to fossil oil deriving sub-

¹⁰ Available at: <https://www.pbs.org/newshour/science/future-mining-resides-city-dump>

stances from citrus peel coming from the fruit juice industry: limonene C₁₀H₁₆ (Byrne et al., 2004). Limonene has the potential to become an important component of the bio-based chemical industry; being a simple hydrocarbon, it shares many similarities with the chemicals we obtain from fossil fuels. Therefore, the technology we currently use on petrochemical feedstocks could be directly used on limonene to turn it into useful products such as bioplastics, potentially replacing polyurethane and yarnable polymers. Due to that during the juicing process the 50% in weight of citrus fruits goes to waste, it will be probably possible to extract roughly 125,000 tonnes of limonene per year worldwide¹¹.

MarinaTex is a UK based startup being developed by the designer Lucy Hughes¹². Lucy tackled the problem of plastic pollution and new biodegradable polymers sourcing. For this reason, she developed a new compostable material designed as an alternative to single-use plastic films consisting of waste material from the fishing industry and sustainable algae. During the fish processing plant tour, she identified various waste streams to work with, including offal, blood, crustacean and shellfish exoskeletons, and fish skins and scales. After researching the different waste streams, it became apparent that the fish skins and scales had the most potential locked up due to their flexibility and strength enabling proteins. It took over 100 different experiments to refine the composition and process to form what MarinaTex is today.

As mentioned in the previous paragraph, one of the advantages of upcycling organic waste is to avoid the emissions produced during its end of life. Bio-digesters are nowadays the most diffused solution to trap the gasses produced, but that still must go through combustion to be transformed into energy (Pan et al., 2015). An innovative solution has been proposed by the Filipino student Carvey Ehren Maigne making him win the James Dyson Award 2020. Carvey and his project AuREUS, developed a compound made from new material from

¹¹ Available at: <https://theconversation.com/orange-is-the-new-black-gold-how-peel-could-replace-crude-oil-in-plastics-47121>

¹² Available at: <https://www.jamesdysonaward.org/it-IT/2019/project/marinatex/>, <https://www.marinatex.co.uk/>

vegetable leftovers which convert UV light into renewable energy¹³. He is currently planning to put it on the market, having his technology a wide variety of applications: windows, building facades and even electric cars.

These projects demonstrate that developing more and more efficient upcycling processes can lead to less primary resources exploitation. Solutions that look at organic waste from a different perspective are currently creating the basis of new potential bioeconomies representing the future in a world in constant demand of resources.

5.1.2 Innovations from below, organic waste DIY upcycling to sustainable bioeconomies

DIY-Materials practice is largely diffused among the projects developed by designers, often using organic waste coming from their own house or being locally sourced (Rognoli et al., 2015). Usually, this approach is adopted for two reasons: firstly, working within the private context doesn't allow the use of sophisticated instruments to process organic waste. Secondly, it gives the projects a potential educational purpose. With this, we can say that designers focused on the process itself to make it adoptable by the regular consumers in fostering better waste management, which will be an indispensable parameter for a hoped-for transition to a post-Anthropocene era. The intent of disseminating alternative organic waste upcycling practices could potentially create scalable phenomena starting from changing the habits of the single citizen until reaching more complex systems such as urban contexts and becoming new forms of potential bioeconomies (Santagata et al., 2021). In this regard, we could mention case studies like the work done by Weißensee Green Lab that designed a process to upcycled vegetable peel (such as asparagus) to create single-fiber¹⁴. As mentioned, the project focuses on making the process accessible to everyone and adopting technologies available in everyone's home, adding, in the end, the invitation to try with

¹³ Available at: <https://www.dyson.com/newsroom/overview/features/november-2020/interview-aureus-system-technology-jda-2020>

¹⁴ Available at: <http://greenlab.kunsthochschule-berlin.de/archive/projects/100>

more household organic wastes. Another project that started having a DIY approach to be a sharable process is the one realised by the designer Michela Milani and successively developed by Whomadeit studio¹⁵. They created tableware from organic waste from food leftovers like carrot peel and peanut shells, following a sharable process to be done at home. Many biodegradable tableware and food-related products have been recently developed, becoming startups using organic waste to create new materials that can be food-safe, resistant, and easy to break down once disposed of. A good example of a project that started as a DIY sharable process and then successively developed is Chipsboard¹⁶. The two founders, Rowan Minkleya and Rob Nicoll, realise structural material boards made of heat-pressed potato peel from industrially processed French fries. They started with a trial-and-error approach, until increasing the amount of production partnering with a bigger company such as the well established French fries producer McCain Foods Limited.

Disposable containers inspired several startups in creating new solutions (Troiano et al., 2018), and some of them started from a DIY perspective making the process successively scalable.

Shellworks is a UK-based startup developed to work with organic waste from restaurant leftovers and extract chitin from crustacean shells to make biodegradable and fully recyclable containers. The project began in 2018, and now they developed an entire catalogue of new products encompassing food and cosmetic containers made to biodegrades.

5.1.3 Organic waste based socially organic bioeconomies

The attention in generating socially valuable projects is becoming part of the new designers' generation's DNA. New forms of bioeconomy from organic waste upcycling are increasingly giving attention to the three pillars of sustainability (Purvis et al., 2019) and its

¹⁵ Available at: <https://inhabitat.com/foodscapes-contemporary-compostable-tableware-made-from-recycled-food-waste/whomade-michela-milani-compostable-tableware-foodscapes-4/>

¹⁶ Available at: <https://www.chipsboard.com/>

social side. Regarding these aspects, fashion is one of the most impactful fields from an environmental (in 2015, more than 16 million tons of textile waste was generated only in the USA, according to the American Apparel and Footwear Association - EPA) (Shirvanimoghaddam et al., 2020) and social perspective, since it favours poor and developing countries women exploitation (in Bangladesh, the world's second-largest exporter of clothes, the 85% of the workers are women working from 60 to 140 hours per week for €62¹⁷ per month). Designers and brands started to develop products and materials utilising textile fibers from organic waste sourced worldwide, being locally processed with the intent of creating all-around socially sustainable forms of business. For example, when banana fruits are harvested, the plant needs to be cut and disposed of creating a significant source of usable fibres (around 100,000 tons/year only from the Abaca type) currently used in a new generation of products aware of their impacts. Banana stem fibers made shoes have been developed by the Colombian designers' duo Diana Feliu and Iván Rojas. They choose to cooperate with 60 artisans using traditional techniques part of the local indigenous communities in the Andes mountains¹⁸.

Bananatex is a Taiwanese Swiss brand realising natural fabrics extracting fibres from the banana plant trunks cut after harvesting. They involve local populations in all the artisanal activities on the field, such as the fiber extraction during the scutching process¹⁹. The Philippines is the biggest pineapple producer worldwide, 2.169.230 million tons in 2010, potentially producing around 72.000 tons of fibers from pineapple waste leaves per year (Hijosa, 2015). Pinatex is a pineapple-leaves-fiber based leather developed in the Philippines by the Spanish designer Carmen Hijosa working together with small cooperatives of local farmers that follow the whole fiber extraction process.

The above-mentioned good practices demonstrate how projects involving local communities in processing the organic waste are part

¹⁷ Available at: <https://www.fashionrevolution.org/exploitation-or-emancipation-women-workers-in-the-garment-industry/>

¹⁸ Available at: <https://brightboys.org/2140-shoes-made-with-banana-fiber-local-and-sustainable-ar.html>

¹⁹ Available at: <https://www.bananatex.info/index.html>

of a new generation of businesses developed using waste and people from all over the world as precious resources.

5.2 Biodesign and biofabricated materials

The awareness of our impact on the planet (personally and as a species) is now reaching a mature state: in the last decade, design and art, as expressions of critical thinking, have profoundly questioned our relationship with Nature, rediscovering its involvement in the production of artifacts and materials as a powerful tool for reconnection, while proposing more sustainable production models. In terms of materials, one of the more evident signs of the Anthropocene epoch is the record reached in 2020, where the anthropogenic mass surpassed all living biomass (Elhacham et al., 2020); however, a re-evaluation of bio-based and circular materials is already in place, as previously described. In the context of materials for the bioeconomy, a new niche in design is bringing a radical vision of the project, including organic and living agents for sustainable and regenerative production models. Myers defined this new design field as Biodesign (Myers, 2012), a transdisciplinary approach incorporating the use of living organisms for the production of materials and artefact; the author highlight how this approach

goes further than other biology-inspired approaches to design [...], Biodesign refers specifically to the incorporation of living organisms as essential components, enhancing the function of the finished work.

The terms defining this emerging approach are derived from the medical sector: Biodesign, biomaterial and biofabrication originally refer to medical tissue engineering. The glossary in the field of Biodesign is still under definition. Concerning materials, those obtained thanks to the involvement of living organisms have been called “biomaterials”, “growing materials” (Camere and Karana, 2017) or “living materials” (Gilbert et al., 2021); to date the most accepted definition was introduced in 2020 by the report *Understanding bio* (Lee et al., 2020), which, referring to the previous work of Mironov (Mironov et al., 2009) and Groll (Groll et al., 2016), stated that the

more appropriate term for such materials would be “biofabricated”, identifying with this definition materials made “of, with, or from living organisms” (Ginsberg and Chieza, 2018).

5.2.1 Leading research in the field of biofabrication

Biodesign has experimented with the most disparate life forms, but among the most promising in terms of scalable biotechnologies, we find mainly mycelium (the vegetative part of fungi), algae, bacteria and enzymes. Mycelium is experiencing a rediscovery as a species, given its importance in the origin and maintenance of ecosystems and being recognized as the protagonist of the wood wide web, a connecting agent of root systems entangling single plants in entire forests (Stamets, 2005; Sheldrake, 2020). The first experiments that saw mycelium as a material for design were aimed at the world of packaging, where the mycelium is grown in stamps on a substrate of agro-industry waste, growing similar to the polystyrene used in packaging²⁰. The final material has insulating properties and can absorb shocks; for this reason, it has also been tested as a substitute for synthetic foams in bicycle helmets²¹. Given its physical properties, mycelium panels have also been developed to serve as thermal and acoustic insulation²². Even the fashion sector did not miss the possibility of experimenting with mycelium, giving life to a new type of leather²³. Algae have been widely tested for biofuels and as a food thickener. The bonding power of some species has been used to develop new materials; their biocompatibility and easy biodegradability in water has made them the good raw material for the development

²⁰ The US Company Ecovative has been the first testing mycelium as a packaging solution. See also their dedicated web page: <https://mushroompackaging.com/> (Accessed September 2, 2021).

²¹ “Grow it yourself” helmet developed by NOS Design in conjunction with Polybion. Accessed September 2, 2021 at <https://nos.mx/es/proyectos/>

²² As in the case of Mogu mycelium acoustic panels and flooring. Accessed September 2, 2021 at <https://mogu.bio/>

²³ The work of Mycoworks or the research of Pura by Mogu are both example of mycelium leather. Accessed September 2, 2021 at <https://www.mycoworks.com/> and <https://mogu.bio/pura-lab/>

of food packaging, sometimes even edible²⁴. Some materials act as fillers, thus avoiding a more significant amount of virgin raw material. Their filling ability has been tested in paper²⁵, plastic²⁶, and even in the development of new DIY-Materials for interior design, as in the case of the collection Terroir by Jonas Edvard (Cecchini, 2017). Bacteria are used to develop different materials too, for example, PHA bioplastics; while in the world of fashion, various bio-manufacturing experiments are underway with enzymes modified to produce a fabric similar to leather²⁷.

The above-mentioned biofabricated materials have been produced by microorganisms and stabilized to become inert for the final production and use phase: still able to perform as materials, with textures evoking their natural origin through “nuances and imperfections as para-linguistic markers” (Pollini and Angelini, 2021), but inexpressive as life forms. Among the biofabricated materials, for the ones most devoted to feasibility, this seems an obligatory step. However, it is interesting to note that in Biodesign, there is also an opposite trend, which sees the living organism as an integral part of the project, able to manifest itself, mutate in time and perform “livingness as a material quality” among others (Karana et al., 2020).

Mycelium is among the most tested organisms to be employed as living architecture (Adamatzky et al., 2021) and tested as a living sensor for computing purposes (Adamatzky et al., 2021): the EU-funded project Fungar is exploring the possibility to develop “a fully integrated structural and computational living substrate using fungal mycelium for the purpose of growing architecture”. Keeping alive the organisms within the entire life cycle of the artifact/material may sound still visionary and provocative, however, in some cases, it can bring the advantages of biological systems. One example is bacteria

²⁴ Evoware is a Taiwanese company producing edible algae-based paper-like material for packaging purposes. Accessed September 2, 2021 at <https://www.newplasticseconomy.org/innovation-prize/winners/evoware>

²⁵ Alga Carta by Favini. Retrieved September 2, 2021 on <https://www.favini.com/news/alga-carta-sostenibilita-upcycling-venezia/>

²⁶ An example is the company Bloom, collaborating with other brands by offering algae biomass as filler. Accessed September 2, 2021 at <https://www.bloommaterials.com/>

²⁷ To date, Zoa by Modern Meadow and Mylo by Bolt Threads are the more feasible examples. Accessed September 2, 2021 at <https://www.modernmeadow.com/zoa> and <https://bolthreads.com/technology/mylo/>

producing CaCO₃ embedded in concrete, able to fill the cracks occurring in the material by filling them with calcarean secretions (Stanaszek-Tomal, 2020). This form of “biological self-maintenance” has a sustainable counterpart in the durability of the materials and the consequent reduction of the need for new building materials. Algae can also be kept alive, benefiting from their ability to absorb Co₂. Ecologicstudio²⁸ designs interior living systems: structures hosting living colonies of photosynthetic microalgae to purify and refresh the indoor air. This enthusiasm for living matter has overshadowed the role of inert materials in the field of Biodesign; however, the role non-living materials can play in hosting life forms is indeed a key aspect of those projects having as their ultimate goal the support of living organisms. A special material feature highlighting the active role of inert materials in Biodesign is the ability of a material to be colonised by life, namely “bioreceptivity” (Guillitte, 1995). This phenomenon has been studied mostly with negative connotations, and addressed as a material “biodeterioration”, but recently this feature has been desired and designed to create the right conditions to host life. The work of Marcus Cruz at the Bartlett School of Architecture is, in fact, deeply exploring this material aspect, also with the potentialities of computational design and digital manufacturing, for the design of bioreceptive façades and tiles, able to greener the city. These tiles support autonomous systems of symbiotic building materials and cryptogamic and plants covers, precisely as it would happen in a forest. Widening this concept to the field of design, Material’s bioreceptivity can be designed based on chemical composition and physical properties

responding to the host needs and preferable environmental conditions, thus enhancing a multispecies environment and a design of mutual interest (Pollini and Rognoli, 2021).

²⁸ Accessed September 2021 at <https://www.ecologicstudio.com/projects>

5.2.2 The role of DIY approach in the development of new biofabricated materials

Biodesign's origin is characterized by a DIY approach and open-source philosophy (Elsacker et al., 2020). The case studies of biofabricated materials were initially experimental and related to speculative design (Aldersey-Williams et al., 2008; Myers, 2012), but it's not uncommon that a designer's DIY approach became later a leading company in the field of biotechnologies²⁹ and, to date, the first dedicated study paths have been established³⁰. Although this approach begins to be outlined in a more structured way, some of its early peculiarities remain, one above all is the necessity of a trans-disciplinary approach, functional to intertwine the practice of design with scientific knowledge and protocols. Myers in 2012 already described Biodesign as a

cross-disciplinary collaboration and creativity prompted by scientific research [...], propelled by global imperatives such as the urgency to develop and implement cleaner technologies and the rise of do-it-yourself "homebrew" biology (Myers, 2012, p. 9).

Do-it-yourself (DIY) biology is one of the main definitions describing the growing movement that in the last decade is trying to push the democratization of life sciences and biotechnology (Walker et al., 2021). Within the movement, often a sort of "bio" extension of that of fablabs, the practice of DIY is not only linked to the development of bio-fabricated materials and artifacts, but also to the equipment needed to work with life forms, focusing on local resources and low-tech solutions, to make life sciences accessible and available to communities. If for DIY-Materials tinkering is an essential activity in developing new materials, for the development of bio-fabricated ones we can talk about bio-tinkering with almost the same

²⁹ Among the examples of companies established in the field of biotechnology after a student or independent research can be counted: Ecovative, Mogu, Mycoworks and Modern Meadow.

³⁰ MA in Biodesign at Central Saint Martins, Bio-Integrated Design (Bio-ID) MArch/MSc at UCL. Moreover many universities are implementing courses and Labs dedicated to this discipline: Symbiotica Lab at the University of Western Australia or the Material Incubator Lab, to name few.

meaning: tinkering with materials of biological origin. This practice was even mentioned in the DIYbio code, developed in 2011 as a framework to achieve a DIYbio community of practitioners across Europe and the US; among other principles, in the US code is possible to read about bio-tinkering “Tinkering with biology leads to insight; insight leads to innovation”³¹. Thanks to its open-source and DIY nature, this approach can also bring positive innovation in remote places, abundant in natural resources but scarce in technological ones. Palacios and colleagues (Palacios et al., 2020), in proposing a methodological procedure for self-sufficient biofabrication in remote territories, include tinkering activities as a fundamental step in the method, with the collection of samples, processing and material experimentation. Moreover, the study highlights activities that may lead to local and circular material solutions, guided by an “approach to the territory”, to create a deep knowledge of the place, its materials and traditions, and allow an approach to biofabrication supported by territorial and cultural aspects.

5.2.3 Biofabrication for a sustainable transition

Curator Paola Antonelli, anticipating the theme of the 22nd Milan Triennale that she would have curated in 2019³², wrote in the foreword of Myers’ Book on Biodesign (2012) that

if human relationship with nature is broken, this design approach makes us hope that perhaps we will be able to fix it from within (p.7).

Imagining post-Anthropocene scenarios, sustainability appears to be an important trigger for designers to start dealing with living matter (Collet, 2013; Camere and Karana, 2017), also thanks to the sustainable features of biofabricated materials, associated with fast renewability, processes that require little energy, water and resources, and life-friendly chemistry. For this reason, many biofabricated arti-

³¹ From the DIYbio US community code. Accessed September 2, 2021 at <https://diybio.org/codes/>

³² Broken Nature was the title of the 22nd Milan Triennale, curated by Paola Antonelli

fact are developed to replace objects often associated with environmental problems. If for mycelium and algae material experiments mainly have the objective of substituting plastic materials that are too polluting (especially because they are applied in contexts where they risk being dispersed, not recycled and where their performances are incompatible with the short life of objects), for bacteria and enzymes (but, again, also mycelium) there seems to be an open challenge to replace leather of animal origin, taken as a symbol of unsustainable material within the fashion system.

The complexity of sustainability is nowadays in the details of these new productions, mostly still at a research stage (Lee et al., 2020), therefore difficult to assess with standardized sustainability metrics (Bak-Andersen, 2021). To assess the environmental impact of bio-manufactured products, it is necessary to evaluate all aspects of their life cycle because they might be more sustainable for some impact categories (e.g., CO₂ reduction) and less for others (e.g., water consumption) (Belboom and Léonard, 2016). Today LCA analysis remains the only way to ascertain the effective sustainability of productions, including those based on biological processes (Pollini and Rognoli, 2021); some early LCA studies suggest that sustainability must be analysed more in detail within the entire biomanufacturing processes, also considering the behaviour of consumers as a key factor for the effective sustainability of any type of new production with sustainable potential (Hildebrandt, Thrän and Bezama, 2021). Therefore, the intrinsic environmental characteristics of bio-manufactured materials are really promising but still dependent on processes that need to be increasingly assessed and improved for better sustainability standards and human habits. Biofabrication starts also to be mentioned for its potentiality in the context of circular economy: the white paper of Meyer and colleagues highlights how fungal biotechnology can be addressed as “solutions for securing, stabilizing and enhancing the food supply for a growing human population” (Meyer et al., 2020), since the mycelium grows on agro-industry waste, and bio-manufactured materials can return to fertilize the soil at the end of their life (if not treated with non-biocompatible materials/chemicals).

Regarding social sustainability it is important to highlight that biotechnology has always been synonymous with a quite rigid lab workspace, requiring scientific skills and expensive equipments, while Biodesign has always been characterized by a DIY/ experimental approach and open-source philosophy. This has also favoured the development of local and low-tech practices. A study by Palacios and colleagues (2020), proposing a “self-sufficient biofabrication protocol for remote territories”, reports how bringing biofabrication “off-grid”, can enhance the use of local materials, boosting circular models. The study also states that the enthusiasm for biofabrication can boost a rediscovery of the pre-existing relationship between natural resources and local culture, which are more robust in the memory of non-urbanized places; especially in isolated regions, where natural resources abound while technological ones are difficult to integrate, the authors state that

in these territories researching biological resources from a biomaterials production perspective becomes necessary in order to establish local and self-sufficient production chains that provide tools for material sovereignty (Palacios et al., 2020).

5.2.4 Biofabrication as a paradigm shift in post-anthropocentric design

One of the main paradigms shifts to which the practice of Biodesign contributes is the old-new concept of the natural ecosystem, based on symbiotic relationships among the different agents of a system for their survival. Biodesign is proposing a more relational vision of the project, expressed above where the organism is alive during the whole life cycle of the artefact - pushing the idea of continuous exchanges of information and materials, taking place between designers and organisms, between anthropogenic activities and the surrounding environment, and between the different agents of a system. Exploring what post-Anthropocene futures will look like is a common trigger in Biodesign, as proposing new visions to overcome hierarchical and polluting production patterns of the past. When concerning living artefacts, one of the strongest links among Biodesign

and post-Anthropocene is the fact that, among designers and users, also non-humans must be counted. Designers guiding the process of biofabrication, feel a sense of care for the organisms involved, which are often perceived as co-author of the project (Collet, 2013; Camere and Karana, 2018; Niinimäki, Groth and Kääriäinen, 2018), leading to a radical change in the perception of “the other”. This inclusion implies transdisciplinary knowledge and non-anthropocentric reasoning (Pasquero and Poletto, 2020), which heavily affect the traditional design practice. Moreover, this declared act of co-creation questions the authorship of the projects, and often the outcomes are *open-ended*, subject to the multi-agents taking part in the process. The mutability of living artefacts, as well as of inert/living assemblages, is read in this context as an “aesthetic approach to socio-ecological issues”, becoming a meta-language enhancing communication with the non-humans (Pasquero and Poletto, 2020). Within this vision, also technology is recognised as a fundamental mediator, becoming “a collaborative agency within nature’s complexity and cross-species social networks” (Davidova and Zavoleas, 2020) in the post-human-centred co-design model, including technological, human and non-human agents (non-hierarchically but with continuous feedback loops of information). Embracing the nature of posthuman ecologies, Biodesign materials explorations reimagine what it means to be humans, and try to understand and embed in the design practice the point of view of other species, envisioning hybrid and dynamic environments, thus tracing new epistemological configurations (Oppermann, 2016).

5.3 Conclusions

Sustainability is a concept in continuous evolution and constantly updating. Therefore, it is legitimate to ask which principles can guarantee an effective transition to a sustainable post-Anthropocene scenario. The most common and shared definition of Sustainability is the one formulated by the Brundtland Commission in 1987, which describes sustainable development as:

the development that satisfies the needs of the present without compromising the ability of future generations to meet their own needs³³.

Such definition was then refined to include the three pillars: the environment, economic, and social factors. It is now widely accepted that to achieve Sustainability, these three pillars need to be balanced. Even in the discourse presented in this chapter regarding the materials that will help humankind for the transition towards the post-Anthropocene, the three pillars are essential elements since the materials themselves have wide repercussions on the environment and affect society and the economy. However, there is a gap in the literature concerning the three pillars as points of reference in the analysis of organic waste materials and biofabricated ones, which could help enrich the discourse on the topic, especially given the complexity to assess Sustainability for new and experimental materials and processes.

Good practices of designers and brands embracing the three pillars of sustainability in realising new forms of bioeconomy represent the ground to build a possible future in the post-Anthropocene. From the collected case studies emerged how innovative solutions to up-cycle waste can match with the three pillars of Sustainability goals. From an environmental point of view, we have seen how we should gradually stop mining and deploying resources focusing instead on improving existing methods of raw materials extraction from the huge streams of waste we produce worldwide. This will create a dual value, breaking down the uncontrollable amount of pollution that waste creates at the end of its life, burdening the environment. Furthermore, it is possible to say that a new way to envision waste is rising from the projects developed by designers able to create new materials starting from a DIY approach until reaching the market. Among them, there are food waste made disposable packaging, new sustainable textiles from waste fibres, organic waste made objects, and a whole new generation of products for the new bioeconomy. Moreover, projects are tackling different aspects aiming to spread

³³ Available at: https://eur-lex.europa.eu/summary/glossary/sustainable_development.html#:~:text=Sustainable%20development%20was%20defined%20in,to%20meet%20their%20own%20needs

awareness as a form of new egalitarianism, treating people and waste as valuable resources reframing the paradigm of manufacturing goods, replacing it with growing new ones.

In an attempt to frame biofabrication within the three sustainability pillars, is it possible to confirm the potential that these materials have in meeting the aims of all three pillars. From an environmental point of view, the potentiality of biofabricated materials is evident, whose performances can equal (if not exceed) those of different materials in use today, but with a strong environmental advantage in terms of consumption and management resources. The environmental potential of these materials is also found at the base of the economic pillar framing biofabrication in the context of a circular and regenerative economy. On a social level, it is essential to highlight the effect of the DIY-bio movement on science democratisation, opening new possibilities for innovation on a local scale and in remote contexts. However, the transition toward the Anthropocene requires also a posthuman perspective. Human activities need to act in a shared environment, including non-human agents as stakeholders; here, the need for a multi-species design approach to expand the reference system to an even wider one must include the well-being of the ecological system as a whole.

For summarizing, the materials that we imagine as the most useful and promising for a transition towards the post-Anthropocene are firstly those that will increasingly be employed using waste and scraps as raw materials, overcoming the traditional dichotomy between natural and artificial to support the changes taking place and those to come. Secondly, the bio-manufactured materials look ahead by including co-design processes with living organisms, putting apart humans and pushing them out of the centre of the action.

Both of these new families of materials respond to the circular bioeconomy principles. We hope that studies will be undertaken focused on their analysis concerning the three pillars of sustainability.

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6. Post-anthropocentric creativity: new skills for a just digital transition

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Abstract

The Post-Anthropocene era profoundly influences human beings who need to develop new competencies and skills, among which human creativity is the most important (WEF, 2020). Indeed, in this digital and green transition, creativity has been recognised as one of the most distinctive human skills to reach a Digital Maturity defined as a “continuous and ongoing process of adaptation to a changing digital landscape” (Kane, 2017). Reaching a Digital Maturity through creative and design empowerment allows continuously understanding and possibly anticipating the foreseeable opportunities and the threats that the digital evolution will offer, developing a strategic approach to the adoption and application of such technology.

Today creativity is a requirement to face the complex social and sustainable challenges of the uncertain future moving towards a just and inclusive digital and green transformation. However, along with digital progress, creativity is also transformed, acquiring new forms and playing the leading role. We should start to ask ourselves how to expand the definition of creativity to make it more inclusive to non-human agents and rethink its values and ethics involved in the process? What new skills, methods and approaches do we need today to design for a more-than-human world?

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This chapter presents the three relevant dimensions – and their balanced relationship – that redefine creativity in the post-Anthropocene era from the authors’ perspectives, which are: Regenerative Creativity, Digital Creativity and Future Thinking.

It is in this context that the IDEActivity Center research group is active, dedicated to innovation studies driven by creativity through design, focusing on the contemporary digital changes (Canina and Bruno, 2018, 2021; Bruno and Canina, 2019a, 2019b).

6.1 Introduction

The digital transformation of the European economy is crucial for preserving international competitive advantages. Companies and public sector organisations need to integrate digital technologies into their business processes, products, and services to fully benefit from the efficiency gains and innovation they may bring while remaining environmentally sustainable and reducing greenhouse gas emissions.

Indeed, a green and sustainable transition is also a crucial step for Europe which is pushed and supported by new dedicated policies. With the Green Deal communication of December 2019, the European Commission has defined a set of concrete measures to get no net greenhouse gases emissions by 2050 and decoupling economic growth from resource use. Meeting these objectives will require significant technological advances in several areas where digital technologies will be a key tool to improve the efficiency and sustainability of every aspect of our lives. Emerging digital technologies are considered a critical enabler for attaining the sustainability goals of the European Green Deal in many sectors.

The global pandemic of COVID-19 has accelerated everything that was already changing. Without any doubts, 2020 was a year of upheaval, uncertainty and unknown territory, disrupting routines and daily life, affecting the way we spend our time and creating, for many, new realities and habits. Businesses had to respond quickly to change, adapting and becoming vehicles for new ways to entertain, shop, meet, exercise, seek medical care. From technology and business perspectives, COVID-19 has been a catalyst for change.

The digital transformation process involves strategic vision, or-

organisational aspects, people empowerment, technologies, and data, which drive companies towards improving their Digital Maturity level. Digital Maturity is a concept emerging along with the growth of the digital economy and industry 4.0 (Aslanova and Kulichkina, 2020) as a response from an organization to cope with rapid technological development through an adequate reaction.

They will have to adapt continuously to never-ending permutations and engage in a never-ending adaptation. The consequence of this is a holistic approach of companies' performance, including internal dimensions of business management and product manufacturing, as well as service delivery, both the relationship with customers and their expectations.

This process has been formalised as Digital Transformation, representing “the continual process aimed at reaching the moving target of Digital Maturity” (Deloitte, 2019) since the operational background is not fixed but rapidly evolving. Such improvement means applying and using modern technologies in the organisation's business processes, services and products to achieve its goals and increase efficiency (Aslanova and Kulichkina, 2020) sustainably and ethically. Improving the output of the digital process means increasing partly the level of maturity.

To ensure a transition toward a Digital Maturity in the Post-Anthropocene era, a new set of skills is needed by humans.

6.1.1 Why new creative skills are needed in the post-anthropocene?

Human-Centred Design (HCD) is founded on the perception of the human as a discrete, individual subject. Yet, our new relations to the natural world and socio-technical systems call these previous understandings into question. The use of HCD methods allowed (technology) companies to move from technocentric to human-centric approaches. What new skills, methods and approaches do we need today to design for the post-human world? Why and what type of creativity? The strategic approach based on human-centred design, increasingly adopted by companies, has proven to be the most suitable

to navigate complexity and the uncertainty of innovation and to transform the surrounding world issues into business opportunities, helping to explore problems and co-create solutions.

Today, more than ever, this approach becomes a fundamental tool that should be expanded and integrated to meet the post-anthropocentric complexity (Davidova and Zavoleas, 2020). Equally crucial is the adoption of certain skills that can provide valuable support in managing uncertainty.

According to the World Economic Forum, creativity is among the top three skills needed to get through these transformations and manage such complexity. Other fundamental skills are critical thinking and the ability to solve complex problems, be comfortable with ambiguity and uncertainty, flexibility, resilience, envisioning and anticipatory abilities necessary for people to bridle the first 5-10 years of the post-pandemic world (Paraboschi and Dalla Rosa, 2016) and be prepared for multiple perspectives in the future.

The new reality we are experiencing has highlighted the need for companies to creatively redesign their processes and go outside the “known”, quickly discover what works for them and what does not. Only those organisations that are able to understand this quickly and orient their activities accordingly will be able to manage the transition in the best possible way.

Creativity is a requirement in the post-Anthropocene era. It helps to face the complexity and move towards a just and inclusive digital and sustainable transformation.

Therefore, it is essential to understand how digital technologies are transforming creativity and how they affect the creative process of individuals or teams, thus, the impact on the practices and tools required to perform it. The emerging digital technologies pervasiveness, their accelerated evolution and the effects they produce, the rapidity with which they change are key characteristics that affect our reality. These circumstances create new cyborgian configurations of living and artificial systems and undermine traditional models of cognition, action, expertise, learning and consequently, creativity (Roudavski, 2016). This chapter presents the relevant dimensions and agents that redefine creativity in the post-Anthropocene era from the authors’ perspectives. An overview will be presented in section 2

using the metaphor of the lever to describe the balanced relationship between three fundamental dimensions: Regenerative Creativity (expanded in section 6.3) that unfolds a new perspective of creativity as a result of the assemblage of human and non-human agency based on the ethics and values of ecological intelligence, Digital Creativity that defines how both human and digital technologies can be agents of creation (expanded in section 6.4) and Future Thinking (expanded in section 6.5) which generates a more exhaustive, innovative and forward-looking approach to the future approach balancing the two dimensions mentioned above.

6.2 Creativity for a just digital transition: post-anthropocentric creativity

Creativity has been widely studied for a long time, and many definitions have been proposed. Since it is a complex and multidimensional concept, its understanding is constantly changing according to the socio-cultural environment around us (Runco, 2014). The definitions of creativity evolve and fluctuate over time. In the last decades, with the advent of Information and Communication Technologies and the acceleration of emerging digital technologies important influences have been registered on the creative process, from the identification of a problem to the acquisition of knowledge till the generation of an innovative idea and its implementation. Also, the cognitive, motivational and environmental components involved in the creative thinking process are strongly impacted by the ongoing changes. These changes need to be understood as it is a fundamental skill that can guide human evolution.

Therefore, to address today's needs of developing creative skills to meet the significant challenges of digital transformation and sustainability, it is imperative to observe existing creativity concepts with the post-anthropocentric perspective. There is a need to reconsider the implications of post-anthropocentrism in relation to human creativity, which is credited as the dominant, yet hugely destructive, influence on the planetary environment (Roudavski and McCormack, 2016). Post-anthropocentric creativity will be explored along two

paths identified by Roudavski (2016). The author suggests thinking about post-anthropocentrism by considering (i) agents, recipients, and processes of creativity alongside its (ii) purpose, value, ethics and politics. According to Roudavski, non-human entities can be seen as creative agents, which will create new set of ethical values and purpose behind such creative output. At the same time, post-anthropocentric creativity must include the process of digital transformation in creative process to address the future challenges.

To visualise and easily understand the mutual relationships between these dimensions, we decided to adopt the metaphor of the lever, showing also that the balance can be achieved. The first dimension, named Digital Creativity, includes the first line of enquiry that consider the agents, recipients and processes of creativity where both human and digital technology are creative agents. The second dimension, named Regenerative Creativity, includes the second line of inquiry that considers the assemblage of human and non-human agency to drive the creative process, underpinned by the set of values and ethical principles. Ecological intelligence is seen as a symbiosis of human, biological and technological domains driving the creative process.

These two dimensions represent the two ends of the lever as they are equally crucial for creativity in the post-Anthropocene. Therefore, they should be balanced through the Future Thinking dimension intended as the strategic approach and vision that shape the future (Fig. 6.1). If one dimension becomes predominant, the equilibrium is lost. In our vision, the post-anthropocentric creativity is shaped by these three dimensions crucial to managing the complexity of cutting-edge digital technologies towards a just and inclusive green and digital transition, i.e. a Digital Maturity. It is wise to extend creativity research toward complex and hybrid creative processes that implicate broadly heterogeneous actors including all forms and systems of life, algorithms and mathematical models, computational objects, physical entities and cultural constructs.

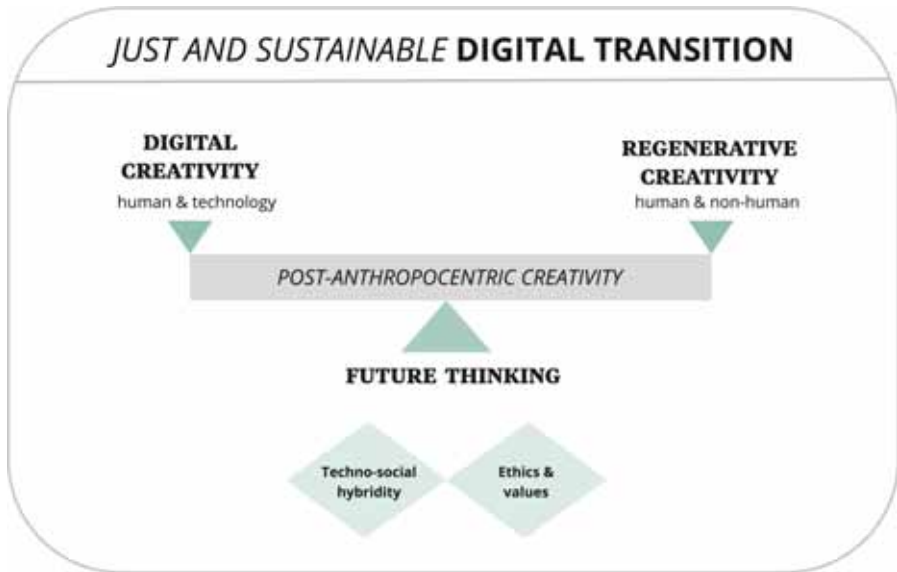


Fig. 6.1 – The three dimensions of the post-anthropocentric creativity.

The following sections provide a detailed description of the 3 dimensions, the skills and the perspective that shape each of them to give a deep understanding of the new conception of creativity in the post-Anthropocene era.

Edward Wilson (2017) defines creativity as a “unique and defining trait of our [human beings] species”, where it is exclusively attributed to humans and make us search for “the innate quest for originality”. Thus, creativity can be regarded as one of the central components of anthropocentric thought. How can we expand the definition of creativity to make it more inclusive and rethink its values and ethics involved in the process?

6.3 Regenerative creativity

There is no doubt there has been an immense devastating impact on our environmental and social systems. Resource extraction, over-consumption, and industry production have produced degradation of the systems. Transition to just and sustainable societies will demand

to shift from degenerative to regenerative ways of living and creating. However, this transition requires new design approaches informed by different values, knowledge, and practices. Post-humanism is an attempt to address the anthropocentric discourse by creating a new conceptual approach to rethink human relationships with the environment. We need to redefine our social practices and systems, behavior, as well as develop a new set of definitions, skills, methodologies and ethical concepts to approach future challenges.

To address acute environmental and social problems, we need to develop new literacy competencies defined by the UN Economic Commission for Europe as (a) understanding complex systems thinking and interconnectedness between generations, class and nature, while (b) emphasizing problem setting, visioning and creative thinking. Thus, the concept of *Regenerative Creativity* is a framework for disentangling systems thinking by incorporating regenerative symbiosis of human, environmental and technological domains. Regenerative creativity embraces the paradigm shift required for the well-being and justice of environmental and social systems. Further, regenerative creativity will be explored through three dimensions: individual level exploring the relations between *humans and non-humans*, societal level addressing the *system of values and ethics* underpinning creativity, and finally the broader symbiotic level embedding *ecological intelligence* as a framework for creativity.

Bruno Latour (1996) has emphasized long ago that both **humans and non-humans** shape the agency. Agency is mostly driven by knowledge, which is assumed to be predominantly a human capacity and defined by human experience. Post-anthropocentrism rejects the idea that humans are the only beings capable of generating knowledge, and allows for other forms, beings, and objects to be included. Scholars within post-humanistic studies try to redefine what and who has the capacity to produce knowledge and engage in the creative thinking process, where new materialism, ecologies, climate, interconnection between elements co-exist (Ulmer, 2017). Thus, what are the mechanisms to activate the different ways of knowing and different sources of knowledge rather than human-induced? How can creativity be fed and stimulated by the new ways of knowing and imagining?

The field of creativity studies has yet much to explore if it expands to the senses and experiences that are unknown to us as humans. In our chapter, we explore the notion of non-human as both including other biological species and infrastructures, as well as technologies that humans interact with. Taking this perspective, creativity can help to enable a more-than-human perspective to challenge our conventional human social practices and beliefs.

Building on that, actor-network theory (ANT) advocates for understanding the relations between assemblages of human and non-human actors which both shape equal agency. In this light, the post-anthropocentric period should not consider creativity merely as a human capacity, but rather treat it as an assemblage between human and non-human entities that produce hybrid knowledge and experiences. Ulmer (2017) points out that the knowledge frameworks that put focus exclusively on the human perspective at the expense of anything else “could be viewed as incomplete”, as well as demonstrate “potential injustice to non-human entities”. By moving away from a preconception that humans are predominantly the objects and subjects of generating knowledge, we open up a broad range of possibilities for creativity that accounts for just and fair consideration to non-human entities.

Design research and practice must move beyond human needs and human experience. It is a challenge to account for non-human perceptions and include non-human entities in the creative and design process. As in the example of designing future cities, non-human perspectives and needs remain largely invisible in the participatory design methods (Rice, 2017). However, nature as a non-human agent

can influence the imagination, too: our experience of or interactions with plants and animals, flooding rivers, disappearing lakes, and rising oceans, soil, mountains and glaciers, weather, climate and seasons, volcanic eruptions, a starry night sky (Milkoreit, 2017).

Imagination and creativity processes need to understand how the interactions between the two domains develop new behaviors and visions for cohabitation. At the same time, digital technologies, as a non-human entity itself, are able to interact with humans or other

non-human entities, such as other species, or infrastructures to produce new forms of knowledge to foster creative thinking process.

While exploring the relationship between human and non-human in the framework of creativity and knowledge production, it is crucial to consider what ethical issues and values such interconnectedness may imply. Roudavski (2020) points out that our current social and political systems have been considering “non-human life to work as capital, commodities, services or labor”. However, post-anthropocentric thinking requires a new understanding of justice that accounts equally for human, biological and technological systems, their interactions, behaviors and cultures. Ethical principles must be based on the concepts of co-creation and fair distribution, without any system taking over the dominant role. As Minati and Pessa (2011) frame that by interacting these systems produce new emergent multiple-systems, as Collective Beings, and not just a new system. As a process, therefore, regenerative creativity stimulates wholeness and connectedness based on mutual reciprocity, where these connections have potential to increase the principles of empathy and fairness.

The concept of creativity implies the process of imagination and production of novel ideas. However, imagining and designing, especially for the future needs, is often a site of hegemonic discourse that can be seen as an instrument of power for the one who is in charge. There is an urgent need to shift the notion of imagination to make creative agency more inclusive. Regenerative creativity can help to uncover things and processes that are marginalised and underrepresented. In addition, developing the set of principles for the concept of regenerative creativity, the notion of *responsibility* must be incorporated. Regenerative creativity enhances the notion of ethics and values in design and power domains, where responsibility must be assumed throughout the process. The creative process empowered by human, natural, digital systems need to bear responsibility for pursuing just and sustainable outcomes. In addition, the creative process has a responsibility for its innovations to our future generations and their well-being (Krznicaric, 2020).

Finally, regenerative creativity embeds both aspects, human and non-human agency together with the ethics and values into a symbio-

sis of ecological intelligence. For the first time, ecological intelligence was defined by Bowers (2011) as the capacity to adapt cultural and social practices to the limits and possibilities of a particular bio-region. Ecological intelligence has been practised by indigenous cultures, while western philosophers later took a different path of consciousness and form of intelligence where rational, abstract, and de-contextualized thinking became prevalent. The figure of autonomous individual and centred self-became very powerful in the West as the basis of political and social justice systems. Today, with the ideas of planet-centric design, biomimicry and nature-based solutions, ecological intelligence has a chance to revive again and establish new ethics and values for the assemblage of human and non-human.

Ecological intelligence is not something we have to invent anew, as it has been a long-lasting practice in our societies. The current challenge is to adapt it to the ongoing digital transformation process. Considering the definition of ecological intelligence which adapts social practices to the biological environment, there is a need to expand its definition to incorporate the digital environment, which has become an integral part of human and non-human beings, as well as larger enterprises like companies and institutions. Thus, there is a need to reconsider human functions in relation to biological and algorithmic digital systems by giving equal agency to all of them. Regenerative creativity can help us to develop and implement ecological intelligence and thus move to a new form of consciousness and knowledge formation.

A new approach is especially relevant today to develop the capacity to imagine solutions for challenging environmental, social and economic problems, otherwise being deemed “wicked problems” for their complexity and interdependence. However, design practices and technological solutions developed in the anthropocentric period has been largely focused on the human needs. In order to imagine new solutions, we need to create new narratives, methodologies and tools to redefine our cultural values and behavior. Regenerative creativity is inspired by nature and technology as non-human agents has potential to include diverse voices to ensure just and sustainable transition. However, regenerative creativity requires new methodologies to produce new forms of knowledge and engage in new forms of creativity

processes. There is a need to expand the human-centered approach that focuses on collecting and generating knowledge through interviews, texts, observations, images, sounds.

The new methods need to consider the symbiosis of ecological intelligence, ethics, values and relations between humans and non-humans to produce meaningful creative output to tackle future global challenges.

6.4 Digital creativity for a techno-social hybridity

Being constantly immersed in an “onlife reality” (Floridi, 2015), human beings have undergone critical cognitive, behavioral, and social changes. Indeed, the digital transition is having an important impact on creating and innovating, which involves a continuous movement across analog and digital and across the real and virtual. The democratisation of digital technologies has opened new opportunities for people to engage in creative activities, generating innovative digital ideas and projects, and contributing to an increasingly diffuse manifestation of creative acts. In this context of digital evolution, with the rising of disruptive cognitive technologies, devices that connect us with people worldwide, and ubiquitous digital technologies increasingly within everyone’s reach, creativity is evolving too taking a new shape: Digital Creativity.

Digital creativity requires people – as human agents of creation – to have new skills, a new digital mindset, and a greater awareness of the actions they perform and their implications for others. A human agent should be able to strategically exploit the opportunity of digital technologies to create an innovative original digital outcome (Bruno, 2021) putting them at the service of the community in any field (Lee and Chen, 2015).

We define the Digital Creativity perspective of the human agent a *creativity-driven technologies* that encompass how creativity impacts technologies, exploring, modifying and guiding their development. Empowering such an ability enables humans to mature towards the evolution of digital technologies and adopt them to create more sustainable, responsible, and equal possibilities in the future. It means

consciously driving technological evolution and empowering innovation through digital technology, putting technology at the service of human needs. This ability entails the understanding and application of a human-centred creative process referring to a mental cognitive process happening in the mind of the creator and a practice happening in the material world through a series of individual and/or social activities to produce original and innovative outcomes.

The human minds today depend on technologies and practices of communicating, remembering and planning. This symbiosis with technology, called “human-technology symbionts” (Clark, 2003), undermines the idea of the mind/body duality by making common functions such as communication, perception or memory dependent on various external devices.

Shneiderman (2000, 2002, 2007; Shneiderman et al., 2005) has consistently undertaken studies on Creativity Support Tools (CST) that are intended as tools, user interfaces, socio-technical environments, or software supporting creativity across domains, empowering users to be more productive and more innovative. The goal of CST is to make more people more creative more often, enabling them to face a wider variety of challenges creatively and successfully in many domains.

According to his view (Shneiderman et al., 2005), a CST should enable more effective searching of intellectual resources, improve team collaboration, and speed up creative discovery processes. They should also support hypothesis formation, speedier evaluation of alternatives, improved understanding through visualisation, and better dissemination of results.

Emerging digital technologies augment human ability to generate novel and useful ideas (Amabile, 1988; Sternberg and Lubart, 1999; Runco and Jaeger, 2012), playing the role of a real active partner in the creative process. Humans and computers work as a duo team, supporting and inspiring each other in different steps of the process.

Companies and artists have already started to use and build their own digital interface to support their creative process, as well as to propose tools that can empower human potential, going beyond the natural human capabilities providing new creative possibilities.

A digital agent can become a co-creator partner that *speeds up and amplifies the creative process's earlier steps*: they can generate, evaluate, or refine ideas and bring them to culmination as full-fledged products. It is the most ambitious vision of human-techno interaction for creativity.

This is possible today thanks to emerging cognitive technologies such as Machine Learning (ML) and Artificial Intelligence (AI), which can autonomously learn and interpret information, combine concepts to generate a new idea, or contribute new ideas in a dialogue with humans. Digital technology can be considered a divergent modifier designed to inspire people and support them in divergent thinking. By replicating or enhancing human cognitive processes, such as analogic and metaphorical thinking, conceptual combination, lateral thinking, creative visualisation the digital agent can speed up and enrich human thinking while augmenting work and learning processes.

Some digital technologies, such as Virtual Reality (VR), can provide immersive realities to generate imaginary, symbolic, or a real-world simulation by altering the surrounding space and objects (Fuchs and Moreau, 2006). They can be used to modify the environment and the space in which the creative activity generates digitally created artificial worlds that can inspire the creator and activate curiosity, interest, and inspiration to augment and diversify possibilities.

Individuals should learn how to adopt emerging digital technologies to empower, enhance and stimulate their creative process and the factors responsible for their creative potential. This dependence extends the human into the world making cognition and action radically distributed. Interfacing with such external devices is unavoidable and if one acknowledges that this context has its own histories, tendencies and agencies human cognition and action also emerge as collaborative: co-performed with nonhuman digital entities (Roudavski, 2016)

We define the Digital Creativity perspective of the digital agent as *digitally supported creativity* that encompasses how creativity can be supported and enhanced by digital technologies and how creativity can be transformed and become yet more digital. This overview showed the impacts the digital age is having on human creativity,

contributing to define the main perspectives with which to approach the digital creativity domain.

The concept of Digital Creativity is strictly related to the idea of Digital Maturity, defined as a dynamic state that an organisation aims to achieve, to improve its integration of digital technologies as support for human activities.

Achieving a Digital maturity for the post-anthropocentric future means being able to use our digital skills and capabilities to engage not only with humans but also with other species and infrastructures to expand into the notion of regenerative creativity.

6.5 Future thinking balancing the hybridity

Why creativity is the skill of the future? Futurists foresee that in the near decades the world's community will traverse through a period of rapid technological innovations that will change the foundations of society as we used to know. The company's environment is rapidly changing towards uncertainty and complexity given by technological changes and evolutions that deeply transform the strategic background (Teichert, 2019). Companies must innovate or disappear. They should more than ever be prepared to face the multiplicity of uncertain futures, anticipate possible scenarios to guide innovation, and take full advantage of the innovation capacity of digital technologies.

The ability to set a long-term vision is a key practice that a company should apply to achieve a Digital Maturity. Long-term vision represents the ability of an organisation to plan a strategy of intervention on a period from 5 to 10 years. Playing the long game is an intentional response to the changes a company sees emerging in the digital landscape (Kane, 2017). Embracing the digital transformation will require professionals and employees to be skilled for managing complexity and dealing with a spectrum of probable future scenarios.

When dealing with the concept of future, the verbs used are often to envision, to imagine, to foresee, to picture (etc.). Interestingly, all of them refer to something that can be seen – an image, a representation, a vision. Indeed, describing a future scenario with words is not

as powerful as translating it through images or artefacts (Prosser and Basra, 2019).

As a strategic approach to explore and critically consider future scenarios defining the preferable ones for everyone, Futures Thinking constitutes the most trustworthy process to explore and rethink creativity for a post-anthropocentric context. Futures Thinking aims to provide companies, decision-makers, designers with the capacity to proactively anticipate changes, recognise opportunities and ease the transition towards desirable futures. Indeed, it allows not only to acknowledge changes in the long-term but also, and above all, to inform today's decision-making activities.

In an article exploring the relationship between Design and Foresight, Hines and Zindato (2016) show how the two fields share an essential tool: scenarios. Moreover, they highlight that both disciplines are characterised by a core phase of generation followed by a “final phase of narration and representation” (Hines and Zindato, 2016). These similarities explain the significant relationship between Futures Thinking and Design which, throughout the years, has led to the definition of new design approaches. The most important ones are Speculative Design and Design Futures.

Speculative Design, is a form of participatory design that contributes to the debate on making design more human-centred, elevating it to a dimension of greater social responsibility (Bottà, 2019); this is possible by integrating this approach into all strategic processes for creating products and services. In 2013, Dunne and Raby defined speculative design in contrast to the traditional design thinking approach aimed at achieving goals through problem solving. Speculative design does not aim to solve problems, but to locate them in a space that extends beyond the present, creating narratives of possible future realities that help us to question the impacts of the choices we decide to make, thus being able to avoid less desirable futures (Dunne and Raby, 2013).

It is a form of critical design, that questions the cultural, social and ethical implications of emerging technologies. A form of design that can help us to define the most desirable futures, and avoid the least desirable (Dunne and Raby, 2013).

A second approach, Design Futures is described by Damon Taylor as a form of Futures Thinking that “involves the attempt to discern the possibilities of tomorrow in the culture of today” (Taylor, 2019).

Regenerative creativity, as a concept enabling human and non-human interaction along with ecological intelligence and values, is however still not included in developing future visions. Digital maturity and digital skills have the potential to use their capabilities to engage not only with humans but also with other species and infrastructures to expand into the notion of regenerative creativity.

At the same time, regenerative creativity has potential to inform the Future Thinking process by expanding the notion of “future” which has been dominated by the human perception of time. What if the non-human time scales and perceptions are very different (slower, faster, or fractioned) from ours and they can enrich and expand our approach to long-term and future thinking. We propose that both *Regenerative Creativity* by tapping into new types of knowledge generated both by humans and non-humans, and *Digital Creativity* by enhancing creative process with the help of novel digital technologies can help to expand the field of innovation for companies and designers to tackle the challenges of the future.

Foresight is the Future Thinking skill to empower to deal with the balancing of Digital and Regenerative Creativity, which is aimed at considering the future as something that can be shaped and influenced by present actions.

There are four phases that characterize the foresight process (Voros, 2005). Firstly, there are the **inputs** which refer to the initial phase of information and data gathering. Then there is the actual **foresight work** subdivided into three further steps: the analysis of collected information which leads to the interpretation activity. This step requires to dig deeper into the analysis findings in order to gain more in-depth and useful insights. The third step is called *prospec-tion* and it represents the synthesis of the previous two. This is the moment when alternative futures are created and explored. The most helpful tools in this context are the visioning methods, such as scenario planning.

Next, there are the **outputs** which represent the vast spectrum of options that have been generated by the previous activities. This part

consists in the successful completion of the foresight process: the final outcome, indeed, is an “expanded perception of strategic options available” (Voros, 2005).

The last part refers to the **strategy**: once the outcomes are available and the process is complete, strategic decisions and actions will be well implemented. Most interestingly, the actual objective of strategic futures thinking is considered to be achieved when a wide and inclusive range of possibilities is obtained.

Uncertainty about the future has always been a barrier to long-term forecasting. Moreover, the further forward we project in time, the greater the range of possibilities and pathways, which increases the level of uncertainty. As futures thinkers like to put it, the “cone of uncertainty” keeps widening. Since the turn of the millennium, however, we have shifted from a cone-shaped future to a new era of networked uncertainty: “networked” because the events and risks we face are increasingly interdependent and globalised, raising the prospect of rapid contagion and butterfly effects and rendering even the near-term future almost unreadable.

Futures Thinking has to raise awareness and “make people think” (Voros, 2003; Reeves et al., 2016). Futures Thinking is an analysis and criticism tool, functional as a “design for debate” and understanding the circumstances and future possibilities. For the same reason, Futures Thinking will never have implications for the present. Futures Thinking is pushing designers’ creativity and making them able to face complexity and multiplicity of futures. Since the nature of this approach tends to push the boundaries of what can be designed trying to tackle broader issues (e.g., climate change, health-related consequences of a pandemic), decision-makers might perceive that Futures Thinking proposals are disregarding their company’s core objectives, thus hindering the understanding of the potential of Futures Thinking scenario building (EU Foresight Platform, 2021). To overcome the challenges of Futures Thinking implementation for the companies and decision-makers, there is a need of a balance between the pragmatic aspect of Digital Creativity together with Regenerative Creativity. To achieve this, we need to understand the ethics, responsibilities of designing and living with non-human systems, both algorithmic and natural.

In this regard, these are the tools and methods for managing uncertainties in the future with the help of design by generating discussion and reflection. Empowering design methodologies with methods from Futures Studies generates a more complete, innovative and forward-looking approach to designing products and services for the future (Canina et al., 2021). Expanding on that, in this chapter we made an attempt to include and redefine the notion of creativity to empower methodologies and discourses in the field of design futures.

6.6 Conclusions

In this chapter, we have underlined the urgency of redefining the concept of creativity for the post-anthropocentric era, which has been named as one of the top three skills needed for the future (WEF, 2020). At the same time, technological advancement and digital transformation are both required to facilitate green and sustainable transition in European countries. As companies try to transform and achieve Digital Maturity, there is a need to ensure this transition is just and sustainable. Otherwise, innovations addressing acute challenges, but locked in the old systems of thinking and path dependency will not bring us closer to a better future.

Based on the two principal pillars for transition of Creativity and Digital Maturity, we have further explored the new methods and approaches that are needed to address the challenges of Anthropocene and ensure their mitigation for design research and practice for post-Anthropocene. By shifting the agency to produce knowledge and creative outputs from humans to include non-human agents, such as biological entities, technologies, digital tools, objects, data, and others, we expanded the notion of creativity.

Post-anthropocentric creativity is considered not as a mere human capacity anymore, but as an outcome of the assemblage of human and non-human interaction. The framework of Regenerative Creativity also implies respective ethics and values, as well as ecological intelligence that presupposes the symbiosis of interaction between human, biological and digital systems. As a result of a symbiosis of digital and human systems, Digital Creativity enhances new skills

and mindset necessary for a creative process, as well as creative process helps to enhance a symbiosis of human and digital interaction.

Inspired by the metaphor of a lever introduced in the Section 1, two dimensions of Digital Creativity and Regenerative Creativity are seen as balancing pillars to develop a new approach to post-anthropocentric creativity. Future Thinking stands as a foundation to provide the balance for both aspects with the aim to develop strategic future visions. The combination and balance of the three pillars is important for companies to adapt for design and innovation to solve the challenges induced by ecological crisis and fast-developing technological progress.

As a challenging thought for shifting to post-anthropocentric era, what if we see not only our biological and digital systems as innovators for creativity but also if we reconsider the role of humans by shifting away from an ego-centric role that has been developed by the Western philosophers. One of the urgencies of the Anthropocene is the growing world population and depleting natural resources. What if we reconsider and expand the notion of “human” in the human-centric approach and consider humans as energies, equally with biological and technological energies. Considering that there is an abundance of human energies, knowledge, empathy - we need to find ways to maximise and use it. In this scenario, Regenerative and Digital Creativity can help us to identify opportunities not only in relation to nature-based solutions but also to recognize the constructive potential and opportunities of the growing global population.

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and materials as a designer, educator and researcher. Since 2014 she investigates sustainable materials, focusing on the relationship between materials and design for sustainability from different perspectives (circular materials, biomaterials, made in waste materials and growing materials). For her PhD research, she is dealing with biodesign - an approach arising from the intersection between design, biology and technology – with a specific focus on how living matters can redefine key sustainable aspects for future productions.

Agnese Rebaglio. Designer and PhD in Interior Architecture and Exhibition. Researcher at the Department of Design of Politecnico di Milano. Member of DHOC - Design for Hospitable Cities research group, she develops design research and projects around innovative processes and forms of “hospitable” places, with particular focus on design for the enhancement and transformation of urban places; the design of setting and furnishing systems for hybrid and experimental spaces and services; the design of processes, spaces and communication to protect marginal situations and for social innovation. She is director of the international Master Design for Public Spaces provided by POLI.design.

Valentina Rognoli. Associate Professor at the Department of Design of Politecnico di Milano. Here, she began her academic career focused on Materials for Design. She has been a pioneer in this field, starting almost twenty years ago and establishing an internationally recognised expertise on the topic both in research and education. For her PhD, she undertook a unique and innovative study on a key but a little treated topic that is the expressive-sensorial dimension of materials of Design and their experiential aspects. At present, her research and teaching activities are focusing on pioneering and challenging topics as DIY-Materials for social innovation and sustainability; Bio-based and circular Materials; Urban Materials and Materials from Waste and food Waste; ICS Materials; Speculative Materials; Tinkering with materials, MDD method, CMF design, emerging materials experiences, and material education.

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The environmental emergency of the last century, highlighted by the pandemic, has led to an urgent need to reformulate the predominant role of human beings on the planet by undertaking a less anthropocentric design approach. This urgency has been especially outlined by a re-evaluation of the concept of the Anthropocene, which can be defined as a geological era characterized by the significant human impact on the geology and ecosystems of the Earth. Within this theoretical framework, the book explores the role of Design as a multifaceted discipline capable of exploring the complexity of a changing world, and reconsiders the human being's position in a pervasive relationship with the contemporary environments (physical and abstract) through a More-than-Human approach.

This volume illustrates reflections, analyses, and interventions guided by or intersected with the concept of the post-Anthropocene, and traces two different scales of observation. The first, explored in the two starting chapters, highlights how the complexity of the topic requires a large-scale analysis perspective in order to be fully understood. The concept of the post-Anthropocene does not exclude the human being as a fundamental component but takes the latter as a departing point to frame wider contemporary needs and issues and to support a call for action to envision and shape the future. The second part of the book instead explores the possibility to include, within this broad discussion, the theme of More-than-Human applied to specific disciplines – linked to the culture of Design – analyzing different aspects that move from taxonomy, application, and creativity.