# Embracing change and supporting transitions

APPROACHES TO SYSTEMIC CHANGE
IN PRODUCTS, SERVICES AND SYSTEMS

Edited by
Stefana Broadbent and Silvia D. Ferraris

DESIGN FOR
SYSTEMIC CHANGE

FrancoAngeli
DESIGN INTERNATIONAL

# Design International series



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ISBN e-book Open Access: 9788835167891

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# Preface

During my long stint with the World Design Organization (WDO), I led several programs and have been fortunate to meet with brilliant people from across the world, design educators, product designers, urban planners, city officials, students with varied cultural and linguistic backgrounds. These experiences have given me a clear understanding of 'transformation' and 'systemic approach' to global challenges. Transformation is the magic word that is surrounding everything we do in our day to day lives! It is also a constant factor in our lives. Be it the ugly *COVID pandemic* or the mysterious *AIGC* humans are learning to successfully 'transform' to a new normal life by making some adjustments to our behaviors. Transformation is currently the most spoken and written topic in the world and this book captures the role of design in facilitating systemic transformation as we adjust ourselves to such change. This book is an excellent collection of expert design topics addressing transformation from multiple perspectives.

The book opens with Authors Broadbent and Ferraris giving their views on the systemic transformations and state that the most sig-

nificant transformation in the last few decades is the integration of human centered approach to design and how interactive design leads to participatory design in almost all facets of design. The Authors also substantiate their statements with a long list of references from well-known designers and authors.

In Chapter 1, Luca Casartelli and Giuseppe Andreoni explain how understanding neurosciences helps designers design better. They present evidence in the form of User eXperience (UX), emotions, affordance and motor planning, User Interface (UI), and memory management, all factors that relate Design to Neuroscience. The Authors conclude that a stronger synergy in neuroscience and design is a promising approach to offer scientific evidence to good design and a better world.

In Chapter 2, Stefana Broadbent presents how «Feminist design is emerging as an alternative voice that can bring together social justice, environmentalism, policy and post colonialism». In conclusion, the Author says, «the model of decentralized, localized, just and pluralistic forms of management proposed by feminist theories can constitute a roadmap for expanding the scope of participatory design».

In Chapter 3, Authors Marco Ajovalasit and Joseph Giacomin show how the design parameters have changed to experience and meaning rather than functionality or interactions. The *Design for Meaning* framework proposed offers a design culture where individuals embrace change and create a foundation for a long-term transformation.

In Chapter 4, Author di Margherita and Isabella Ruina aims to examine the sources of stress in working environments, especially in the healthcare industry. The Author presents a series of examples and research to show how important it is to improve the work environment and reduce stress to promote healthy life-styles.

Chapter 5 deals with the data for urban biodiversity, a topic that is very relevant as the society is redefining its relationships with nature and the planet more than ever before. Authors Gabriele Colombo and Andrea Benedetti takes the reader through few data visualization models and dashboards that can be helpful as tools for the public engagement for urban biodiversity.

Chapter 6 describes how Computational Design is changing with the advent of AI and how to manage complex parameters through

simulated three-dimensional environments. Author Giorgio Buratti takes us through the maze of algorithms and computational design models using AI tools.

Chapter 7 presents interesting data on how games have become more important in the scientific study of complex human behavior beyond children. Author Maresa Bertolo shows how games can help assess cognitive and behavioral factors of humans.

Chapter 8 is one of my favorite sections of this book. It deals with challenges in product development in the current era. Prof. Silvia Ferraris takes us from the days of Industrial Revolution where the focus was on industrial design to how human centered design factors have become inclusive of product development today. This chapter also shows how design methods are changing with the introduction of AIGC and other technologies.

Chapter 9 examines two key concepts, meta design and inclusive design. Meta-design seeks to turn complexity into opportunity for innovation. Authors Venanzio Arquilla and Federica Caruso present the value of meta-design in the design process through a set of tables. They also trace back the origin of Inclusive design to 1950 when design for specific disabilities were produced to benefit segments of the society. The Authors also present the evolution of inclusive design today with good examples.

In Chapter 10, Author Carla Sedini presents an interesting topic *how does design deal with complexity* and proceeds to get the opinions on design transition, design culture, design's impact on society from well-known design experts, product and service design, design historians and journalists. It must be noted that the conclusions were arrived with the help of ChaGPT!

Chapter 11 deals with Design Thinking and the role of startups in Innovation. Authors Gianluca Carella, Francesco Zurlo and Svafa Grönfeldt present that innovation is the primary catalyst for regenerating and expanding economies in a highly complex business environment. They quote (Luger and Koo, 2005) that startups are the key drivers for technological innovation, economic agility and job creation. The Authors present various approaches of design thinking that can help startups to innovation and avoiding failures. A good lesson for modern day business practice.

Chapter 12 stresses the need for supporting social innovation. Author Marta Corubolo shows how Cities and governmental bodies recognized design for social innovation in Italy where the citizens were encouraged to be eager and experiment ideas for sustainability and inclusive ways of living in uncertain times. He also gives an example of the school of neighborhoods in Milan to stimulate and enable innovation.

**Srini R. Srinivasan**
**President Emeritus & Senator**
**World Design Organization**

# Bracing ourselves for acceleration: a design perspective on systemic transformations

**Stefana Broadbent, Silvia D. Ferraris**

Design is a field in constant transformation, regularly embracing new disciplines as it extends the domains within which it operates, widening its scope of action and adopting new tools to respond to the evolving demands. One of the most impactful transformations of the last few decades was the integration of human-centred approaches into design. From human-machine interaction, ergonomics, and collaborative work, the concepts extended to service design, interaction design and design innovation ensuring that a participatory approach to project development became an integral part of the methodology of most design fields. This approach not only modified design processes of products and services, but contributed to embedding the discipline more deeply into debates about democracy, policy, social services and innovation, as reflected in current collaborations between design and the public sector. As well as driving innovation and successful commercial projects, inclusive, participatory, human-centred design has become a bedrock of democratic programmes that want to ensure the fair representation of all the stakeholders involved. However, underlying this fundamentally progressive form of design was an idea

of stability and growth. Ensuring that more and more people could access services and products was predicated for instance, on the continued lowering of the price of technologies and the resources necessary to build them. The rapid availability of most natural resources, the globalised flows of production and distribution, and the access to worldwide intangible assets such as knowledge and expertise, were a given. We could rely on a certain continuity of experience from decade to decade. Climate stability, reduction of disasters, stability of institutions and continuing betterment of services were assumed as relatively constant. Social innovation could confidently depend on growing education and the increasing empowerment of people in a world that could absorb more discerning users.

We are now faced with something completely different. A level of uncertainty that, as Bruno Latour (2017, 2018) says, is so fundamental that *we don't know where to land*. Climate change is moving humanity into unchartered territories and creating uncertainty as to the directions our physical world will take, while also raising questions about our social, economic and democratic future. As described in the ONU's Sustainable Development Goals, there are widely different kinds of issues that need to be addressed urgently: climate change and the related environmental breakdowns, such as loss of biodiversity, depletion of natural resources, rising pollution and acidification of ocean waters, etc.; social and political instability, connected to the decoupling of international economic and strategic alliances, and related consequences such as wars and migratory phenomena; rising inequality in access to food, energy, education, and well-being. The awareness of these challenges is increasing at individual, social and political levels, but the complexity and interconnectedness of problems require global, coherent, and systemic transformations that are exceptionally difficult to implement. In the past, technological developments provided a feeling of progress and possible solutions to complex issues, but today even the recent new applications of AI are providing little clarity on the form and impact they will have on society in the coming decades.

The overall outlook requires a profound reassessment of the role of the designer, which is potentially more transformative than anything we have previously experienced as a discipline. From a social

and cognitive point of view, systemic uncertainty is a radical shift with few contextual anchors; including transitions that can take opposing forms, from de-growth to extreme inequalities, from a redefinition of our relationship with nature to the depletion of some material resources. There seem to be a limited number of reference points to turn to and little support from known frameworks of behaviour of social and institutional relations. This broadens the challenges for the design disciplines that have no choice but to embrace increasingly system-shifting approaches to any project they pursue in an effort to capture some of the contextual variability and support transitions towards positive directions. It can mean different things for different design subfields, from focussing on material ecosystems to more extensive impact analysis, or the systematic inclusion of new forms of data modelling. Design has strived to embrace systemic frameworks by analyzing the complex chains of material and relational dependencies for some time, however, as suggested by the Design Council (2020), the current situation requires designers to adopt a system-shifting stance rather than a system-conscious approach:

> **[...] an important question for design is how to contribute to accelerating deliberate transition (or intentional emergence), and doing so in a just and equitable way. Meeting that challenge will require us to expand both knowledge and practice. We need to develop a better understanding of how to connect innovations and propositions at these different levels to increase the pressure and opportunity for change. That will involve new 'objects' of design – for example how to design not only the products, services and operating models that exemplify a new system, but the supporting conditions and transitional activities that help a system to shift (Design Council, 2020).**

The system-shifting approach means that systemic design is not only striving to reduce adverse effects but supporting the direction of change, an objective that is well in the nature of what it means to be a designer. One of the strongholds of design, even in the face of uncertainty, is that design should always contribute to support social transitions towards a more desirable state by creating the enabling

conditions for the integration of innovative solutions in production, infrastructure, governance and practice.

This volume presents a wide and diverse range of theoretical, practical, and experimental methodological approaches that characterise a selection of the works emerging in the last few years from the Department of Design of Politecnico di Milano and that demonstrate the collective effort being made to address the incredible variety of the transitions we are facing. The complexity of the challenges, and the systemic approaches needed to address them, mean that the efforts can only be collective and multidisciplinary. No single project or single design group can take on board the demands of situations as complex as the transformation of food systems, mobility, health provision or energy transition. Collectively, however, each project can contribute to creating elements which become components of innovation that in turn can be mobilised by other systems; those *supporting conditions and transitional activities that help a system to shift*, as put forward by the Design Council. This is what we characterise as an example of collective intelligence. The basic principle of collective intelligence is in fact, to harness multiple perspectives, voices and contributions which can jointly contribute to make progress in complex domains where there are few established solutions. At the core there is a recognition that we need an ever-expanding set of expertise and lived experiences to understand phenomena but also to find appropriate solutions. The topics presented in the following chapters cover a range of design fields and hopefully show the complementarity among the research programmes and the increasing collaboration with new disciplines and methodologies.

In the field of interaction design for instance, we cannot understand what's happening in the digital world without taking into account the economic, professional, political and environmental precariousness that defines most of today's experiences. For the majority of users, online activities are based on an attempt to regain forms of control over social space, information flows and the physical environment. In this context, the opacity of algorithmic processing in a growing number of platforms and systems used by the public, reduces the feeling of agency, and therefore gives rise to fears and refusals. In particular, the profiling of individuals, which leads to the selective

presentation of information, is seen as a precursor to more serious forms of categorization that can make interactions with institutions, services or systems even more arbitrary. In this sense, the chapter by *Pillan and Ruina* whose analysis of the changing work experience puts a focus on the growing sense of precariousness workers are feeling, and calls for an ethics of well-being. On the other hand, by offering tools for predicting and analysing huge quantities of data, AI reinforces the sense of mastery and the potential for controlling the growing complexity of our world. The tension that introduces artificial intelligence, therefore, revolves around the sense of mastery and control, a tension deeply felt in the design community which is wondering how to integrate this technology without being swept away by it. The chapter by *Buratti* which proposes how to integrate AI in design processes is an attempt to harness these technologies for empowering designers. In her chapter on feminist approaches to AI, *Broadbent* also presents radical examples of AI development that are local, distributed, and driven by participation. *Colombo and Benedetti* provide an innovative take on how data can be used in participatory processes for urban regeneration; while *Andreoni and Casartelli* propose an integration of the results of neuroscience in the design process. Indeed, in the tradition of STS (Science and Technology Studies), technological development is critically examined in order to counter the deterministic positions that consider the current solutions to be the only possible routes of development and suggesting ways that would ensure that the development of artificial intelligence, for instance, could become an integral part of system-shifting design.

In the field of product and service design, tools and methods such as design thinking, envisioning, codesign, storytelling, that were adopted by other disciplines attempting to tackle complex and wicked problems, had a significant impact on business strategies and business development (Brown, 2009; Cross, 2006; Verganti, 2009) as shown by *Carella, Zurlo and Grönfeldt's* chapter. In this perspective, adopting a framework to define "meaning" also plays a role in generating product value for the final user. *Ajovalasit and Giacomin* argue for increased attention and emphasis on the part of designers to conceiving, measuring and validating meaning. However, the current large-scale challenges are pushing design to embrace an even more

systemic approach: there is a growing effort to situate innovative products in infrastructural transformations that, in turn, presume social and technical solutions. The chapter by *Corubolo* shows some of the institutional tensions and requirements that emerge in this process of experimentation. But infrastructural changes have to be supported by behavioural and social changes, and in this sense the analysis of games and gaming processes by *Bertolo* describes how some of the mechanisms can be mobilised to engage people in transformative activities. In fact, from space-making to food systems, service designers are being called upon to help redefine how complex chains of systemic interactions support citizens in creating new practices of living and working. *Sedini*, in her interviews with designers, captures their reflexivity in defining this new role. Similarly, *Arquilla and Caruso* aim to evolve the approach to inclusivity in design, updating the meaning of the concept and anticipating it in the design process by integrating it into the meta-design phase. In fact, several of the authors discuss the current role of designers, questioning the focus of their work and their design frameworks. *Ferraris* shows how the representation models of design processes have evolved over time, along with the evolution of the discipline, highlighting how design scholars constantly update their models to include new steps, methods, and tools.

Looking at all the contributions collectively, it is noticeable that each researcher is focussing on revisiting their subject of interest in the light of the new challenges, setting goals, and applying a rigorous approach to their studies. Although the topics might seem unconnected from one another, there are elements that recur.
Design researchers are certainly aware of the transformations we are immersed in, and therefore place their research in a global context, relating their goals to wider perspectives; for instance by including inputs from other disciplines such as neuroscience, or by using new technologies such as artificial intelligence, and by addressing new topics such as biodiversity. Also, they reflect on what design can bring to the table; the multidisciplinary nature of the discipline and the intrinsically flexible way of thinking and addressing problems is seen by many as particularly adapted to face complex and wicked problems such as the ones discussed here. The result might be the emergence

of new design domains focussed on systems design, just as in the last decades we saw the arrival of participatory design, sustainable design, and service design, and more recently circular design and transition design. But it could lead to the updating of consolidated design domains, such as product or communication design, through the implementation of new research tools, technologies and methods that are more firmly entrenched in system analysis, taking elements from other disciplines such as biology, climate- or data science.
In either case, design researchers might need to develop new versions of the design processes that currently involve, in very simple terms, a series of steps to investigate a problem, explore existing and possible solutions, conceive some concepts, and develop them. Every time we have seen the introduction of new design domains or the updating of existing ones, it has led to a transformation or updating of the design process models, by introducing new steps, constraints, tools, and reiterations. As representations of practice, these new models become tools for self-reflection and supports for communicating with the other stakeholders. However, scholars are increasingly questioning whether any of these approaches are sufficient to tackle the systemic nature of the challenges of the 21st century or whether an integration has become essential.
Irwin proposes a *Transition Design approach* to address wicked problems and catalyse systems-level changes, and states that «we call it an *approach* rather than a *process* because this work will require a variety of tools and methodologies, used in different ways as no single, prescribed process would be effective in all circumstances» (2018). Irwin highlights the nascent state of the proposal and encourages other researchers and practitioners to provide feedback, critique and engagement to contribute to its development with the objective of co-constituting a new area of design focus aimed at systems-level change. Irwin's proposal sets itself in a wider direction of scientific research and policy which considers that a collective intelligence approach is the only way to start addressing the transitions we are facing. Collective intelligence is understood as the enhanced capacity that is created when people work together to mobilize a diverse range of knowledge, information and solutions. When these contributions are combined to become more than the sum of their parts we talk

of an *emerging collective intelligence*. It is widely agreed that the challenges we are facing can only be addressed by radical systemic transformations, which in turn can only be the product of a collective effort characterised by the integration of multiple viewpoints and paradigms. To avoid dispersion of resources however, there is the need for some common goal or framework and the possibility of mutual learning and exchange. This book hopefully provides not only an insight into the research projects of Polimi's design department, but also a platform for exchange and collaboration.

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PART 1

# Embracing other disciplines

# 1. Translating neuroscience into the design of systems, experience and interaction: new perspectives for designers

**Giuseppe Andreoni, Luca Casartelli**

Advancement in neuroscience represents one of the most fascinating scientific endeavours of recent decades. Neuroscientific progress contaminated a wide range of disciplines spanning from epistemology (e.g., phenomenology of perception) to economics (e.g., game theory). In addition, neuroscientific progress reveals new challenges for ethical and anthropological issues (e.g., free will, end-of-life, responsibility, etc.). More recently, design and neuroscience have also found several points of contact: User eXperience (UX) and emotions; affordance and motor planning; User Interfaces (UI) and working memory management are some of the dyads relating the two disciplines. However, a theoretically-robust and experimentally rigorous terrain to explore and fully exploit the potentiality of this synergy is still lacking. Translating neuroscience into the design of systems, experience, and interaction is an emerging frontier: illustrative issues in which neuroscience can provide significant insights for designers will be presented and discussed here.

## 1.1 Non-motor functions of the *motor system*

Research in brain sciences clearly ascertained that the so-called *motor system* is not only involved in purely motor functions (motor control, motor execution), but also plays a critical role in more complex, higher, non-motor computations (Rizzolatti and Sinigaglia, 2016). This represents a fundamental turning point in neuroscience, for the understanding of brain architecture supporting human behaviour. This also signifies implies a fascinating paradigm shift for designers, being a totally new way through which we consider – from a neural perspective – the multilayered interaction between individuals and objects.

Among neuroscientists it is a well-established idea that our brain recruits very similar neural resources when it encodes the execution of a specific action (grasp-the-bottle-to-drink), and when it encodes the simple observation of the same action performed by another individual. In other words, at the neural level there exists a sort of *motor representation* of a specific action, regardless of whether this action is first-person-executed or simply observed. The neural resources supporting the elicitation of specific motor representations have been often referred to as *action execution – action observation network*, or *mirror mechanisms* (Bonini *et al*., 2022). Motor representation is a key construct in motor neuroscience. Of particular note to designers is that motor representation proves how the *motor system* goes well beyond purely motor functions, being characterised by significant properties of generalisation, abstraction, and socially-oriented tuning (Casartelli *et al*., 2018). So, what does this mean?

First, it means that motor representation does not encode only very detailed aspects of an action (the peculiar precision grip to pick a small pin), but it entails the recruitment of very similar neural resources even when two actions with the same goal are performed with different effectors (press-a-button with the right or left hand, or with a foot, or with a stick). Thus, regardless of this action, a specific neural representation of pressing a button is observed or executed with the right/left hand, and even with the right/left foot. In these terms,

we can refer to the generalization property of the motor representation. The study of these generalised patterns could be very effective in Human-Machine Interface design (HMI) or even in the design of objects of everyday life. This also shows how the *motor system* has effector-independent encoding properties. Neuroscience is providing the reference paradigms to implement the task's affordance.

Second, convergent studies suggest that motor representation shows a relevant abstraction property, being able to encode, for example, the *value* of the grasped object (Caggiano *et al*., 2012). More simply, neural activations supporting motor representation can be modulated by the value that agent attributes to the grasped object (banana or pretzel for monkey; wedding ring for bride or jeweller). This means that the *motor system* sees objects not only in terms of things-to-be-grasped, i.e., in concrete *physical* terms. The *motor system* also catches abstract features of an object, i.e., its axiological property and immaterial significance. In this sense it becomes clear how cognition (and the neuroscientific studies on this integrated approach to the object matching the mechanics of shape/grasp fitting with the not-material value of the object) contributes to the design for the usability process.

Third, at the neural level the motor representation of a daily-life action (move-the-candy) is modulated also by the specific *recipient* (move-the-candy-in-the-box vs move-the-candy-in-Tom's-hands) even in cases where the two actions are largely comparable from a biomechanical perspective. This implies that our *motor system* can modulate its activations according to the presence of social (Tom) or non-social (box) recipients (socially-oriented tuning property). In turn, this suggests that the *motor system* is sensitive to the presence of other individuals (that may also be potential co-agents in a future joint action), and it has an interpersonal motor mapping of the surrounding space (Caggiano *et al*., 2009; Danjo *et al*., 2018; Stangl *et al*., 2021).

Why should generalisation, abstraction, and socially-oriented tuning properties of motor representation be of interest for designers? Why should this at-first-glance "technical" neuroscientific issue be relevant to multidimensional analyses that characterise the designer's effort? They are pivotal because they force designers to

also consider subtler, non-motor properties of the *motor system*. In turn, this promotes a deeper understanding of the way through which human interaction with objects (e.g., acting with; acting upon; etc.) can be projected. Taken together, these findings clearly demonstrate how the motor system is very *smart*. If the motor system is to be a mere executor of commands coming from other brain areas, we should also reconsider the connection between the human motor system and the object (please refer to the construct of embodied cognition, Gallese and Sinigaglia, 2011). Below are concrete examples of how designers are called to tackle challenges such as these.

One of the most studied and fascinating properties of the human motor system is its ability to plan actions (e.g., the very early ability to combine the activity of muscles, joints, fingers to grasp a little ball, Sylos-Labini *et al*., 2020), and then execute them apparently effortlessly. Efficient motor planning is pivotal to maximise our interaction with objects, environment, and other individuals. A former, naïve, view considered motor planning as a rigid process entailing a sort of step-by-step computational approach; in other words, it considered motor planning as the ability to support the passage from A to B, or from B to C (and in the case of complex actions, also from C to D, or from D to E). Significantly, this view considered A-B, B-C (C-D; D-E; X-Y; etc.) as independent steps. Benefitting from the discoveries ascertaining subtler and more complex properties of the motor system (generalization/abstraction/social-oriented tuning), it has been demonstrated that individuals incorporate what they have to do in the final part of the action (B-C) even from the initial phases of that action (A-B). This ability has been defined as distal planning or second-order motor planning (Rosenbaum *et al*., 2012) (for an illustrative daily-life case, see Figure 1). This basically indicates that the A-B step is not independent from the final outcome B-C. Supposing you have to move one dice from the point B into a small box placed at the point C1, and alternatively to move the same dice from B into a large box placed at C2 (C1 and C2 are spatially the same point, only the dimension of the box changes). If you start moving your hand from the starting-point A, then distal planning theory implies that the biomechanics of the A-B act is not independent from the outcome (small box vs large box). More simply, when you execute the A-B part of the action, your brain

is already taking into account the final outcome C (C1_small box or C2_large box), and accordingly it will drive the kinematic profile of your action (i.e., A-B will be faster in the case of the large box because it is easier to put the dice in a large box, and slower in the case of the small box because it is more difficult to put the dice in a small box).

Why should this be relevant for designer? The answer both stimulates and touches the domain of affordance. When designers analyze the best way to project the handle of an object, they should consider not only the proximal outcome (to grasp the flowerpot, but also its potential distal outcome (to place it on the bottom or top shelf).
If the flowerpots generally placed on the top shelves, the designer should consider that it has to be grasped by its lower part.
In contrast, if it is generally placed on the bottom shelves, the designer should consider that it has to be grasped by the upper part (i.e., in biomechanics, the *grasp height effect* states that when one grasps an object to move it to a new position, the grasp height on the object is inversely related to the height of the target position; see Ansuini *et al*., 2018). Empirical observations probably led many designers to already adopt this strategy or recommendation, but neuroscience provides robust and experimental support to this practice (Figure 2).
In contrast, other features of human brain functional architecture remain basically unexplored by designers. An additional illustrative example is presented in the following section.

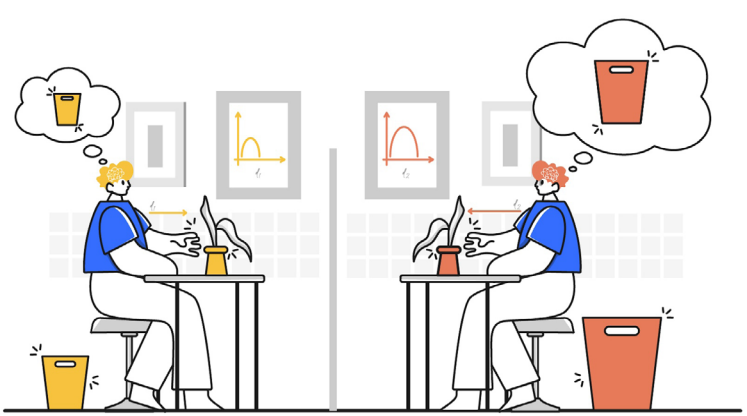

Figure 1.
Distal planning maximizing the interaction with objects, environment, and other individuals.

Figure 2.
Grasp height effect: grasp height on the object is inversely related to the height of the target position.

## 1.2 Predictive brain: expectations drive both action and perception

Although walking is generally considered a taken-for-granted ability, it is evidently not the case for everyone. For innumerable reasons (e.g., Parkinson's disease; stroke; neuromuscular disease; ageing; muscular strain; etc.), an individual can experience temporary or chronic difficulties in walking. However, even limiting our analysis to healthy individuals, proficiency in walking should not be taken-for-granted. A deeper analysis can show how walking can be complex and multifaceted. Indeed, healthy individuals continuously have to adjust their gait pattern to accommodate environmental (asphalt or dirt road) and contextual (crowded street or isolated route) requirements (Matthis *et al*., 2018; Santuz *et al*., 2018). This implies the combination of a multilayered set of non-motor computations involving – among others – sensory and perceptual processing. There are further arguments supporting the idea that walking is not just related to our legs. First, influential studies have demonstrated that any cognitive effort during walking (e.g., count; remember the itinerary; remember your friend's birthday date; etc.) have an impact on the gait's biomechanical pattern. This phenomenon has been explored in the so-called *dual-task* experimental designs (Camicioli *et al*., 1997; Lindenberger *et al*., 2000). Clinically, dual-task design is widely employed to promote early detection of neurocognitive

decline in ageing or prodromic signs of neurodegenerative disease (Ting *et al*., 2015). Second, and probably more surprising, walking is largely influenced also by our expectations. Healthy walkers efficiently combine prior knowledge concerning the peculiar features of the terrain to maximise performance and safety (e.g., this woodland trail is risky when the terrain is slick; this morning it was raining, now it is not raining, but it is cold and cloudy so the terrain will be damp; it will be dangerous, so I have to be prudent). Notably, it is not necessary for the expectation to be grounded on a well-structured and conscious thought. Normally (and automatically) we modulate our steps passing from asphalt to lawn when descending from the pavement.
A recent study by Ciceri *et al*. (2023) showed that even a simple auditory stimulation evoking a specific risky or safe scenario (e.g., seaside during a autumnal lightning storm or sunlit and bright summer day) is enough to modulate the biomechanics of walking. This is in marked contrast with participants walking on a treadmill (i.e., the terrain and, more generally, all *physical* features were virtually identical in both scenarios), which suggests that current motor performance is influenced not only by *physical* features of the terrain or the individual's condition (e.g., fatigue; hurrying), but also that the individual's expectations play a fundamental role in modulating the biomechanics of walking (Figure 3). Thus, by referring to the impact of expectations on walking activity, we also foster an additional neuroscientific insight for designers that concerns the construct of *predictive brain* (Clark, 2013; Teufel and Fletcher, 2020).

Figure 3.
Walking is not just matter of using our legs: influence of neurocognitive, social and environmental factors on our behaviour.

Neuroscience suggests that how one individual perceives an object depends only partially on the physical characteristics of the object (small, rough cold, etc.) and the environment (darkness, chaos, etc.). A better understanding of how individuals' brains sample and organise information, and then plan interactions with objects, can effectively represent a turning point for designers. Notably, this is especially true in domains such as health design in which clinical populations may have both particular needs or limitations in dealing with objects (seeing, grasping, moving, etc.), and potentially altered predictive mechanisms (Sterzer *et al*., 2018; Chrysaitis and Seriès, 2023). Considering the very real example of grasping a bottle of milk from the refrigerator for breakfast, how you grasp it certainly depends on its shape, weight and dimension. However, how you grasp it also largely depends on the expectation that it will be cold (you cannot be sure, but it very likely has been there all the night. So, it should be cold…). Your expectation does not concern a *real* and *immutable* feature of the object, but it concerns your subjective belief concerning the temperature of the object. Designers should be aware that one individual's understanding of the world largely depends on her/his specific and idiosyncratic expectations. In other words, designers should be aware that perception is an active and constructive process, as strongly supported by robust experimental evidence (Teufel *et al*., 2020). In turn, in considering user experience designers cannot neglect the fact the how one individual interacts with an object strongly depends on what she/he expects from that object. Is it possible to map any individual expectation, and in turn set accordingly the project of our vessel? Obviously, it is impossible. First, any individual is unique; and her/his expectations are also unique. Second, individual expectations are not set in stone, they are dynamic across time. However, designers could consider the fact that – generally speaking – specific environmental or personal situations usually result in *common* expectations (e.g., if the milk is in the fridge, it will be cold; if the waiter is bringing the pizza to your table, the plate will be hot).

Focussing on expectations in sensory and perceptual domains, predictive brain framework seems to face a double challenge (Press *et al*., 2020). From one side, it stresses the need of maximising veridical percepts (percepts that reflect the true state of the world).

From the other, it underlines the crucial role of informative percepts (percepts that convey what we did not already know).
The term percept basically refers to effective sensory/perceptual phenomena that an individual has experienced from the first-person perspective (Casartelli, 2019).

In recent years, many computational models that tried to explain how expectations can render perception as either veridical or informative seemed to imply that these approaches were mutually exclusive. To maximise a veridical percept, a common hypothesis is that perceptual experiences are dominated by expected events (if you are watching a documentary on the North Pole, the white animal will be a polar bear, and not a sheep). This would imply that individuals increase the accuracy of their perceptual representations by biasing them according to prior expectations (de Lange *et al*., 2018). In contrast, to take advantage of an informative percept, a hypothesis is that perceptual experiences of common or expected events are suppressed (e.g., if you are grasping a valuable vase, you will reduce the processing of the predicted sensation of the vase touching your fingers, and this will allow you to be particularly responsive to unexpected events like the vase slipping). The prioritisation of unexpected events promotes the updating of an individual's models and beliefs (i.e., what it did not already know) (Richter *et al*., 2018), and this may help to explain why we cannot tickle ourselves. Both computational models are efficient in explaining one part of the system. The problem is that our interaction with, and our interaction in, the world seems to need both a propensity that optimises veridical percept (i.e., biasing towards expected events), and one that optimises informative percept (i.e., biasing towards unexpected events). A recent theoretical model suggests that these propensities should be considered together, and we should focus on their temporal dynamic: individuals are initially biased towards processing expected events (it is parsimonious to limit the computational cost of brain operations, as also suggested by heuristics in UX domains), and individuals subsequently switched their resources to upweight events that are particularly surprising (the tendency to be alerted to face unfamiliar scenarios is a well-preserved evolutionary development) (Press *et al*., 2020). If they are to embrace this dual-process model, an interesting insight for

designers will concern the way they address the so-called *perceptual bistability* (PB).

A naïve view would consider any object (e.g., a vase) simplistically as an object (i.e., the vase that my son gave me). However, it is obviously an oversimplified tale. A classical case study in neuroscience concerns the presence of one specific stimulation that can result in multiple perceptual outcomes (Blake *et al*., 2002; Rassi *et al*., 2019). This phenomenon has been referred to as PB. Although it can refer to distinct channels (auditory, tactile; proprioceptive), for the sake of simplicity we focus here on visual PB. Eminent examples of visual figures resulting alternatively in two perceptual outcomes are the Necker cube, the Schroeder stairs, and the Rubin's vase-face illusion (Wade, 1996). Compelling studies demonstrated that the perceptual switch (e.g., face-vase / vase-face) is predictable from brain oscillatory activity and connectivity (Rassi *et al*., 2019), and more generally is regulated by the dynamic interaction between low-level (shape; colour; brightness; etc.) and high-level (memory; lexical cue; etc.) factors (see also Ronconi *et al*., 2023). Among high-level factors, a significant role is played by expectations (if you are in a flower shop, you will be probably biased to see a vase). Designers should benefit from neuroscientists' efforts in elucidating perceptual experience of bistable stimuli. To perceive a vase is not he mere connection between the visual human ability and specific "physical" features of the object (e.g., shape; material; etc.). Objects are not mere things-to-be-grasped. Visual perception of the vase is an active and constructive process.

## 1.3 Conclusion

Translating neuroscience into design of systems, experience, and interaction is a promising endeavour to provide new reference paradigms and scientific soundness to designers' creativity. Designers already employ some neuroscientific principles in their work, probably coming from empirical observations but without the theoretical generalisation derived from the in-depth comprehension of the neural and computational architecture of these principles. To prioritise the

synergy between neuroscience and design can help to fill this gap. The application of neuroscience of motor and logical interaction improves the design and affordance for our living environments and related technological systems. In this sense the social impact of such an approach could be analysed in its importance. The presented examples of neuroscientific principles seem relevant to support this concept. The *motor system* has *smart* properties and it is not limited to motor execution and motor control, so the gesture is driven by intention, by the required affordance, and by the shape and material of the object. In this preparation to use, perception (visual and tactile *in primis*) is an active process strongly contributing to the physical and cognitive interaction (and use) of objects, and it is where individual expectations play a critical role. All these facts indicate how designers can exploit this richer understanding of the neuroscientific bases of human interaction to design the best fit or affordance, user experience and user interface even in complex human-machine systems. Thus, a stronger synergy in neuroscience and design is a promising perspective on providing scientific evidence to good design and good design for everyone.

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# 2. Integrating feminist theories into design: the case of participatory Artificial Intelligence

**Stefana Broadbent**

In an effort to address the climate crisis that is transforming our world, social science disciplines are engaged in a systematic scrutiny of the economic and social models that have so rapidly led to the current environmental degradation. Among the analytic frameworks being deployed, feminist theories are providing a longstanding tradition of critical analysis of the dynamics of power, exploitation and dualistic thinking. These concepts are particularly relevant when wanting to understand the common roots underlying the exploitation of natural resources and social and gender inequality. The urgency of adopting a renewed perspective on society calls for both theoretical and practical approaches, and the solutions which take into account the gender dimension are increasingly seen as a fruitful avenue to address both the expressions of structural inequality and of natural resource depletion. Starting from this objective, recent eco-feminist theories propose an alternative framing of resource management and conservation as an integrative ecology of just economies within living worlds. Eco-feminist proposals for climate justice and environmental preservation are based on local, decentralized, pluralistic economic

and social models that are inclusive, just and potentially regenerative. Feminist systemic models of environmental and social response to the crisis offer the field of design a set of ideas that can well fit into the traditions of participation and social innovation. Feminist design is emerging as an alternative voice that can bring together the different streams of design for social justice, environmentalism, policy, and postcolonialism. In 2024, for instance, two books have been published exploring the potential intersection between design and feminism, *Feminist Designer: on the Personal and the Political in Design*, an edited volume by Alison Place (2023), which collects the writings of more than fourty designers to examine how to innovate the design process; and *Designing Gender: a feminist toolkit* by Elsie Baker (2023), which explores design projects which challenge gender inequality. The focus of both books is not on the role of women in design, but how feminist theories can inform design processes and projects.

The integration of machine learning and artificial intelligence in most domains where design operates, make them a central locus of reflection for designers and may offer the opportunity to use the eco-feminist lens to expand the boundaries of intervention. Feminist perspectives on AI are raising the issues of material and labour exploitation in the *production* of AI systems, and discrimination and victimisation in the consequences of their *application* (Eubanks, 2018). While AI is being hailed as a potential avenue for addressing the climate crisis, feminist scholars are joining their voices to those of other critics who are raising concerns about the devastating material costs in terms of energy and water consumption involved in running these systems (Crawford, 2021); on the indiscriminate appropriation of data produced by humans for private profit (Couldry and Mejas, 2019) and the risks of profound injustice in the application of algorithmic models in decision-making processes that concern people's lives (Hildebrandt, 2021).

Viewed from any perspective, AI technologies in their current mode of development seem to be predicated and entrenched in a logic of exploitation, and as eco-feminist scholars argue, are the product of a worldview in which extraction of value can come at the expense of certain natural categories. However, alternative approaches are emerging which centre on ideas of participatory AI, democratic AI and

distributed AI. These are all attempts to bring AI into spaces of public governance and democratic values, and to anchor the impact of potential benefits emerging from these technologies to the construction of common goods. They also are directions that fully resonate with social innovation models while offering frameworks that would allow practices to progress towards more systemic transformations.

## 2.1 Feminist theories and eco-feminisms

Eco-feminism lies at the intersection between two primary political movements of the late 20th and early 21st centuries: feminism and environmentalism. Eco-feminist theories strive to expose the interdependence of social inequalities and environmental consequences, and conversely the effect of environmental degradation on the increase of marginalisation (Warren, 1997). The eco-feminist critique (Gaard, 2010) bases itself on viewing global capitalism as a patriarchal structure based on the exploitation of, not only women, but of the colonised, the poor and the non-human environment (fauna, flora, and ecosystems in general). The growth in global capitalism, beginning with the Industrial Revolution and massively expanded after the Second World War, has brought about huge technological, economic, and scientific advancements, but is inextricably entrenched in the unprecedented abuse of nature and peoples. The feminist perspective points out the western dualistic models of rationality that distinguish men from nature (Plumwood, 1993) and attributes a hierarchy of domination and subordination to each of them, as a root cause. Within this worldview, nature is considered irrational, unpredictable, potentially hostile (all categories attributed equally to women, who are seen as being closer to nature) and therefore requiring to be dominated and controlled through rationality which is defined as a superior category of thought. In this context, to be classified as *nature* means to be defined as a passive resource, a background with limited agency, available to be used and moulded, and *naturally* supposed to be dominated.

In the feminist critique, the step from considering everything in nature inferior and needing to be controlled, to exploitation and ex-

tractivism, has led to economic models that are extremely destructive for the environment and unjust for women and minorities. According to Jessica Weir (2009), thinking hyper-separation «places humans in a relation of mastery with respect to earth others and limits their capacity to respond to ecological devastation. Humankind loses the ability to empathise and see the non-human sphere in ethical terms». The realm of nature in other words, becomes an unlimited resource and a receptacle for waste. Thus, in this analysis, the current capitalist economic system is based on the extraction of resources, be they in the natural or the social world, with little or no reciprocity. The exploitation includes not only the existing natural resources such as minerals, oil, water, land, but also the control of future resources through the managed reproduction of fauna and flora to serve economic purposes, and more recently, human experiences through the collection of data.

## 2.2 Critical theories of data and AI

From the vantage point of feminism, but also of science and technology studies, systematic analyses on data and artificial intelligence have emerged that raise serious concerns as to the implications of the current frameworks within which large AI systems are being developed, namely: extreme centralisation, private ownership, deregulation, and appropriation of resources be they natural or social.
These are the same concerns, incidentally, that underlie the regulatory efforts in the EU and US (Halim and Gasser, 2024).
To describe such economic models, Couldry and Meijas (2019) have coined the term *colonialist machine learning*. Kate Crawford (2021) has pointed out the materiality of the extractivist model underlying AI development; Timnit Gebru (2021) has criticised the significant biases in data models; and Eubanks (2018) provides some damning examples of the injustice arising from the application of its models to vulnerable populations.

The two books by Couldry and Mejias (2019 and 2024) make the strong claim that the extraction of data from peoples' online activity by companies working in the digital industries, is a direct continuation

of colonialism and the exploitation of natural resources by colonising economies in previous centuries. Their argument is not metaphorical, they insist that data exploitation, as appropriation of human life through data, is a new form of exploitation. They show that digital platforms in all domains from work to leisure health and education, capture and translate our lives into data, and then extract information that is fed into enterprises which then sell it back to us. This dispossession of human experience happens because these human features are just there, free to be taken, devalued, exactly like indigenous land was *just there* to be claimed. Critique of data grabbing has been voiced by many other commentators of digital economy (Zuboff, 2018; O'Neil, 2017; Acemoglu, 2021; Mazzucato *et al*., 2022; Broadbent *et al*., 2024) and is the current object of lawsuits and regulatory efforts such as the EU AI Act of 2024.

Kate Crawford (2021) on the other hand, starts by reminding us of the materiality of digital economies. Our digital services are made of cables, devices, server farms, all of which are made of minerals that must be mined, plastics that are difficult to recycle, and all of which require vast amounts of energy and water to run (Cara, 2022). Current numbers show that there are 4 billion devices in the world, 1.4 million km of underwater cables, and 8000 data centres. The materiality of the digital ecosystem raises the well-known issues of resource depletion, pollution, and carbon production. The $CO_2$ impact of digital services is currently estimated at 2.1% to 3.9% of overall emissions (Freitag *et al*., 2021), which is higher than the airline industry. AI is expected in its current form to increase these numbers even more and have a devastating impact on climate change by contributing to the transformation of the soil through mining, the pollution of fresh water, and the burning of fossil fuel for energy production.

Moving to issues of labour, digital services and AI rely on hundreds of thousands of low-wage workers, usually in emerging economies, to moderate content (Casilli, 2019), train machine-learning algorithms, correct and improve outputs from systems and maintain the infrastructure. The labour laws that regulate these jobs are under considerable scrutiny as the level of precariousness is exceedingly high.

Finally, in the list of issues that digital services and AI, in particular, are raising, is the question of bias and injustice. There is a vast

amount of literature on the biases that are inbred in the databases and data sources used by large machine learning systems (Gebru, 2021; O'Neil, 2017; Acemoglu, 2021), which has shown the consequences of skewed sampling and underrepresentation of some populations. Eubanks, 2018 has given a chilling account of the biases inbuilt into the algorithms and the real-life consequences that predictive systems can bring about with weighing variables or performing stepwise model selection on datasets. The Feminist Generative AI Lab, started by the Convergence program AI, Data & Digitalisation and led by Sara Colombo at TU Delft, is also challenging standard practices in data science, which can perpetuate and reinforce existing biases and power imbalances.

The growing field of feminist critique of AI (Wajman, 2021; Browne *et al*., 2023; Noble, 2018; Nissenbaum, 2021), highlights many of the same issues that have been raised in analysing the social and ecological consequences of traditional industries. The centralsation of production, distribution and governance which characterises the energy industries, for instance, defies principles of social justice by reducing participation in the decision-making processes, the distribution of benefits and costs and representation of the people and entities concerned. In the field of machine learning, Browne (2023) exposes the structural injustice of predictive systems that are left in the hands of private ownership, and the limitations of a traditional regulatory approach which focusses on liability limitation. Browne pushes for a new form of public body with citizen representation capable of bringing to the table the contextual and underlying dynamics of structural injustice.

> **On substantive questions such as how personal data ought to be collected and how its use be governed, or how much analysis should be done on the biased outcomes of algorithms before their assessments and predictions become the bases of policy, or how ought the Government to plan to counter the socio-economic effects of automation of certain labour market tasks, it is highly likely that a group of citizens would draw substantially different conclusions to those of industry experts or politicians. I argue that this is the key to creating a very different sort of public-body**

**approach to AI-generated structural injustice than the models we currently have in play (Browne, 2023, p. 365).**

The damning analysis of the ecological impact of AI technology exposed by eco-feminist and climate activists (Crawford, 2021; Cara, 2022; Monserrate, 2022) pushes the question of civic control and participation in the development of these technologies also in the realm of governing the infrastructures that enable them. One such example is the requirements of the huge server farms where computations are executed. Their consumption of energy and fresh water are so impactful on the localities where they are implanted, that local governance is paramount to avoid an unfair distribution of resources between citizens and digital companies. In communities where 30% of the energy and water risks being directed to the data centres, the decision can *only* be collective and democratic.

Considering all the complex issues mentioned above, there is an emerging consensus that participatory AI is the only way to avoid the perpetuation of the structural problems of the economic models of the last 50 years, potentially at a far greater scale given the expected impact of machine learning technology on society and the environment.

## 2.3 Designing participatory AI

In recent years Nesta's Centre for Collective Intelligence has started analysing and funding projects that attempt to integrate collective intelligence and machines. Crowdsourcing information and knowledge, as has been done by the most successful examples of collectively created knowledge commons such as Wikipedia, OpenStreetMap and Linux, is a complex endeavour that requires content and governance models to be managed. On the other hand, citizen platforms such as Decidim (deployed in Barcelona, Reykjavik, Helsinki etc.) to collect opinions and suggestions; the participatory budgeting systems tested in many EU cities, or the wide consultations such as the EU Conference for the Future of Europe, have produced vast quantities of citizen-generated content that have been costly to analyse and

synthesise. The scientific projects such as Zooniverse, which have been a reference in the field of citizen science, have also hit some hurdles in maintaining the commitment and participation of their volunteers, as have the patient groups that harness knowledge from its members (Broadbent, 2014; Nesta, 2015).

Nesta has therefore started looking at ways to integrate AI systems in collective intelligence projects and has contributed to the funding of some initiatives that attempt to see collectives designing machine learning systems to improve their work (Nesta, 2021).

One of these projects is Sepsis Watch from the Duke Institute for Health Innovation, a sepsis detection and management platform that uses deep learning to predict the likelihood of a patient developing sepsis. The Sepsis Watch model was trained to identify cases based on dozens of variables. Its training data consisted of 50,000 patient records with more than 32 million data points. It was successfully integrated into hospital operations, with data flowing from electronic patient records and alerts being incorporated into physicians' workflows. The original proposal to develop an AI-based solution was driven by a team of frontline doctors. The team included implementation experts, machine learning experts, and clinical experts. Participatory design was used to improve the accuracy and appropriateness of the technology solution and importantly, to retain agency and control of decision-making for clinical staff.

**The first twelve months of the project were used to establish the team, characterise the problem, and start designing the data pipeline and work- flow for the model. First of all, clinical experts curated the local datasets and selected the parameters that the model was trained on. After this, the teams dedicated one year to developing the AI system, and integrating it into a user-facing platform which became Sepsis Watch. After a model was created, clinicians evaluated the performance of the model based on known cases of sepsis, which led to further fine-tuning. Together with nurses, the clinical experts also reviewed multiple versions of the user interface for the tool (Nesta, 2021).**

Another participatory model of AI development that Nesta describes (2021) is a project in the Mazvihwa Communal Area, Zimbabwe, where land management problems were arising from woodland grazing areas being transformed in cropland. The Muande Trust, a local community research organisation, helped develop the Zimbabwe Agro-Pastoral Management Model to explore potential systemic behaviours under a variety of rainfall variation scenarios and combinations of management interventions. Using participatory modelling, local stakeholders helped define the parameters and data to be used by the model and examined the impact of different types of interventions through simulations. The model visualised different actions and impacts which led to question some land management practices and led to policy changes that allowed the reuse of fallow fields for farming (Eitzel *et al*., 2020).

As in the case of Sepsis Watch, the crucial element of participation was in the definition of the model itself and in particular in the balance given to persistence over time rather than average annual harvest.

> We defined persistence as a set minimum amount of cows, woodland, and harvest at the end of every model year; we calculated average annualized harvest by dividing total accumulated harvest by the number of years before the modelled system dropped below any of the persistence thresholds (if it did so). Average annualized harvest was therefore a shorter-term measure of sustainability: a particular run could maximize harvest at the expense of livestock numbers or woodland biomass and only last a few years but with potentially excellent harvest, resulting in a value of "not persistent" and a high annual harvest for that run. In contrast, persistence was a longer-term measure of sustainability: a model run might last all 60 calendar years with cows, crops, and woodland above the persistence thresholds, while the average harvest over that time might be correspondingly lower (representing a classic resilience trade-off). From a climate adaptation sovereignty perspective, the people of Mazvihwa should define their own persistence thresholds: what constitutes "enough" harvest, cows, or woodland for a village the size of Mudhomori (approximately 100 households in 2013). (Eitzel *et al*., 2020, p. 7).

These brief examples show that it is possible within complex AI systems to envisage design processes where stakeholders govern the definition of goals, of data and algorithms (by defining and weighing the significant variables), and the testing and evaluation of the outcomes. In both cases local distributed participatory models drove the technology to produce benefits for the community concerned.

While participatory models of technology development are certainly not new, the complex and opaque nature of machine learning technology raises new challenges in terms of enabling greater control by multiple stakeholders. The Collective Intelligence Project, an organisation which aims to create better and more collectively-intelligent models of governing transformative technologies such as AI, has proposed a framework for Democratic AI. At the core of the approach is the idea that it is possible to develop more processes for public input into AI systems and manage the collective governance of training data to improve the data supply chain, including opt-out and transparency processes. A governance model that is squarely in the hands of stakeholders and the public is presented as a way of ensuring that infrastructures, design and implementation, impacts and oversight are in the public domain. This approach not only shifts the control of the technology but also promotes it for projects of public interest. The issues related to the environmental impact of such technologies are therefore subsumed within a strategy of public good. It is possible to imagine, as proposed by legislators and technologists, that choices of deployment would be made, also taking into consideration their environmental effects.

## 2.4 Conclusions

The longstanding tradition of human-centred and participatory design has been a first step towards integrating the worldviews of people involved in transformations of their physical or social environments. The feminist perspective adds a layer that is often missing in human-centred approaches – the issue of power and environmental degradation. While this question is set in the broad context of structural injustice, it does lead to pushing the boundaries of partici-

pation beyond individual agency and the ability to carry out goals and intentions. Formulating an innovative approach to AI development that transfers the control of data, development implementation and infrastructure in the public realm, is a way of extending participatory approaches to encompass a more significant control over resources. The model of decentralised, localised, just and pluralistic forms of management proposed by feminist theories can constitute a roadmap for expanding the scope of participatory design. Embedding design in the work of defining ownership, governance, monitoring and legislation as well as the structures of interaction between the different actors, means embracing systemic transformations.

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# 3. Design For Meaning: a review of progress

Marco Ajovalasit, Joseph Giacomin

The increased material wealth of industrialised societies in recent years has led to debate about the meaning of designed artefacts, and the role of meaning in the innovation processes of businesses, governments and non-governmental organisations. Characteristics that are lower in *Maslow's Hierarchy of Needs*, such as safety, comfort and interactivity, are increasingly seen as *minimum requirements* rather than areas which provide competitive advantage. Internationally there is a growing awareness that design can no longer concentrate on functionality or even interaction but instead must focus strongly on matters of experience and meaning. The aim of this chapter is to present a review of the need for meaning in design and of associated developments in the field.

## 3.1 Changes in the socio-cultural context of the 21st century

The sophistication of 21st century technologies and the complexity of 21st century social behaviours are reshaping the way people live

and interact with designed artefacts (Wallman, 2015; Norman, 2023). For example, the integration of new ubiquitous technologies necessitates new behavioural approaches and new design methodologies (Follett, 2015; Amershi *et al*., 2019). Cultural, social, and environmental shifts have prompted anthropologists, designers, economists, psychologists, and sociologists to reassess their approaches to shaping expectations and meanings in relation to commercially designed artefacts (Douglas and Isherwood, 2021).

In the luxury automotive sector, for example, companies are adapting to people's shifting sense of *luxury*, prompting a re-evaluation of their strategies (Stylidis *et al*., 2016). Once defined mainly by exclusivity, aesthetics and heritage, luxury now depends more on perceived quality and on strategic communication to resonate with people's desires and support their sources of meaning. The current focus often lies on engaging people in value creation through human-centred design approaches (Gkatzidou *et al*., 2021). Factors like the pandemic (Contreras-Contreras, 2023), the expansion of globally interconnected digital systems, and the availability of Iot artefacts (Harper *et al*., 2008) have reshaped interactions beyond face-to-face encounters leading to expectations of more rapid and more personalised services (Saniuk *et al*., 2020). Artificial Intelligence infiltrates homes through products like voice assistants, altering daily living environments and experiences (Spallazzo and Sciannamè, 2022). And technologies such as social robots (Dörrenbächer *et al*., 2022) and autonomous road vehicles (Giacomin, 2022) are acquiring new symbolic roles which influence the way people communicate, create identity, establish relationships and build rituals and habits.
Though often subtle rather than abrupt, the shifts are influencing behaviours and meanings (Stolley, 2005).

Designed artefacts often carry cultural and social meanings, underlining their non-neutrality (Krippendorff, 2006). And in a multicultural world there can be conflicting meaning systems which evolve within a community, shaping the meaning of the artefact over time (Wenger, 1998). Several authors (Crilly *et al*., 2004; Krippendorff, 2006; Sudjic, 2008; Siefkes, 2012) have highlighted how ambiguity can lead to personalised and contextualised meanings that differ from the designer's original intent. And others (Williamson, 1978; Bal and Bryson,

1991; Dourish, 2001) have emphasized that an artefact's meaning lies primarily with the people who interact with it, rather than with the designer. Such divergences have in fact been verified by Ajovalasit and Giacomin (2019), who noted substantial differences in the meanings assigned to artefacts by designers on the one hand and by the general public on the other.

Given the ever-increasing complexity of our technologies and the ever-growing societal sophistication, it would appear that tools are needed in support of design activities for the purposes of conceiving, measuring and validating meanings.

## 3.2 Goals of the chapter

Despite the commercial, philosophical and sociological groundwork, ambiguity surrounds the term *meaning* in design practice. The term is often used without consideration of its exact nature or its individual components. And diverse theoretical perspectives exist in relation to its precise definition (Neuman, 2006; Danesi, 2007).

But despite the difficulties, the meanings people assign to their artefacts provide the answer to the key design question of *Why?* (Sinek, 2009). Thus, this chapter reviews the term *meaning* by looking at business, economic, linguistic, cultural, psychological, and sociological perspectives, and identifying key points that are of relevance to design practice.

An operational definition of the term *meaning* in the context of designed artefacts is provided. In addition, a vocabulary of meaning and a *Design For Meaning* framework are presented. The chapter concludes with examples which illustrate the three main categories of meaning that are of the greatest relevance to design.

## 3.3 What does *meaning* mean?

According to standard dictionaries of the English language the word *meaning* can express at least three concepts:

- the sense or signification of a word or sentence;

- the significance, purpose or underlying truth of something;
- the motive or intention of something.

In *The Measurement of Meaning*, Osgood *et al*. (1957) highlighted the multifaceted nature of meaning across disciplines. They delineated linguistic, psychological, and sociological meanings, each pertaining to different aspects of language, cognition, and behaviour.

Philosopher Mark Johnson (2007) discussed how meaning manifests as differences in experiences. And anthropologists (Diller *et al.,* 2005) have suggested that «meaning is the sense we make of reality; assigning meaning to experience is how each of us creates the story of our life and its ultimate value and purpose».

Lakoff and Johnson (1980) proposed that people recognise, categorise, and evaluate the personal or symbolic meaning of a designed artefact based on their own interpretations, memory retrievals, and learned associations. While Murphy (2023) added that people adopt different meanings which provide different options for action based on their categorisations of their lived experiences, and the importance those experiences assumed. Richins (1994) supported such views by suggesting that people prioritise possessions reflecting personal relevance in achieving their intended goals.

Heskett (2002) has suggested that *significance* in design explains how forms acquire meaning through usage and assigned roles, often becoming powerful symbols of habits and rituals. And Baudrillard (1968) went as far as to suggest that «people value objects not for what they do, or what they are made of, but for what they signify».

Sociologists such as Csikszentmihalyi and Rochberg-Halton (1981) have emphasised that designed artefacts serve as more than functional tools, acting as relational mediators that influence the long-term aims, objectives, and behaviours of individuals or groups. The sociological meanings that artefacts play in communicating information about their owners has also been considered by Richins (1994) who noted that people are active participants in their communication system, choosing and valuing artefacts for their meaning within the cultural system. And Verganti (2011) suggested that «meaning represents the profound psychological and cultural reasons people use a product».

Thus, disregarding the purely linguistic sense of *meaning*, it can be argued that people probably seek to answer two primary questions

when assigning one or more meanings to a designed artefact: *What is it?* and *What does it stand for?*

Such an approach diverges from the ontological view of *meaning* as a universal entity attached to objects. Instead, it emphasises that the meanings of designed artefacts stem from their intentional use within specific contexts and communities (Zimmerman, 2009), and that the associations formed during interactions are collective and intersubjective (Dourish, 2001).

The operational definition of *meaning* adopted here is close to English words like *motivation*, *goal*, *purpose*, *importance*, *value* and *significance*. The sense of the term that is adopted in this chapter involves the reasons why a person engages with something or someone, and the sense of purpose involved.

## 3.4 Categories of meaning in design

The meanings people associate specifically with consumer products were analysed by Friedmann and Lessig (1986), who stated that «one can regard consumer behaviour as a continuum ranging from information processing to aesthetics consumption».
«On the one extreme we can see a logical, methodical information-processor using choice heuristics. At the other extreme we see the consumer aesthetically consuming based upon such feelings as fun, elation, and hedonic pleasure».

And Fournier (1991) extended the logic by suggesting that consumer products can be grouped according to the nature of the consumption experience by placing them along the continuum from utilitarian to hedonic. He defined eight general categories of consumer meaning: utility, action, appreciation, transition, childhood, ritual enhancement, personal identity, and position or role. Adopting a somewhat similar approach, Diller *et al*. (2005) suggested fifteen categories of meaning: accomplishment, beauty, creation, community, duty, enlightenment, freedom, harmony, justice, oneness, redemption, security, truth, validation, and wonder.

Giacomin (2017) has defined three categories of meaning for the artefacts of design. The category of *function* primarily focusses

on how artefacts operate, serving practical purposes and providing capabilities. It encompasses situations where physical or informatic use is emphasised, with less regard for psychological or sociological factors. The category of *ritual* is instead mainly concerned with the expressive and symbolic activity the artefact allows or supports. Ritualistic meaning is about artefacts enabling interpersonal communication or engaging people in repeated intentional behaviours of symbolic value. The final category, that of *myth*, is about artefacts providing mostly symbolic meaning. This category does not necessarily require externally visible activity on the part of people, but instead involves the conveying of symbolism, metaphors and values on the part of the artefact.

## 3.5 A vocabulary of meaning in design

Research by Ajovalasit and Giacomin (2024) has established a linguistic vocabulary for constructing interview questions, questionnaires, and other ethnographic and co-design elements in relation to meaning. An analysis was performed of the contents of the major online English dictionaries, of the WordNet lexical database, and of several of the major English language corpuses. By means of frequency counting, thematic coding and the use of natural language processing algorithms, a series of macro-components of the construct of meaning were identified globally, and then separated into the individual components of function, ritual and myth.

This yielded 355 semantically related words and phrases and three dominant thematic groups within each category of meaning. The thematic groups *purpose and intention*, *operation* and *action* were closely associated with the concept of function. The thematic groups *ceremonial*, *habitual* and *spiritual* were closely associated with ritual. And the thematic groups *belief and story*, *fiction* and *symbolism* were closely associated with myth. Table 1 presents a summary of the results by bringing together the major dictionary definitions, the values implied by those definitions, and the three dominant thematic groups within each category of meaning identified by Ajovalasit and Giacomin (2024) and Diller *et al.*'s (2005) fifteen core meanings.

| Meaning category | Dictionary definition | Value expressed | Thematic groups of meanings | Relevance to Diller's core meanings |
|---|---|---|---|---|
| **Function** | • the way something works or operates;<br>• the natural purpose of something or the duty of a person. | Functional/utilitarian value | • purpose and intention<br>• operation<br>• action | • Accomplishment<br>• Duty<br>• Security<br>• Validation |
| **Ritual** | • a series of actions or a type of behaviour which is regularly and invariably followed by someone;<br>• a set of fixed actions and sometimes words performed consistently and regularly, especially as part of a ceremony or collectively. | Symbolic intrinsic value | • ceremonial<br>• habitual<br>• spiritual | • Creation<br>• Community<br>• Harmony<br>• Oneness<br>• Redemption<br>• Truth |
| **Myth** | • a traditional story, especially one concerning the early history of a people or explaining a natural or social phenomenon;<br>• an idealised, exaggerated or fictitious conception of a thing or person;<br>• a widely held but false belief or idea. | Social and iconic value | • belief and story<br>• fiction<br>• symbolism | • Beauty<br>• Community<br>• Enlightenment<br>• Freedom<br>• Justice<br>• Truth<br>• Wonder |

Table 1. Categories of meaning described in terms of major dictionary definitions, implied values and the thematic groups as found in Ajovalasit and Giacomin (2024) alongside Diller *et al.*'s (2005) core meanings.

## 3.6 A design for meaning framework

Research suggests that people prioritise meanings alongside the functional benefits when shaping their self-identity and world-view (Ravasi and Rindova, 2008). Holt and Cameron (2010) have for example argued that «functional benefits are social constructs, not objective facts as often assumed by economists and engineers». When people assign symbolic and social values to artefacts, they perceive them as possessing enhanced functionality, quality, and trustworthiness. Barthes (1973) argued that meaning and function are connected, with function itself carrying symbolic value. In fashion, function often serves as a myth, justifying the existence of seemingly superfluous objects (Chapman, 2005). Given the polysemic nature of meaning, a framework for conceiving, measuring and validating meanings could prove useful to designers.

In fact, when considering design, innovation and strategy, Barden (2013) has suggested that successful innovation always requires a goal-based strategy which ensures relevance and provides clear signals of meaning. He argued that the meaning a signal triggers should never be arbitrary. It should instead always be the result of the shared

associations between signals and goals which evolve through social interactions within a community. As shown in Figure 1, a brand/artefact strategy should align with consumer goals, and the signals conveying meaning should activate the intended mental concepts and goals in the mind of the consumers.

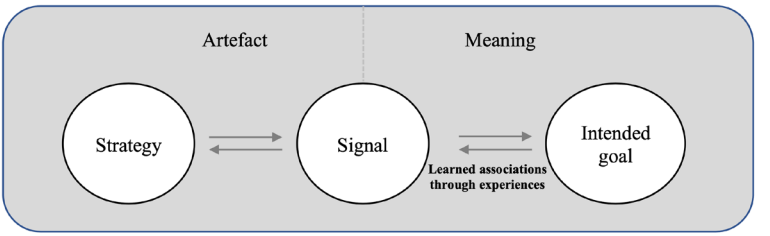


Figure 1.
Meaning construct: translating strategy of designed artefacts into signals that activate people intended goals (adapted from Barden, 2013).

Giacomin (2017) has proposed the *Design For Meaning* framework of Figure 2 to serve as a reference for commercially active designers when dealing with such matters.
The framework can help designers to clarify, decide upon and communicate:

- the relevant corporate or brand ideology;
- the exact form of value people are expected to perceive;
- the exact form of meaning people are expected to perceive;
- the adherence required to an existing function, ritual or myth;
- the opportunity or need to define a new function, ritual or myth due to technological or societal change;
- the exact focal metaphor of the artefact;
- the physical, informatic and manufacturing specifications of the artefact.

The framework emphasises the need in the early stages of a design process to decide whether the new design should adhere to existing meanings and metaphors that have traditionally been associated with the technology or with the brand. Or, instead, to disruptively attempt new meanings and metaphors that will likely distinguish the artefact from existing offerings. The need to invest time and effort towards the development of desired new meanings is emphasised in the framework by the presence of the term *meaningfication* which has been operationally defined as «the use of data, design ethnography, real fictions and co-creation for the purpose of designing artefacts based

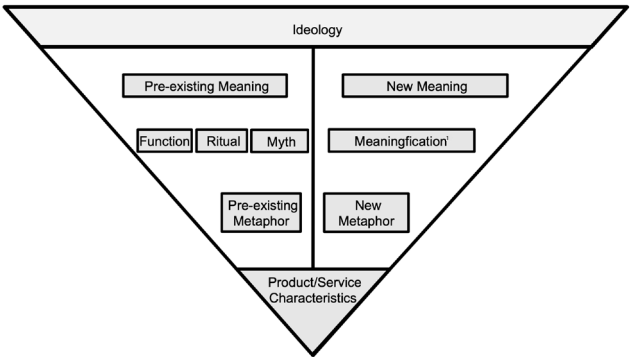


Figure 2. The Design For Meaning framework (reproduced from Giacomin, 2017).

Note 1. The use of data, design ethnography, real fictions and co-creation for the purpose of designing artefacts based on new meanings wich emerge from the interconnection of evolving patterns of technology, experience, personal identity, social identity, value assignation and consumption.

on new meanings which emerge from the interconnection of evolving patterns of technology, experience, personal identity, societal identity, value assignation and consumption».

## 3.7 Examples of functional, ritualistic and mythical meanings

The examples discussed below can help to illustrate how artefacts of design can have functional, ritualistic or mythical meanings, or, in some cases, combinations of the three. While some of the examples prioritise function, others gain significance through personal associations, rituals or symbolism.

Google Maps exemplifies artefacts with functional meaning because:

- it offers a useful, usable, convenient and natural way to search for information;
- it allows natural human behaviour to operate with maps' data with its draggable interface;
- it allows for efficient use promoting the sense of confidence in people.

The wearable Fitbit activity tracker exemplifies artefacts with both functional and ritualistic meanings because:

- it elicits the purpose of it wearing on the wrist, turning every step into data connecting to the person's goal in an explicit way;
- it operates with relevant features that help people think with the evidence of data;
- it adheres to sequences of actions that foster motivation,

rewards, and goal attainment, irrespective of an individual's fitness level or experience.

Self-care coaching apps, such as the award-winning Fabulous, promote healthy behaviours via largely ritualistic meanings. Tian *et al*. (2018) have suggested that:

- engaging in a ritual enhances people's perception of control over their calorie consumption and their selection of nutritious foods;
- it provides people with a prevailing ceremonial storyline of aspiring to become the ultimate, healthiest, and most formidable version of oneself, akin to an elite athlete, thus bringing a symbolic value to people;
- the app encourages people to adopt consistent habits over time to reinforce their healthy behaviours.

A typical automobile for personal use is an example of an artefact that has both a functional meaning as transportation and a mythical meaning as an expression of the lifestyle and identity of its owner. Urry (2004) has argued that from the early 20th century onwards automobiles have been:

- the major item of individual consumption after housing that provides status to its owner/user;
- the dominant culture that sustains major discourses of what constitutes the good life, what is necessary for an appropriate citizenship of mobility, and which provides literary and artistic images and symbols;
- the quintessential manufactured object produced by the leading industrial sectors and the iconic firms within 20th century capitalism.

And, finally, a teddy bear (Solomon, 1990) is an example of an artefact that has a largely mythical meaning for its owner since it:

- suggests a world that looks a great deal safer and more innocent than our own;
- recalls loveable fictional characters such as Winnie-the-Pooh;
- helps people to revisit their childhood, escaping the burdens of adult responsibilities.

## 3.8 Conclusions

This chapter has noted a series of 21st century changes in technology, society and culture that are affecting people's perceptions of designed artefacts. Several voices from the research literature have been cited in relation to these changes and to the need to design artefacts differently.

The *Design For Meaning* framework presented here offers a shift in the mindset to embrace a systemic approach to change (Capra, 1984). By fostering a design culture that promotes innovation through meaning, individuals are more likely to embrace change and create a solid foundation for long-term transformation. Meaning captures all those values that collectively «encompass our ways of acting in the world and ethical behaviours related to our social interactions and personal inner development» (Walker, 2011, p. 187).

Explicitly and implicitly, it has been argued that product characteristics that are situated lower in Maslow's *Hierarchy of Needs* (1943) such as safety, comfort and interactivity, are increasingly perceived as minimum requirements rather than as sources of competitive advantage. This position is supported by professionals such as Almquist *et al*. (2016) who proposed an updated hierarchy composed of the four macro-categories of functional, emotional, life-changing and social impact.

This chapter has reviewed a number of well-known interpretations of the meaning of *meaning*, and has proposed one in particular that has for some years served as the basis for the work of this chapter's authors. The results were summarised of a recent analysis by the authors which established a linguistic vocabulary for constructing interview questions, questionnaires, and other ethnographic and co-design elements in relation to meaning. The recent analyses were performed based on the contents of major online dictionaries of the English language, of the WordNet lexical database, and of several of the major English language corpuses. By means of frequency counting, thematic coding and the use of natural language processing algorithms a series of macro-components of the construct of meaning were identified globally, and when separated into the individual components of function, ritual and myth.

The *Design For Meaning* framework presented here emphasises the

need to decide whether a new design is to adhere to existing meanings and metaphors that have traditionally been associated with the technology or with the brand. Or, instead, to disruptively attempt new meanings and metaphors which will likely distinguish the artefact from existing offerings. Finally, this chapter has provided a small number of examples that can help to illustrate how different artefacts can have different meanings for their owners and users.

In conclusion, this chapter has argued the need for an increased attention and emphasis on the part of designers to the conceiving, measuring and validating of meaning. In the 21st century people are demanding more from their products, systems and services. And in many cases what the people are requesting is more meaning. Going forward it may prove wise to integrate tools which deal expressly with meaning into the design processes of many artefacts. For example, as Max Tegmark (2017) has suggested, «it's not our Universe giving meaning to conscious beings, but conscious beings giving meaning to our Universe».

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# 4. Design for well-being at work: ethical issues, opportunities and research perspectives

**Margherita Pillan, Isabella Ruina**

The design discipline is evolving as a result of multiple tensions, including contemporary social, environmental, political, and economic global transformations. Designers are developing a new awareness of their important role in the search for solutions for complex problems requiring articulated actions, including cultural changes, redesign of services, and creation of new socio-technical systems. Notably, the evolution of digital technologies, including data collection and processing through machine learning and artificial intelligence, opens promising innovation of all social systems and offers the opportunity to develop new approaches for the goals of sustainable and inclusive development aimed at the prosperity of people and planet.

Designers can play an important part in addressing innovation towards progress. In the social dialogue that should accompany the transformation and the generation of solutions for complex problems, design – as a discipline, realm of knowledge, and professional knowhow – relies on: consolidated and specific skills such as design research and user studies; the ability to create shared languages within multicultural project contexts; and problem-solving.

This expertise is associated with the practical capabilities of developing prototypes and demonstrators supporting the exploration of highly innovative scenarios and enabling the validation or questioning of new proposals through verification actions. Envisioning new scenarios and creating a common platform for inclusive projects requiring the collaboration of multiple stakeholders is a key design competence for developing innovative socio-technical systems. Assessing the feasibility, testing the acceptability, and predicting the short- and long-term impacts of innovative solutions are fundamental tasks when dealing with systems that affect people's lives, such as those dedicated to health and well-being. User- centred design approaches allow the optimization of material and intangible solutions from the point of view of end users and the identification of features that could threaten people's rights. Anticipating and managing possible issues that may arise from digital solutions that involve collecting and processing personal data is a core task that designers can manage.

These capabilities enable designers to become main actors in transforming several social systems; among other research fields, designers are acquiring an expanding role in developing new approaches to health care and prevention.

The research reported in this document aims at developing new approaches for the investigation of well-being and sources of stress in working environments, and the document summarizes the preliminary results of a multidisciplinary activity aimed at developing new solutions for the collection of data on lifestyles and the factors that can have an impact on workers' health. More specifically, the document provides preliminary theoretical research on healthiness in contemporary work contexts, focussing on office work. Also, this research explores how recent transformations (i.e., technological revolution, globalization, and the climate crisis) have impacted the work context, spreading a sense of uncertainty reflected in workers' well-being.

The study was developed as a research activity for MUSA, an Innovation Ecosystem funded by the Ministry of University and Research as part of the National Recovery and Resilience Plan (MUSA – Multilayered Urban Sustainability Action – project, funded by the European Union – Next Generation EU, under the National Recovery and Resilience Plan (NRRP) Mission 4 Component 2 Investment Line 1.5:

Strengthening of research structures and creation of R&D *innovation ecosystems*, set up of *territorial leaders in R&D*).

Since working environments and organizations are currently going through a tremendous transformation, new research on the impacts of contemporary work conditions on the physical and mental well-being of workers is needed. The MUSA project tries to respond to this necessity, with a specific focus on office work and on the possible risks of health endangerment due to the organization's present activities. The general aim is to identify suitable strategies for the investigation of problems and solutions to work-related health issues, compatible with the sensitivity of collecting personal data in working contexts. In this, several dimensions are included: physical and mental well-being; digital well-being; co-design of solutions for well-being and stress prevention.

The definition of suitable strategies has its roots in the preliminary analysis of the multiple factors influencing health and well-being in the working environment, highlighting specific points of attention requiring further investigations.

Work is what humans do to produce goods and solutions for survival and prosperity; and the diversification of professional roles in society corresponds to the construction of complex social organizations exploiting human capabilities. It has various forms – from highly professionalized and specialized work to unacknowledged and hidden activities, such as domestic work for the care of people and homes – and it is the infrastructure for all social systems.

Work is also fundamental for the sustainable development of countries. It is a reference for the Sustainable Development Goals (SDGs) in the ONU Agenda 2030 – for example, for Goals 1 and 5 – and the specific focus of Goal 8 addressing «inclusive and sustainable economic growth, full and productive employment and decent work for all».

Work's multifaced nature reflects also on the meaning associated with it. According to the European Values Study (2008) the concept of work for Europeans includes three different dimensions: first, the *ethic of duty*, which means the moral duty people feel towards society; second, the *instrumental dimensions*, meaning work as the means by which people obtain some benefits; and finally, the *expressive dimension*, also called post-materialistic and related to the sense of

self-fulfilment that people can reach through work. Ensuring well-being at work is relevant for social inclusion, social justice, health expectations of individuals, and the efficiency of the economic system, impacting the productivity of organizations (Misra and Srivastava, 2023). The term *well-being* and *mental health* are sometimes wrongly considered to be synonymous, but it is important, for the scope of this research, to make a distinction.

According to the World Health Organization (WHO): *Mental health is a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community. It has intrinsic and instrumental value and is integral to our well-being.* This definition explains how well-being is a subcategory of the general concept of mental health.

## 4.1 Evolution of work and work-related issues impacting well-being

We are today facing significant and rapid changes which are reshaping our societal landscape, exemplified by phenomena such as globalization, radical advances in technologies and automation, and the climate crisis. These widespread transformations impact working scenarios and organizations, while the social meaning of work itself changes throughout the years.

Studies examining pre-economic societies reveal a lack of uniformity in defining *work* (Chamoux, 1994). While the value of labour gradually emerged during the Middle Ages, the term itself only began to be associated with productive activity in the 17th century (Méda, 2017). By the 18th Century, the term *work* crystallized, thanks to the conceptual detachment between workers and the commodities produced. However, work was still regarded as an activity and continued to resonate as something similar to a sacrifice (Smith, 2002). This idea changed at the start of the 19th century when work became the *essence of humanity*, the place where people can channel their potential and transform the world through their actions.

In the 20th century, another metamorphosis took place, distancing work from its negative connotation and embracing two new positive

meanings: as the way to obtain some benefits; and, more importantly, as the means by which people can achieve self-fulfilment, demonstrate their personal capabilities to the world, and feel represented by their *social status* (Castel, 1995). In the 21st century, as a consequence of post-Taylorism and the progressive relevance of subjectivity in the job, work becomes an opportunity to perform. Hence, the modern idea of work includes all these different meanings: a factor of production; the essence of humanity; and the means of assuring our wealth, benefit, and protection.

Considering the evolution of work and its organization paradigms, technological innovation is a crucial factor impacting processes, environments, activities, and skill requirements. Digital and Information and Communication Technologies (ICTs) are the main leverage for transforming economies and the employment market.

In office work, ICTs opened new ways to personalize work modalities and potentially produce more inclusive work conditions. Moreover, digital tools promote flexibility which brings work-management autonomy (Bordi *et al*., 2018). The sad fact is that autonomy can be just an illusion, resulting in a controlled system of rewards and punishments for individual performance which pulls the strings of the work experience.

Collaboration at a distance, work from home, and work schedule flexibility find their counterpart in the crumbling of the division between life and work, on a mental and practical level (Bordi *et al*., 2018).

This introduced the term *technostress*, defined as a specific type of work stress that can cause anxiety, fatigue, scepticism, and inefficacy associated with the use of technology (Salanova, Llorens and Ventura, 2014). Technostress materializes in the invasion of working moments and interpersonal communication; in what we expect to consider as free time; in the difficulty of having a suitable estimate of the personal investment in work and the time dedicated to it.

The right balance will be found in the compromise between the opportunity for the worker to manage their time and the awareness of knowing when to stop, to prevent the concretization of that dystopian future of self-exploitation described by Abdelnour (2013).

The impact of digitalization is not limited to *personal* working modalities but also affects industries and work processes. As described by Hirsch (2016), here the scenarios are contradictory: digitization

is producing rich opportunities for business, including new forms of entrepreneurship and independent work. It is associated with more complex work processes, but also with smarter products and services and, potentially, more sustainable ones. Additionally, job losses due to digitization should be counterbalanced over a long-term period. On the other hand, the requirements for job skills are more complex, requiring frequent upgrades and producing a growing demand for intellective skills while reducing routinized work. And this is affecting all levels of employment, including management.

The change in work dynamics is also caused by the evolution of the meaning of work discussed above. According to Misra and Srivastava (2023), a recent trend sees individuals increasingly integrating their passions and hobbies into their career paths. This shift suggests a rising inclination to seek happiness in the workplace, contrasting with the traditional view of work merely as a *responsibility* and a means to earn enough money to live. This feature of the modern work adds to a post-materialistic perspective, where happiness is not unequivocally linked to material wealth, but to the fulfilment of personal goals such as belongingness and self-expression (Desmet and Pohlmeyer, 2013).

Addressing another major challenge, that of the global consumption of materials, has never been as prominent as it is now (Krausmann *et al*., 2009). At the same time, people are concerned that the ecological transition will dismantle the economy, leading to a regression in growth and consequently jeopardizing employment, which is closely interconnected with it.

The same technology revolution that brought us here, allowing and pushing mass production at lower and lower costs and shaping the climate crisis, can now help us to find new ways to create energy and, in general, to produce with fewer harmful impacts. But, in doing so, we first must find the right balance between the idea of prosperity and constant growth and the awareness that this abundance is destroying the planet, and we humans are not excluded.

A further trend is represented by the competitive drive triggered by globalization, which in the era of the Internet has accelerated processes and increased global competitiveness (Bertoloni, 2016), requiring employees to always strive to reach the top and devote

themselves to work (Thilagavathy and Geetha, 2020). All the phenomena described above have affected the work context, in both positive and negative ways, but, overall, are making it extremely uncertain. The repercussions of this uncertainty can be found in the increasing trend of stress among workers; in fact, according to Leka and Jain (2010) one in three workers in Europe is stressed because of work.

## 4.2 Diversity and work-related health issues

Nowadays, the workforce includes an increased presence of women, the elderly, single people, and childless couples (Gragnano, Simbula and Miglioretti, 2020): this means that the concept of well-being has begun to include other actors with different needs. On the other hand, the present position and satisfaction of women and ageing people are complex, and the condition of equal employment opportunities is, at an international level, a goal that is far from being achieved.

The European Commission (2022) presents data on the gender pay gap (at 13% in 2020) and unpaid work, confirming the situation of women's underrepresentation in the labour market, and the overburden on women for care in family, but also reports positive trends in the growth of education in the EU. Critical points of attention in Europe are, still, life-work balance, gender segregation in the labour market, and cultural stereotypes. The creation of suitable work organizations apt to promote women's employment in fair conditions is still a goal requiring dedicated research, strategies and policies.

At the same time, the conditions of ageing people at work also require further investigation. The ageing of societies requires the prolonging of active work. The impact of work demands and organization can be both positive and negative on the health and well-being of ageing workers, depending on several factors, as reported by Pak *et al*. (2023). Consequently, the relationship between health and age of retirement is complex, reflecting the roles work has in the life of individuals. Abeliansky and Strulik (2023) investigated the impacts of different types of jobs on health. In their research, they distinguish between different clusters: high- and low-education workers, blue-

and white-collar occupations, and high- and low-status employees. The research reports statistical differences among the groups and reveals a non-trivial correlation among job types and impacts on health. According to the authors, low-status workers develop more health deficits, both before and after retirement, in relation to high-status and white-collar workers.

Gender differences are also considered, indicating high advantages associated with retirement for white-collar women. Education appears as a main factor influencing health. Retirement has more positive impacts on low-status workers than on high-status ones. This highlights the importance of well-being strategies being flexible and inclusive, considering the unique needs of everyone involved, rather than following a *one-size-fits-all* approach.

## 4.3 Work satisfaction: an indicator of well-being at work

Work satisfaction, in terms of adequate remuneration and personal fulfilment, is a complex concept that has been investigated by several authors, revealing its potential as an indicator of the level of well-being in the work context.

Bailey *et al.* (2019) point out a large variety of facets in which this concept is articulated, assuming that meaningful work is at the centre of the development of human resources.

Work requires a personal investment of physical, cognitive, and emotional energy to perform tasks that are characterized by specific variety, significance, and identity. The feeling of adequacy of the reward depends also on the sense of the usefulness and value attributed to the tasks or to the final goal of the performed work.

The meaningfulness associated with work therefore has several dimensions, including the psychological state derived from the job characteristics, personal engagement, and psychological empowerment; the spiritual dimension related to the sense of joy and of connection through work to a greater sense of good; values related to individual fulfilment including autonomy, freedom, social recognition, self-expression, serving others, and acquisition of a public identity.

## 4.4 Strategies for researching

The importance of researching work-related mental problems asks for the creation of innovative approaches and the literature provides valuable directions.

Rugulies *et al.* (2023), analyze the consequences of mental health problems that are associated with higher absence at work, unemployment, lower income over a lifetime, and impaired quality of life, with consequent impacts on possible exacerbation of mental disorders and physical well-being. The authors point out the limits of earlier research and identify directions for future investigations including: the need for better theoretical frameworks; improved understanding of biophysiological mechanisms; innovative approaches to the collection and analysis of data; and the understanding of the role played by the contexts.

Pega *et al.* (2023) point out two specific goals for research in Italy: *i) Adapt monitoring of working conditions to the changing world of work, focusing on psychosocial risk factors. ii)Harmonise data on working conditions from records and registers for use in the national Information System for Prevention in the Workplace and expand the system's capture of psychosocial risk factors*.

This framework matches the Spoke 2, WP3 *Big data and innovative approaches to improve global health and wellbeing* of MUSA and the goal of developing innovative health solutions to create prevention and promote of healthy lifestyles, recognizing the importance of new approaches for the detection of work-related triggers of stress.-

But how do we define stress? According to Abreu *et al.* (2002) «stress is the psychological and physical state that results when the resources of the individual are not enough to deal with the demands and pressures of the situation».

Analyzing this definition, two concepts emerge: first, stress is a psychophysiological state. According to Aigrain *et al.* (2016), stress elicits physiological, affective, and behavioural responses.
This means that, in order to assess the health of individuals in a specific context, it is fundamental to integrate to qualitative measures (e.g. self-reports and questionnaires) as the gold standard (Scherz *et al*., 2020) in the monitoring of physiological data. In this regard,

commonly used wearable devices (e.g. FitBit, Empatica, etc.) (Scherz *et al*., 2020; Pakhomov *et al*., 2020), represent a non-invasive tool to detect stress biomarkers (Giorgi *et al*., 2021) and can be employed as a valid resource during well-being assessment research.

The second concept contained in Abreau *et al*.'s definition (2002), is well explained by the demands-resources (JD-R) model (Demerouti *et al*., 2001), which asserts that if the resources of the individual are not enough to deal with the demand of the work (e.g., long working hours), this imbalance generates stress. Considering that, we still have to make a distinction, since demand is not intrinsically negative (Bordi *et al*., 2018). This concept is described in the framework of stress by Lu, Wei and Li (2021), which distinguishes between sustress (inadequate stress), eustress (good stress), and distress (bad stress). According to this model, if a demand is perceived as a mild challenge, where resources are sufficient to deal with it, the response of the body is positive, generating eustress.

On the other hand, if demand is perceived as a hindrance, where resources are not adequate (e.g. I have to do this job in a short time, but now it is time to go home) the individual will be distressed. Hence, stress is not always negative, and we need a certain amount of it to stay motivated and productive. Unfortunately, distress situations occur more frequently, with a negative impact on both the employees and the companies. In fact, work-related stress reduces work performance and increases absenteeism (Lockwood, 2003), resulting in an economic loss of 2.5% of GDP in Europe (EUROSTAT, 2017).

Stress does not only affect the mood of the person but also brings physical negative outcomes, such as musculoskeletal disorders, cardiovascular health, diabetes, and so on (Weale *et al*., 2023). For this reason, it is fundamental to assess the level of stress and well-being of a work context, not just to make work a place where health is assured, but also a place where health is promoted.

## 4.5 Conclusions

The rethinking of the organization of work should accomplish the goal of increasing individual satisfaction, decreasing stress at work, delay-

ing retirement, and promoting healthy lifestyles. These goals should be harmonized with the requirements of efficiency and positive performance, with the awareness that work conditions significantly affect motivation and commitment.

Literature reviews confirm the need for new research to provide scientific results about potential strategies for rethinking work to create inclusive, healthy, and desirable work conditions.

Some relevant issues emerge when addressing the question of well-being at work, which are derived from the meaning of work itself: first, and at a lower level, work represents a place where social justice is realized since it is how people earn money to live. But work cannot be simply a place that allows us to *survive*, since people are experiencing their desire to live and feel fulfilled in what they do. In this way, work is becoming a place where people can feel realized and build personal development.

At the same time, huge changes are reshaping the structure and meaning of work. People are nowadays faced with a technology revolution, globalization, and the climate crisis. In this situation, people are called to rethink the way they work, produce, and consequentially, have an impact.

Work environments are the contexts where people spend a very significant part of their lives, and the work conditions impact their personal identity and lifestyles, physical and mental well-being, and long-term health. Investing in research to prevent work-related diseases is a matter of social justice and convenience, and workplaces should be considered ideal contexts to investigate health, not only to reduce risks of work-related pathologies but also to promote awareness and healthy behaviours. Concerning the specific tasks of the MUSA project that are the reference for this document, the roles of the designers-authors of this document are multiple, and include: the preliminary literature review aimed at framing the complex issues of defining and measuring well-being and stress; devising suitable approaches for the collection of functional data through the use of wearable devices and tools for gathering information on the subjective experience of users; conducting tests and assessments to evaluate the acceptability and meaningfulness of the devised approach. Finally, the authors consider it essential to ensure that the whole research

process can be conducted according to the principles of full respect for the rights of the workers involved in the process.

The desirable scenario we want to propose in this article is inspired by *The Imperative of Responsibility*, by Jonas (1984), which states: «act so that the effects of your action are compatible with the permanence of genuine human life». According with Jonas, people should include human value in the ultimate goal of production, and not only the related monetary growth. This means considering physical, psychological and social parameters to assess our level of well-being as humans, leaving behind the illusion of an economic growth without any disastrous repercussions on our lives.
Our research on well-being and health at work is a contribution to this perspective.

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PART 2

# New approaches for design research

# 5. Curating data for urban biodiversity: three catalogues on local issues in Milan

**Gabriele Colombo, Andrea Benedetti**

Preserving urban biodiversity is a widely recognized goal, with cities implementing initiatives to achieve it. However, when examining policies and local efforts, conflicts often arise among citizens, municipalities, and private stakeholders. Debates on urban biodiversity leave digital traces on social media, forums, and newspapers.
This text illustrates the potential of online data to inform planning and participation in urban biodiversity projects. In contrast to established formats for data analysis, such as dashboards, we explore catalogues as tools to curate, analyze, and display data from online sources. Through case studies focused on biodiversity policies in Milan, this chapter demonstrates how curated datasets displayed in printed catalogues can be used to map debates surrounding urban nature. As catalysts for public engagement, catalogues prioritize individual data points, promote the slow fruition of data, and give space to marginalized voices.

## 5.1 Mapping urban biodiversity with the web

Faced with unprecedented transformations, our society is redefining its relationship with the natural world: in the age of the Anthropocene, extractive capitalism, and the climate crisis, humanity must reconsider its influence on the Earth. Among the most evident human effects on the planet, biodiversity loss has escalated to the magnitude of a mass extinction (Cowie *et al*., 2022; Kolbert, 2014), and the protection of nature has jumped to the top of the global agenda. The European Commission (2020) has embraced a long-term plan to reverse the degradation of ecosystems with the EU Biodiversity Strategy for 2030, and the United Nations (2023) have placed the fight against biodiversity loss at the core of its sustainable development goals.

While there is widespread agreement regarding the importance of restoring natural biodiversity, in practice, it remains a complex issue. In the urban context, the generic desire for more nature clashes with the unique characteristics of different areas, the diverse needs of citizens, and economic interests, often sparking intense negotiations over public space.

Given the challenges of reconciling nature and city needs, designing inclusive and effective solutions for urban biodiversity requires considering a multitude of actors, positions, and interests. To ensure inclusivity and incorporate diverse viewpoints, municipal administrations often resort to participatory design processes, engaging community members in collaborative processes of meaning-making and design. While the aim is to provide everyone with a voice in the planning process, conventional forms of public engagement have struggled to attract a diverse range of participants, often prioritizing those at the top of the social hierarchy and marginalizing underrepresented voices (Lowndes *et al*., 2001; Witkowski *et al*., 2021; Thorsen, 2023). In this context, the need arises to reformulate concepts and methods of public engagement and stakeholder mapping, devising approaches that actively consider the multiple voices of those potentially impacted by urban-nature design initiatives.

In addition to offline discussion venues, such as public hearings or conferences, different actors present their arguments, advocate for causes, or express their positions on online forums, blogs, and

social media platforms (sharing images, memes, videos, comments, hashtags, or mentions). As a result, the internet has become a pivotal space for capturing the multitude of actors, voices, and perspectives intricately connected to urban biodiversity issues.

Taking a cue from analytical frameworks from media studies and digital sociology, including controversy mapping (Venturini and Munk, 2022), digital methods (Rogers, 2013), and issue mapping (Marres, 2015), we outline methods for collecting, analyzing, and presenting online data on the debate around urban biodiversity in printed catalogues. These catalogues display user-generated content, giving space to individual data items, foregrounding marginalized voices, and facilitating public engagement around projects and policies aimed at preserving urban biodiversity.

First, we examine consolidated practices of engaging with data in the urban context, specifically focussing on data-driven dashboards. Second, we introduce the concept of *curating data* as an alternative approach to using online materials to inform urban projects. Third, we exemplify this approach through three catalogues serving as case studies. These catalogues collect and analyze data concerning local issues related to urban biodiversity in Milan. Finally, we discuss how the curating data approach and the catalogue format can support policy-making, design actions, and participatory activities around urban biodiversity.

## 5.2 Visualizing urban data: dashboards and catalogues

As an alternative to other forms of information monitoring, such as dashboards, the approaches and formats we present here prioritize granularity and disaggregation. Indeed, when using user-generated data to monitor the discussion around a (urban) issue, dashboards are ubiquitous. Dashboards track developments and performances through neatly displayed and interactive representations of data to facilitate their understanding for various audiences. Dashboards are widely used in different fields (Sarikaya *et al*., 2019), including urban biodiversity, commonly visualizing indicators such as wind, air quality,

traffic, or tree maintenance (Riffat *et al*., 2023). They are designed to be clear, fast, and digested representations of data from different sources combined with filtering systems, drill-downs, and indicators visualized as arrows, traffic lights, and percentages, offering a glanceable overview. Dashboards help monitor and understand complex issues and are often a platform for participatory actions, especially in city development (Pluto-Kossakowska *et al*., 2022).

While dashboards provide functional affordances to monitor complex issues, they also present challenges. Among others, the high level of aggregation could favour «mechanistic, unsophisticated decision-making regimes», and «less aggregation» (Sarikaya *et al*., 2019) could be required in some contexts. Furthermore, the neat representations of data in dashboards convey an apparent objectivity that centres the interests and views of its authors without considering marginal or subversive voices (Sarikaya *et al*., 2019, p. 688).

In contrast to traditional dashboards, we propose a different way of handling data: curating it carefully. Curating data involves «selecting, organizing, and looking after the items» (Stevenson and Lindberg, 2011) stressing the qualitative and subjective nature of the activity. Instead of lumping everything together, we create catalogues that display each item separately. This approach encourages engagement with individual data items and invites users to spend more time exploring them.

### Curating data and catalogues as sites of curation

Curating data refers to the intentional act of selecting and organizing individual items. This concept is borrowed from museology: when curating items in their collection, a museum curator selects the finest items, arranges them according to a unified theme, and then «engages the public in a conversation around the collection» (Fraser, 2019, p. 2). The concept of curation can be extended to data practices: Curating data (as opposed to collecting data) emphasizes the interpretive gesture and framing of the author (Benjamin, 2021) and frames the activity as a non-neutral practice where biases and personal upbringings are impactful, against the narration of objectivity and data (Calvert, 2023). Expanding on these ideas, we argue that *curating* involves dedicating time to data, prioritizing manual collec-

tion methods over automated ones, and conducting this process with *care* (Puig de La Bellacasa, 2017).

We connect the concept of curating data with the catalogue format, a standard structure found in exhibitions, museums, and industrial design. In these domains, curators meticulously oversee artworks and items, which are then presented in catalogues, showcasing the complete collection. Etymologically, the *catalogue* reflects the concept of order, similar to how lists bring unity to diverse items (Eco, 2019, p. 113). When items such as text fragments, images, and web page screenshots are grouped together, they are seen as a single unit due to their shared context (Eco, 2019, p. 116).
Catalogues can be found in disparate contexts: in exhibitions, they represent the artworks in a collection, along with their metadata such as the author, when they were produced, and other additional information. Applied to digital-born data, catalogues can also be designed as expressive artefacts to comment on social issues (Lavigne and Brain, 2020), political events (Quealy, 2021) and place-making processes (Colombo and Gray, 2023).

Building on these examples, we contrast the catalogue to the dashboard for exploring urban data. Catalogues shift the focus towards selecting, ordering, and organizing a dataset without simplifying it into aggregated data visualizations like dashboards do. We propose a specific catalogue structure articulated in three parts: an introduction, a visual summary employing conventional data visualization methods, and a detailed listing of items featured in the dataset. Catalogues are then printed in a format that users can browse physically.

## 5.3 Actors, statements and language: three catalogues for urban biodiversity

We detail the curating data approach through three analytical angles: actors, statements and language. Through the web, one studies the actors in a debate, their positions, and the language they use to advocate for their position. In what follows, we use three case studies in Milan to illustrate how curating data can inform the understanding of urban biodiversity. The cases investigate three emblematic

issues that impacted Milan on different scales: the pruning of a single wisteria tree in Piazza Baiamonti evolved into a media-fuelled clash involving the municipality, local organizations, and public figures; the spontaneous woods of Via Falck represent a disputed area among the organization who sold it, the investors who bought it, and the people who inhabit it; Forestami, a reforestation project aiming to plant millions of new trees across the entire city, has sparked debates regarding the effectiveness of such endeavours.

**The woods of Via Falck: actors and language**

In the San Leonardo neighbourhood, located northwest of Milan, there is an approximately six-hectare area hosting a spontaneous forest with abundant plant and animal biodiversity. In 2022, the land-owner decided to transfer the building rights in the area to private investors. The proposed real estate project includes student housing, commercial spaces, social housing, and tall towers that could accom-modate up to 1500 new residents. However, it would entail the drastic transformation of the area and the felling of numerous trees.

The discussion surrounding the area was examined through the Google News portal, where all articles on the subject were gathered. All actors mentioned were identified by analyzing the text of online news articles. In this process, actors are defined following Latour's definition, which suggests that even objects, and more broadly, non-human entities, play active roles in articulating issues and relationships (2007). Embracing a comprehensive understanding of what constitutes an actor in this debate highlights the diverse voices potentially interested and involved in the project: private companies and organizations, political figures, and activists, as well as plants, place names, materials, animals, and buildings. The catalogue *A Plea, a Tree, and the Pope* includes news articles, identified actors, and the sentences in which they are quoted.

The catalogue illustrates the actors engaged in the area and their relationships, as identified through their co-mentions within the same articles. The analysis reveals a distinct separation between discourse about the real-estate endeavour and that concerning the natural environment. In a network visualization displaying actors' references in the articles and linking those mentioned together, plants and

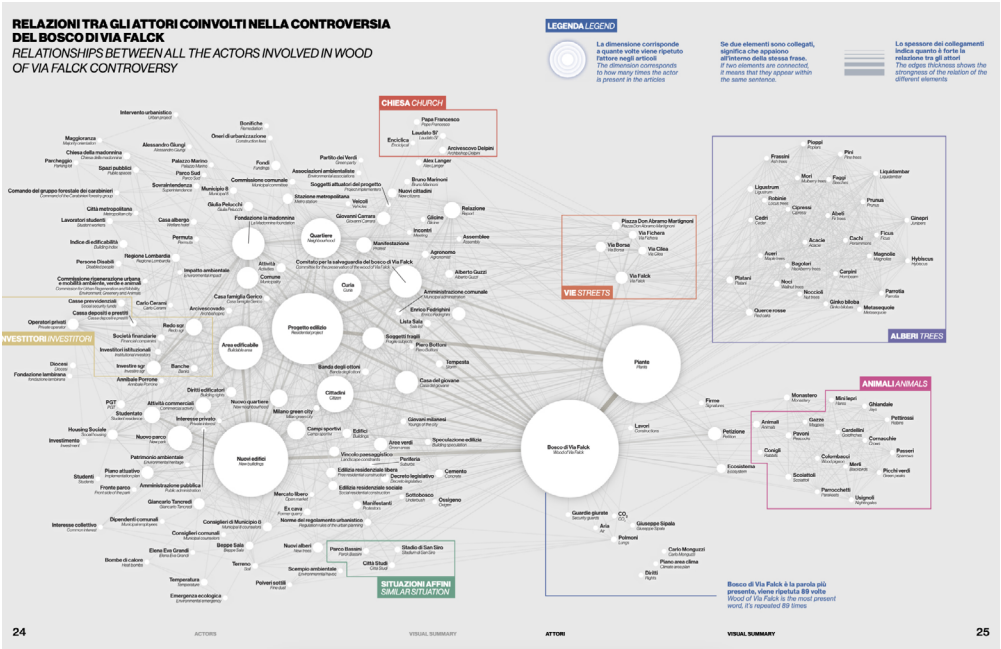



Figure 1.
Two extracts from *A Plea, a Tree, and the Pope*. Above, the visual summary accompanying the list of actors Below, an example of quantifications mentioned in news articles. Source: https://agc-exhibition.densitydesign.org/projects/a-wood-182-actors.

animals are entirely isolated from the main debate, forming a distinct cluster (see Figure 1). This configuration highlights a clear opposition between two perspectives: the discussion involving flora and fauna is detached from the construction project discussion. The distinction is further detailed in the list of actors, displayed alongside the articles from which they were extracted, showing how each word was framed in the original context.

Another aspect pertains to language. By flicking through the catalogue, it becomes apparent how the communicative code of measurement and quantification is widely employed in newspaper articles addressing the future of the area. Endangered plants, new buildings, company shares, and square metres – every facet of the debate is meticulously conveyed through measurements and quantities used to advocate various positions. This specific use of language might lead to a disconnect from how local residents perceive urban areas in terms of biodiversity, prioritizing statistics and indicators over affective relations.

**Forestami: statements**

Forestami, initiated in 2018 and promoted by the Metropolitan City of Milan in collaboration with local entities and private companies, aims to plant 3 million trees by 2030 to counteract climate change. Thanks to cooperation with private companies and an effective communication campaign, it has gained visibility, sparking both positive and critical opinions, particularly regarding the maintenance and survival of the trees.

Through the analysis of the comment space, dubbed *the bottom half of the web* (Reagle, 2015), the analysis explored the multitude of opinions – or, to use a term borrowed from controversy mapping (Venturini, 2010), *statements* – that actors express regarding the urban reforestation project. The debate was analyzed using comments from Instagram, Facebook, and X (formerly Twitter). Each comment was summarized into a statement that captured its tone and intention and subsequently categorized by theme. The analysis, compiled in the catalogue *Remember to water the trees*, highlights the various positions of users, from the most enthusiastic to the most critical. The predominant theme from the analysis revolves around the re-

sponsibility associated with urban green spaces: Is greenery considered a common good that citizens take care of or a service that institutions must guarantee? Another emerging theme concerns the (lack of) maintenance of trees, which users highlight in their criticisms of the Forestami project. The most common critique is that Forestami is seen as *greenwashing* by online communities (Figure 2), solely focussed on achieving reforestation goals, without adequately considering the long-term care and maintenance of the planted trees. Insights like these enable municipalities to identify perceptions concerning public initiatives for urban biodiversity and tailor communication strategies to address them effectively.

**The wisteria of Piazza Baiamonti: actors and statements**

In Piazza Baiamonti, situated in the Porta Garibaldi district, plans are underway to construct the National Resistance Museum. The project would involve cutting down existing trees, including an 80-year-old wisteria, four lime trees, and a horse chestnut. The wisteria, in particular, holds sentimental value for the local community and visitors to the area, who have voiced criticisms regarding the construction methods and the pruning and removal of the trees. Notably, the debate has garnered involvement from both nationally and locally recognized figures, leading to a rich and heated online debate.

To analyze the debate surrounding this project, we focus on the alignment between statements and actors. Here, we operationalize the notion of 'alignment' through language, in the sense that «when multiple actors use the same language, or when publics do so, they align» (Rogers, 2018). Which actors use the same language regarding the project and share a similar position? What alliances are formed through shared positions? The discussion has been examined through 130 videos from various platforms, including Facebook, Instagram, Google Video, TikTok, and YouTube. The primary positions expressed in each video have been identified, categorized into macro-themes, and attributed to the individuals who articulated them (Figure 3).

The analysis maps alignments and misalignments among actors based on their shared issues and language. For instance, there is an apparent disconnect between the issues and languages brought

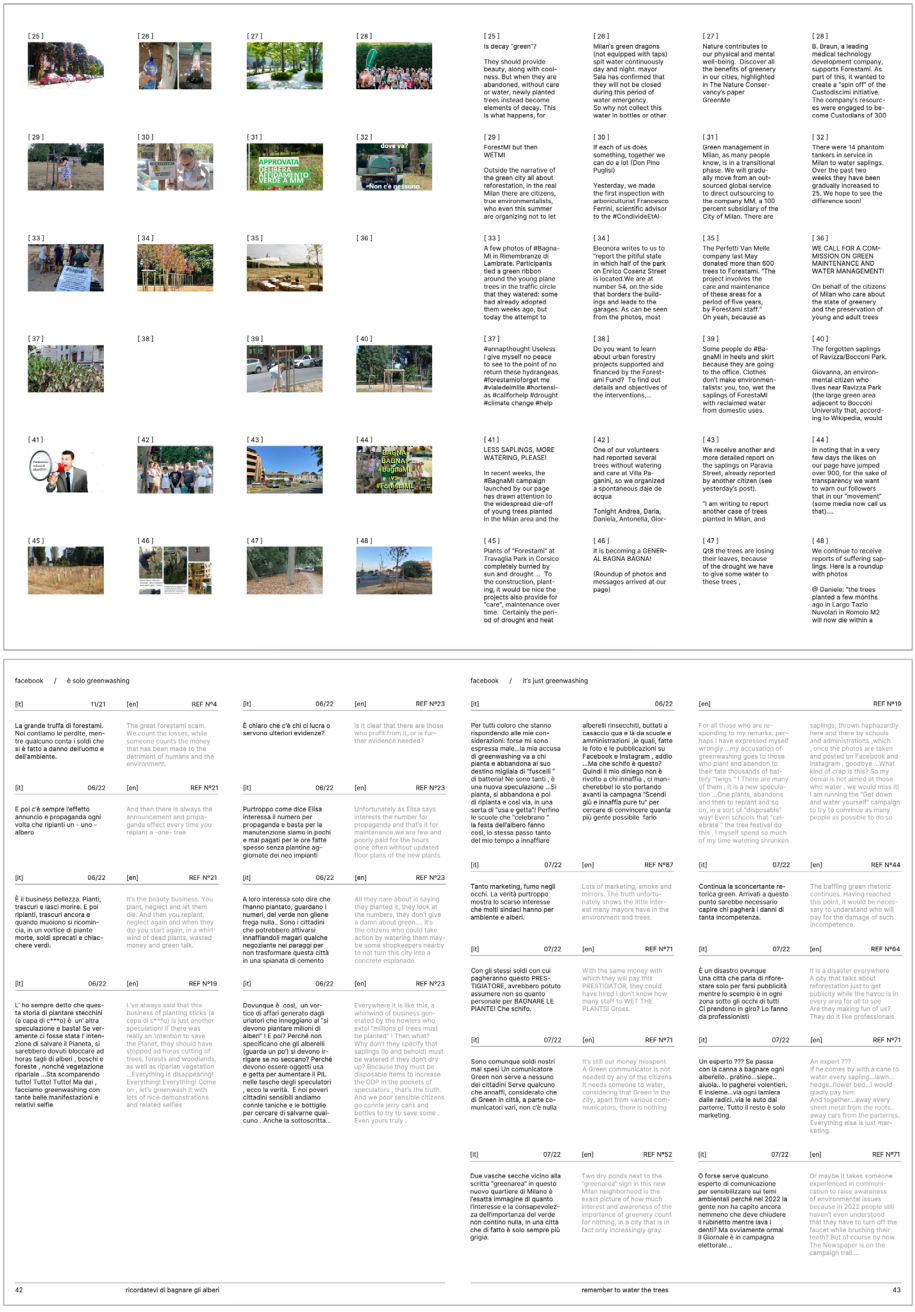

Figure 2.
Sample of a section from *Remember to water the trees*. Above, the original posts from which the comments were collected. Below, a portion of the comments belonging to the *greenwashing* thematic group. Source: https://agc-exhibition.densitydesign.org/projects/remember-to-water-the-trees.

forward by politicians and those by citizen groups. Politicians and city representatives tend to focus on the municipality's policies or lack thereof, while associations and citizens are more concerned with preserving urban nature, particularly the wisteria. The analysis also uncovers unexpected alliances resulting from shared language. For instance, right-wing politicians criticize the municipality (of an opposing colour) for sacrificing nature for urban development, aligning themselves with associations advocating for the preservation of urban nature. Doing so, they appropriate themes typically associated with left-leaning citizen organizations, resulting in an unforeseen coalition.

## 5.4 Catalogues of data as tools for public engagement around urban biodiversity

Urban biodiversity, particularly at a local level, often triggers conflicting perspectives on its preservation and restoration. Current practices of monitoring online debates through dashboards prioritize aggregated and digested views of large volumes of data. Drawing inspiration from curatorial practices in art, we suggest using catalogues as an alternative format for gathering, representing, and examining online data about urban biodiversity policies.

Catalogues require researchers and designers to reflect deeply on their role as *data curators*, stressing the qualitative and subjective nature of the process (D'Ignazio and Klein, 2020).
As a visual format, the catalogue stands in opposition to the tendency towards reduction seen in conventional data visualization approaches (Manovich, 2011), exploiting the generative power of *assembly* (Parry, 2023) to showcase diversity by unflattening data items.

The catalogue diverges from standard data visualization techniques that prioritize simplification through aggregation methods such as summing, averaging, or counting, aimed at simplifying *data for easier consumption* (Pelzel, 2021). The catalogue directs attention to individual data points, foregrounding less prominent voices within the dataset. For example, one can follow users that are less active and post less, or comments that generate fewer likes or views.

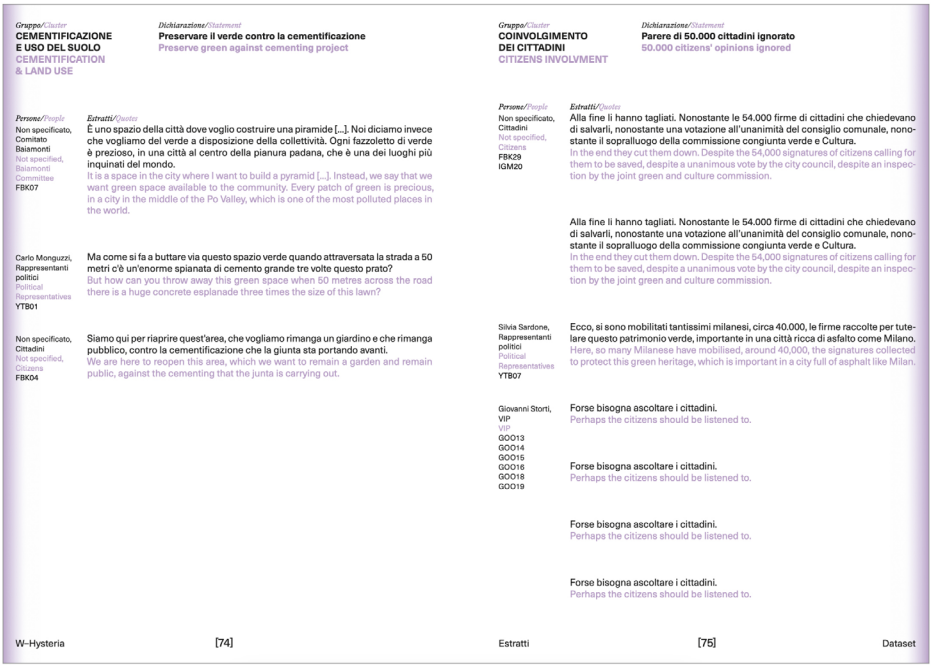


Figure 3.
Two-page spreads from *W(H)ysteria*. Above, two pages of the catalogue surfacing statements from videos. Below, the list of actors in all their appearances. Source: https://agc-exhibition.densitydesign.org/projects/the-glitchine-diorama.

Consequently, catalogues can serve as a tool to identify actors and opinions that might otherwise go unnoticed when using traditional aggregation methods, thereby enriching the mapping process with nuanced perspectives.

In this context, the curating data approach, along with the catalogue format that embodies it, aligns with feminist calls for data science to embrace diversity and amplify marginalized voices, often silenced «in the service of clarity, cleanliness, and control» (D'Ignazio and Klein, 2020). As a feminist method that privileges multiple perspectives, the catalogue format does not assume homogeneity and does not merely summarize, treating each data point as a distinct entity. This approach facilitates the exploration of «continuities and resonances» among elements (Ahmed, 2017). However, it is crucial to recognize that marginalized voices might not always want to be included in the analysis: Invisible actors who used hashtags or replied to highly public figures could appear in the dataset, and including them in catalogues without their consent could raise ethical issues.

Moreover, because they highlight marginalized perspectives, catalogues can guide participatory design efforts, assisting researchers, designers, and planners in involving overlooked stakeholders (in addition to established stakeholder mapping methods) and mobilizing new pockets of the public. Who should sit at the table of participation? Whose interests matter? How can planners and designers engage effectively with diverse actors?

Finally, as printed materials, catalogues offer opportunities for participatory workshops and public engagement activities, serving as *conversation prompts* (Manzini, 2015) to explore alternative perspectives on the issue at hand. For instance, in the project mapping reforestation in Milan, statements from citizens, ranging from observations of dead trees to expressions of scepticism about the initiative, could prompt discussions among stakeholders.

While dashboards have been used as tools for community engagement (Pluto-Kossakowska *et al*., 2022), catalogues provide a slower approach to data consumption, which can be advantageous in participatory settings, contrasting the quick insights of visualization summaries and indicators. In this regard, time plays a crucial role in engaging with catalogues: navigating a dataset by flipping pages

extends the duration required to comprehend and analyze the data, prompting observers to engage thoughtfully and attentively.

Cities, faced with unprecedented transformations, require inclusive and systemic actions that can mediate between conflicting interests. While data can be a valuable source to map and understand urban dynamics, with traditional approaches in data science and visualization, the risk is suppressing pluralism and marginal voices in the service of clarity and quickness of insight. Here, we have presented *curating data* as a slower way of working with online data that foregrounds marginal points of view. While the inclusive mapping of diverse positions is not enough to act in complex contexts that characterize urban nature, it is undoubtedly a starting point for informing more effective and careful design actions.

## Acknowledgments

The authors thank the students of the Final Synthesis Design Studio of the Master's Degree in Communication Design at Politecnico di Milano, in particular Michela Chignoli, Ziqi Huang, Francesca Mattiacci, Vanessa Medda, Hanya Nie, Shuyu Zhang, Sara Matilda Montorio, Federico Corbani, Alessio De Nicolò, Kseniia Havrylova, Helena Maciukiewicz, Marco Trabattoni, Anastasiia Zaiarniuk, Fatemeh Maher, Sofia Bonfanti, Andrea Burchiani, Bingru He, Tommaso Prinetti, Benedetta Riccio, Yasemin Umac, YiYou Zou.

The research presented here has been funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.4 - Call for tender No. 3138 of 16 December 2021, rectified by Decree n.3175 of 18 December 2021 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU; Award Number: Project code CN_00000033, Concession Decree No. 1034 of 17 June 2022 adopted by the Italian Ministry of University and Research, CUP, D43C22001250001 Project title *National Biodiversity Future Center - NBFC*.

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# 6. Drawing, design and algorithms. Theoretical statements and experimental practice for a shared *poiesis* in the age of Artificial Intelligence

**Giorgio Buratti**

Drawing has always preceded any construction activity in the design process. The act of drawing constitutes a moment of organizing ideas, managing resources and forecasting results, which is made possible by using dedicated tools. The introduction of the computer as a drawing tool has brought about an epochal change: in addition to contracting execution time and increasing the accuracy of the sign, the computer allows drawing in a practical simulated three-dimensional space, enabling the expression of more articulated forms.
Initially used as a functional *digital drafting table*, differing little, from a conceptual point of view, from the traditional modes with ruler and square, the use of the computer has progressively conditioned the design process so much, that today it's difficult to separate it from design practice. With the new millennium, economic and cultural changes have accelerated the advent of a digital and globalized society. Increased computer literacy has involved designers, leading them to investigate the processes underlying the operation of daily-used digital tools. The conscious use of the computer stimulated a new type of modelling based on information-processing logic and freed

the designer from the traditional CAD software constraints.
This increased mastery has enabled a growing group of researchers and designers to develop their own drawing applications adapted to their specific individual design and research experiences. The form is now studied and generated by drafting algorithms, systematic procedures based on a succession of uniquely interpretable instructions that lead the computer to achieve a given goal. The discipline of drawing has thus evolved from iconic representation to the formalization of relationships and processes.

## 6.1 New paradigms for the discipline of drawing

In this new paradigm, different design instances can be articulated in emergent relational structures that require new theoretical analysis tools and understanding, capable of maintaining a high level of design coherence. It is necessary to manage the interaction among multiple parameters through diagrams capable of articulating programmatic interactions that operate as reactive systems in domains where real and virtual are increasingly overlapping. The etymon of the term virtual, from Latin *virtus*, meaning strength but also capacity or faculty, leads back to the concept of possibility, that is, of unexpressed potential far from opposing the real, representing a different mode of the existing (Levy, 1997). This meaning accurately interprets those phenomena related to the technological and social evolution that led to the advent of the Metaverse. This new paradigm transcends the concepts of hypertextuality and multimedia associated with the Internet's first phase through simulated three-dimensional environments. In those domains, virtual, augmented or mixed reality technologies mediate the fruition of meanings and interaction with objects and other users. Whether it is a virtual space in the Metaverse based on VR/AR technology or an application dedicated to a specific context, digital simulations require an abnormal amount of heterogeneous data to be processed. Thus, several models of AI capable of detecting, classifying and describing the data needed to make the entities' and objects' behaviours in virtual spaces plausible have evolved in parallel

with the establishment of digital realms. Continuous computing acceleration has already made various AI applications available, which quickly emerged from research environments to project themselves onto the market, quickly becoming pervasive realities capable of generating text, images, videos, and musical themes from simple textual input. The potential expressed by these tools is reminiscent of the transformative impact of CAD applications, a revolution that has profoundly altered the way we think about, design, and represent objects, spaces, and cities.

These questions highlight the need for framing AIs in the evolution of digital design and modelling and a greater understanding of the operation principles by a deeper analysis of human-machine interaction, which goes beyond the causal assumption *I write a word, I get an image*, and anticipates the challenges, with particular attention to ethics, posed by the use of these tools. Compared to algorithmic modelling, the advent of AI poses an inevitable and far more destabilizing question about authorial subjectivity and the emergence of new, plural and composite forms of collaboration between man and machine.

## 6.2 Algorithms for design: Computational Design and AI

Although often considered a single entity, Computational Design and Artificial Intelligence (AI) are two different approaches derived from a common matrix. Both rely on the use of algorithms to derive solutions or results, but the goals, methods, and degree of process autonomy are significantly different. Computational Design is the label that, over a decade, has summarized several approaches known as parametric modelling, algorithmic modelling, evolutionary modelling, and generative modelling. Even today, the terms are often combined (e.g., parametric-generative modelling, generative-emergent, algorithmic-evolutionary, etc.) to highlight one or more aspects related to the concomitant rise of digital technologies and postmodern complexity science in the design world.

The cross-fertilization between systemic theories, which study the

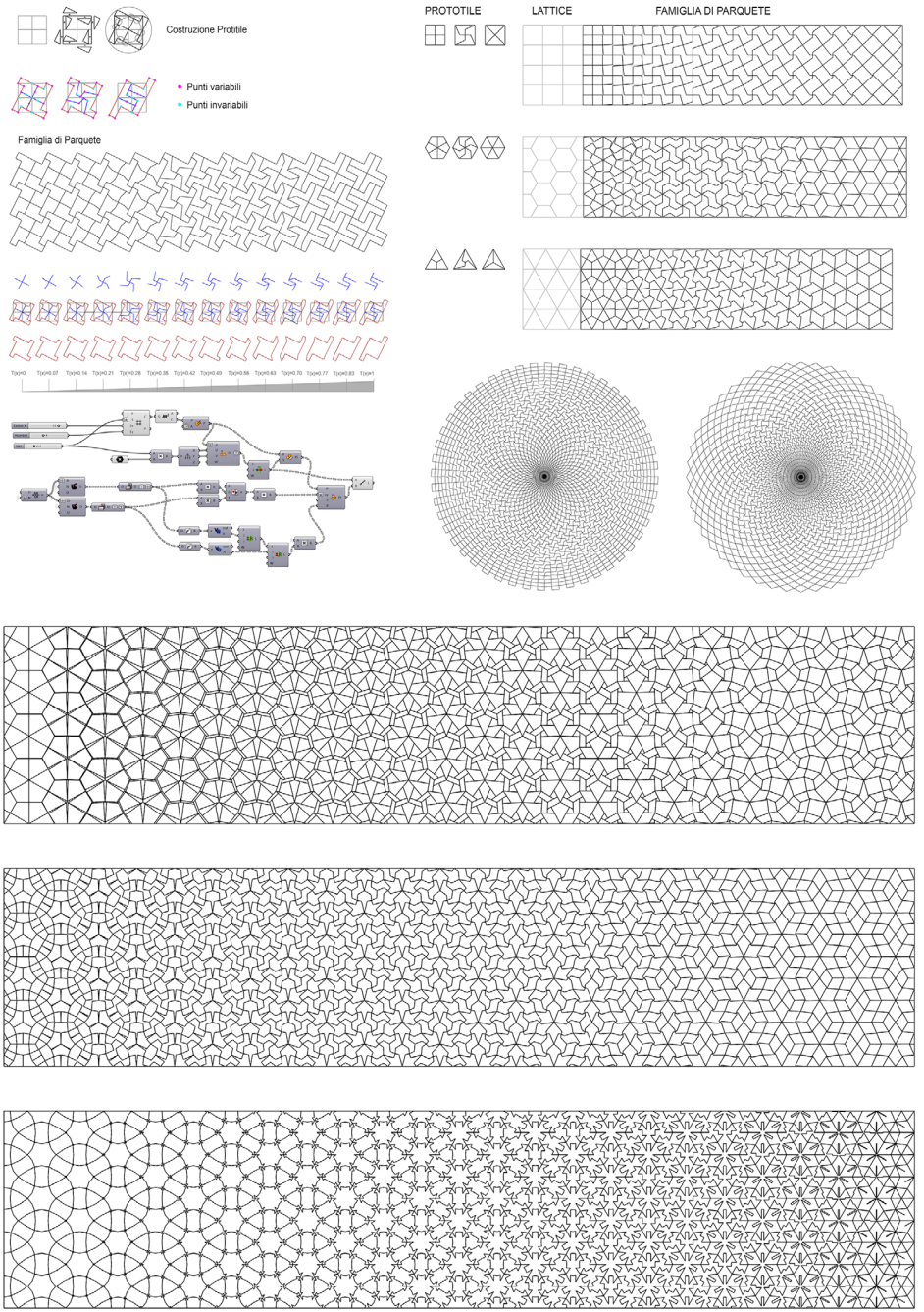
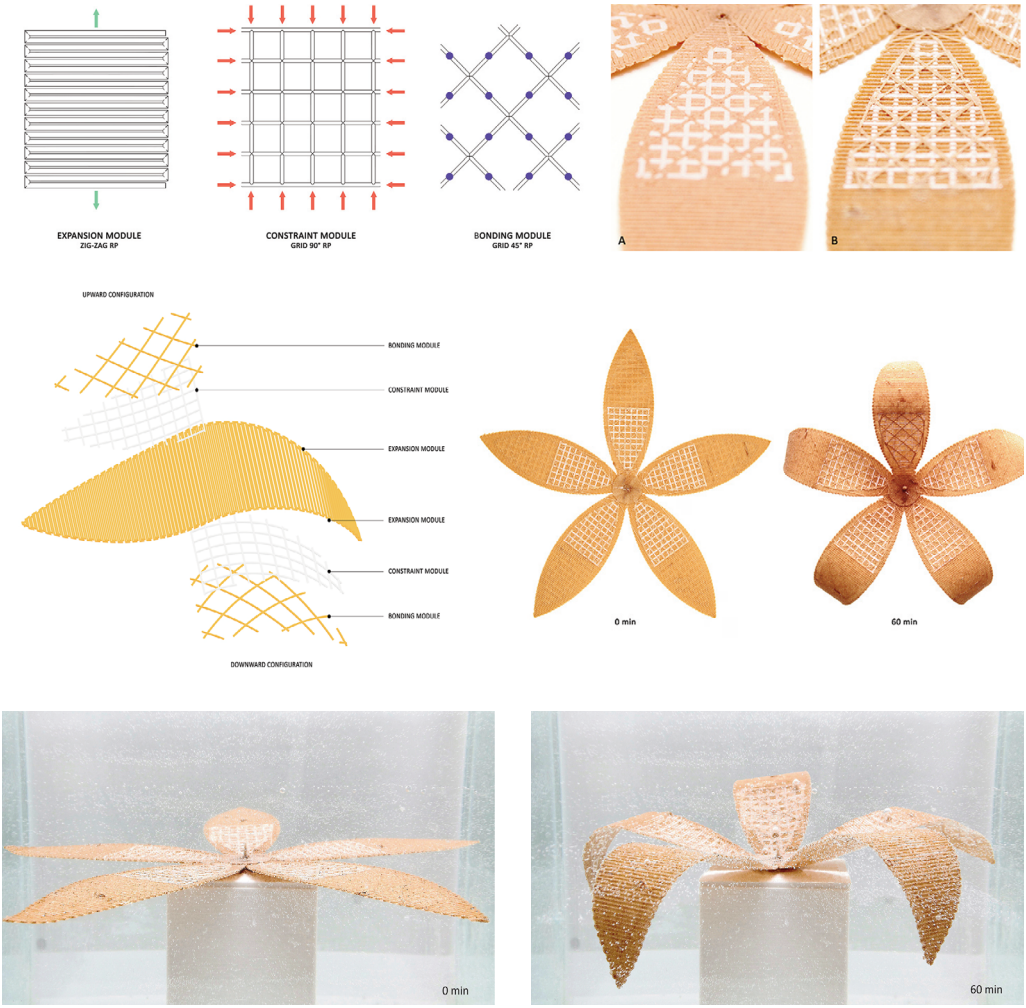



Figure 1.
Parquette deformation study, a dynamic pattern creation and control exercise, was realized using Grasshopper, a visual aid for scripting Rhino Mcneel software. Source:G. Buratti, 2023.

ability of complex systems to self-organize while maintaining equilibrium, computer processes and design practice, has indeed defined an interesting conceptual and research framework (Codgell, 2018).

## 6.3 Computational Design

Computational Design involves a conscious use of the computer tool that goes beyond the function of representation and visualization, allowing control of the codes by which the processor constructs form. This is usually done through visual aids for scripting, applications that make formal relationships explicit by bringing out their interconnections and dependence on parameters that influence the algorithmic path outcome (Figure 1). The outputs are, in turn, usable as input data for further commands to form a data network, an ideogrammatic morpheme of multiple achievable outcomes. This interconnective structure clarifies the positions of the algorithms that become procedures (Migliari, 2000) corresponding to the formulation of the model's interpretive hypothesis and the multiplication of its representations. Among the usable applications, Grasshopper, a Rhinoceros plug-in from McNeel, has become the iconic tool for this current trend. Used internationally and enriched by a series of add-ons, it has proved to be a tool capable of responding to the many issues inherent in the need for increasingly integrated design, which promotes a research direction based on the centrality of the code-procedure concept. Form is not defined as a priori but results from refining conceptual, communicative, structural, and geometric instances, leading to the most responsive result (Figure 2). The designer focusses on the process, created ad hoc to achieve the best possible outcome in response to specific design problems. Through the computer tool, it is possible to synchronously manage a considerable amount of data related to the different stages of the design process, addressing previously unassailable morphological problems (Figure 3).
One of the most pervasive and influential design theories of our time has thus been reversed, overcoming arbitrary stylistic commonalities in the search for a language that is not predetermined but contingent, freeing the design act from any preconceptions, traditions or trends.




Using Terzidis' words (2003), «for the first time perhaps, the design might be aligned with neither formalism nor rationalism but with intelligent form and traceable creativity». Ultimately, Computational Design is an approach that uses computer algorithms and computational capability to automatically generate a set of design solutions based on specific parameters and constraints that meet designer requirements. The growing potential and evolution of the method have led to further exploration of heuristic optimization strategies peculiar to mathematics and computer science, which are helpful in the search for efficient solutions in the face of large amounts of data, called Evolutionary Algorithms.

Figure 2.
The fabrication of biologically inspired and hygro-responsive morphologies with Wood Polymer Composites (WPCs), highlights how control of kinematics through computational design enables dynamic mechanisms of shape change in response to environmental factors. Source: M. Filippucci, G. Pelliccia, 2023.

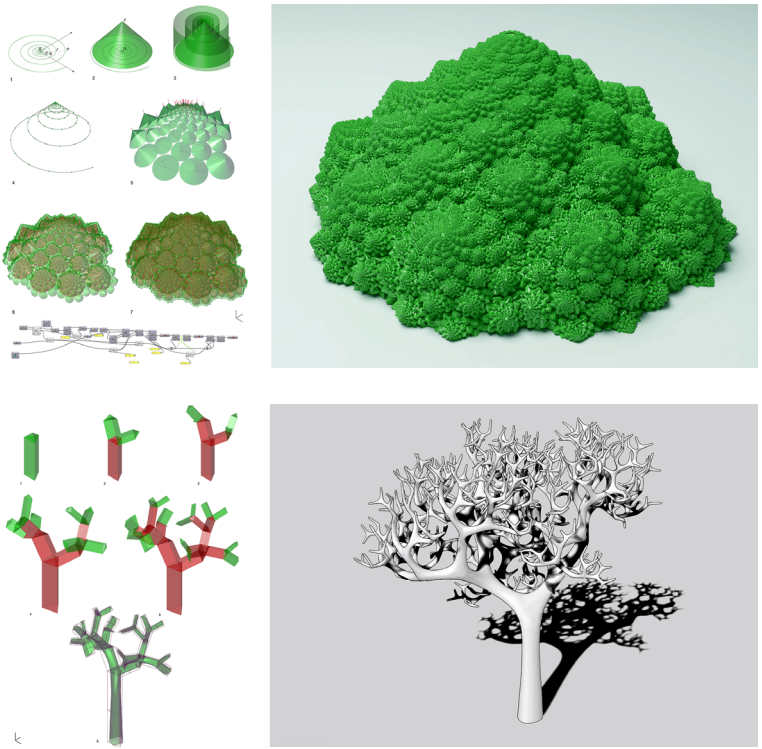


Figure 3. Computational morphogenetic study on biological growth processes. (above) Growth principles of Roman cabbage; (below) branch development of a deciduous plant. Source: G. Buratti, 2021.

## 6.4 Evolutionary algorithms

Genetic or Evolutionary Algorithms are procedures based on the Darwinian principle that predicts that organisms best suited to a specific ecosystem have a greater chance of survival, transmitting advantageous characteristics to subsequent generations. Used as a design tool they allow, by iterative processes of random recomposition homologous to sexual reproduction, to obtain the morphologies that best meet the formalizable and quantifiable conditions (materials, physical and temporal constraints, set purpose, user interaction, economic and production factors) that distinguish any project. Compared with traditional algorithms, procedures that are easier to follow step by step, Genetic Algorithms act with a certain degree of autonomy, due to the randomness of the recombination processes. They fall to all intents and purposes within the field of study of Artificial Intelligence, enshrining a new evolutionary leap for drawing and representation.

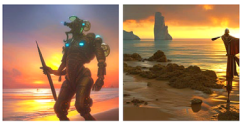
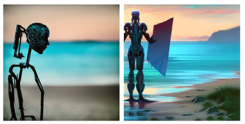
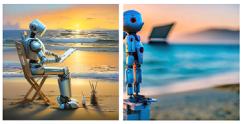
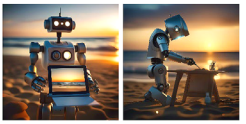
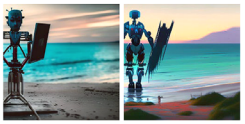
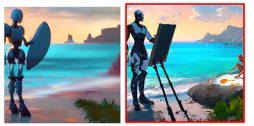
## 6.5 New frontiers: AI for representation

Generative AIs could create novel content based on prior data, but the function principles differ significantly from Computational Design. Today, the application domains of these tools range from obtaining text, images, videos, and musical motifs from simple textual input. However, the development of AIs has been a tortuous process, covering some seventy years of highly purposeful moments that have alternated with periods of stagnation.

Ever since the conference at Dartmouth College in 1956, where John McCarthy introduced the evocative definition of Artificial Intelligence sanctioning the actual birth of the discipline, the evolution of software able to reproduce capabilities typical of human cognition such as interaction with environment and people, learning, adaptation, understanding and planning, has been closely linked to technological, scientific and contextual advances (Buratti *et al*., 2021). Unsurprisingly, the last decade of hardware acceleration has produced numerous tools capable of generating images from natural language text descriptions. This application uses highly advanced algorithms: Artificial Neural Networks (ANNs), which are computational models that use a connectionist approach to calculation. In a primary interface named Prompt, you type words or simple phrases that describe the image you want to get. A source image can also be used in some cases, although integration with written text is often required to obtain interesting results. In most cases, the link between the typed lemma and the signified image is made using the Prior device, which relates the written word to a database of taxonomized images. All images that refer to the terms used will then be selected from the database the algorithm draws on. The development of datasets has been facilitated over time by the never-ending growth of the Internet: millions of images associated with their respective text descriptions are already available on the Web, managed by the Hyper Text Markup Language (HTML), which allows the layout and formatting of Web pages, labelling and recognizing the different elements of a multimedia page. It is possible to reconstruct considerable datasets quickly through the <Img> and <Alt> tags, which identify an image and the textual part that explains its content. The construction of the data

collection plays a crucial role in the training and operation of these applications: if the inputs are missing, of poor quality, or biased, the results will be corresponded. The collected data must be processed and transformed into a new image that meets the specifications provided by the user via prompts. This is the most technologically complex moment: it is not enough to compose an image patchwork to obtain an innovative reworking, but the concept of Latent Space must be introduced.

Latent Space is the virtual device that provides the processor with structured and quantified information on a picture's qualitative parameters. It is a multidimensional space that considers 500 or more variables, among those found to be most efficient in image generation during training. Within these spaces are parameters that a human would hardly distinguish, but for a computer, they create meaningful regions and clusters that can capture the image's essence.
Each point in Latent Space defined by the words can be regarded as the ingredient in the *recipe* that generates a possible image (Figure 4). Compared to the processes used in Computational Design, neural network-based machine learning algorithms analyze large amounts of data to draw autonomous conclusions or predictions.
The path to the image is characterized by a process of hermeneutic circularity based on repeated trials in search of the best results. There are no fixed rules for how a neural network-based AI outputs information so the results may be surprising and unexpected regarding effectiveness or graphical technique. Still, they are often far from the user's initial mental prefiguration. As for the possible use for design purposes, other than visual communication, the results are not controllable enough for project use, except in the initial concept stages, more as suggestions than as actual technical/constructive deliverables.
Unlike algorithmic modelling, where handling large amounts of data is under the designer's control, the parameters remain hidden in Latent Space in generative AI applications. In both tools, the first result often doesn't meet the designer's needs. Still, while algorithmic modelling makes it easy to interpret and modify variables, with AIs the process is too haphazard for the highly hierarchical and time-optimized path any project implies. This does not detract from the fact that AI has enormous transformative potential, perhaps more significant than the

| Words typed in prompt | Dall-e 2 | Midjourney | Stable Diffusion |
|---|---|---|---|
| 2° ATTEMPT<br>Generative AI, artificial intelligence drawing, a paintbrush, a beach at sunset |  |  |  |
| 4° ATTEMPT<br>Generative AI, artificial intelligence drawing, a paintbrush, a beach at sunset, calm Mediterranean Sea |  |  |  |
| 5° ATTEMPT<br>A humanoid robot, it paints on a beach at sunset, painter's ease, calm Mediterranean Sea, no photorealistic. |  |  |  |
| 7° ATTEMPT<br>A humanoid robot, it paints on a beach at sunset, painter's ease, calm Mediterranean Sea, no photorealistic.<br><br>(*repetition*) |  |  |  |

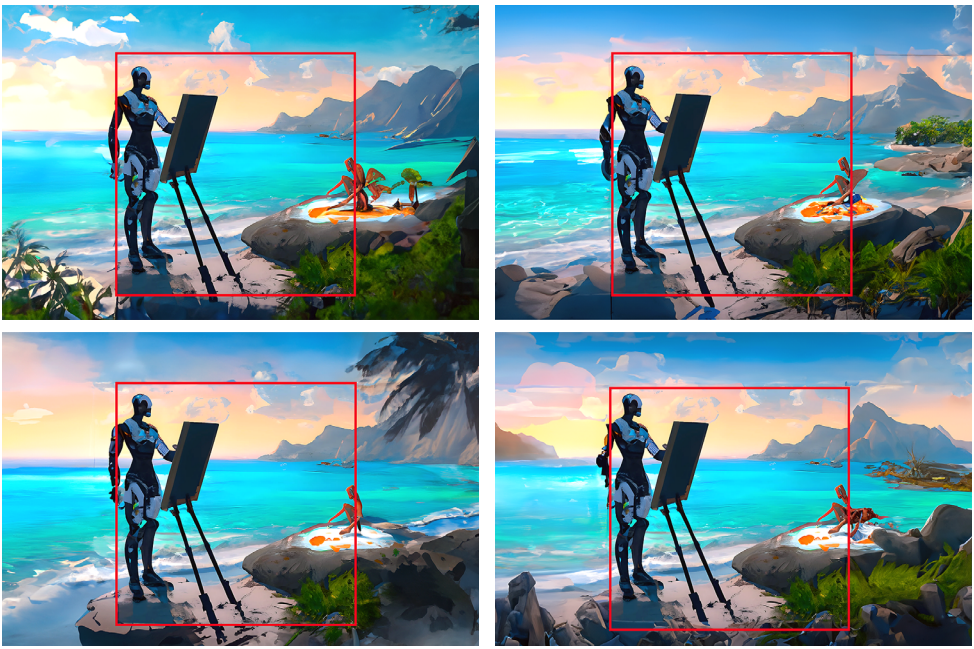


Figure 4.
Example of results of the three main text-to-image Artificial Intelligences available today from the same text instructions. A series of attempts are often required before the desired result is achieved. It is necessary to understand the operating logic of AI specifications in order to use them properly. The image framed in red was later chosen for an outpainting operation with Adobe's AI Firefly. Source: G. Buratti.

impact of CAD applications of the last century. The incredible development speed related to the peculiar workings of neural networks is not comparable to that of any other technology in human history (Figure 5), making it difficult to produce any development forecasts.

## 6.6 Conclusion

Beyond the general interest aroused and the ensuing social uproar, the continuity of AI with the Computational Design processes, which have long been in robust development, is evident. The elements of real innovation concern the poietic process – which has always been partly delegated to the technology used, from the pencil to the modelling software – the availability of an unthinkable realism linked for the first time to the tool and not to the author.

More than an authentic dialogue with the computer, it is possible to speak of a further anthropological mutation of the human/machine relationship. It is not yet possible to establish a proper conversation in the etymological sense of *cum-versare* (*cum*=with; *versare*= to turn around, to find oneself), that is, of dialogical confrontation. These AIs receive instructions, and only then can they sift, select and process

Midjourney v.1 (February 2022) Midjourney v 5.2 (October 2023)

Figure 5.
Images were obtained by AI Midjourney using the same prompt indications. The continuous training to which users subject AIs has promoted a significant improvement in results in a short time.
Source: G.Buratti.

unimaginable amounts of data. Despite textual input, the prompt does not have much in common with the natural language we write and speak daily; it is somehow a hybrid between natural language and programming codes. With machines, at least for the present, there can be no real communicative relationship, hence the randomness of fruitful and surprising, now frustrating and disappointing, results that can be obtained. At present, the detectable advantages are:

1. A significant time saver, especially for correction operations and cleaning up an image, the time savings are considerable substantial, allowing the user to focus on creative processes.
2. New features such as Outpainting and Inpainting. For generic or background images, excellent results can be generated quickly, while specific depictions may take time or effort to achieve.
3. Image graphic quality. The results obtained are often high-level visual solutions.

However, these positive aspects are accompanied by some key critical issues:

1. Lack of *originality*: the outputs created are based on the database and the training received. This leads to continuously dealing with the same data in a continuous repetition and recomposition of existing patterns.
2. Content distortion: Generative AI uses training data to generate new information. If the former contains distortions, the obtained data will reflect those biases. The quality of training data is essential to create plausible and realistic data. The ethical component related to what is produced with these tools is often mislead by the term *intelligence*, by which these tools are classified. Humans are endowed with moral principles that discern right from wrong based on cognitive concepts dictated by upbringing and culture of reference. A generative AI follows the designer's programming and is not conscious of motivations or any consequences of what it generates. Some applications have already been criticized for creating stereotype-based images that risk fuelling misogynistic and racist behaviour. This is also why the AI Safety Summit, held in London in November 2023, outlined a common

strategy for all stakeholders to establish the ethical criteria and moral challenges posed by this technology.

3. The traditional concept of intellectual and/or artistic authorship is challenged: no longer a well-defined author, but a diffuse distribution of authorship, where both human and machine, including those who designed and trained it, participate in the result. On the one hand, there is the question of protecting authorial rights about the content used to train the algorithms. On the other hand, can the works produced by generative AI be protected by copyright?

The first question is the most complex, as it challenges the basic operating principle of neural networks: the need to use large amounts of existing data for training. At the writing of this paper (March 2024), the World Intellectual Property Organization is examining this issue, intending to establish regulatory principles. At the same time, many authorship rights holders, from image repository companies such as Getty Images through prominent newspaper publications to graphic designers, artists and photographers, have taken legal steps to protect their work.

Future research should study which operations of the design process can be delegated to machines, leaving designers to focus on highly creative activities. From this perspective, design becomes a matter of choice: machines produce countless variations, while humans choose according to their own visions and purposes.
This involves a shift from tactics to strategy (Picon, 2020), from how to why, ushering in a new way of understanding the profession, more akin to the role of curator rather than that of craftsperson.

## Acknowledgements

I would like to thank Marco Filippucci, researcher at the Department of Civil and Environmental Engineering, Università degli Studi di Perugia, who provided the Figure 2 images, a remarkable example of the Computational Design potential.

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# 7. Games as motivational triggers: features and issues

**Maresa Bertolo**

Despite being an intrinsic part of our human nature, games became an object of scientific study only in the second half of the 20th century, when research moved from only focussing on children's play and on specific titles (such as *Chess*, a game that is the topic of hundreds of books in itself) to the study of the multifaceted and complex relationship between human beings, play activities, and the artefacts allowing them. Among the several important changes the last decades have brought to Western societies, the significant spread of adult gaming stands out as the object of interest of scholars from several fields, and raises a series of issues contemporary Design has to take into consideration. The study of games and human behaviour together with experience in Game Design provides tools capable of motivating, capturing and fascinating players; such tools are nowadays at the disposal of designers from a variety of fields, from communication to products and services. We have access to methods and tools potentially capable of influencing users beyond their acknowledgment, prompting the need to get to know them and the ethical concerns they can raise, considering them with caution and awareness of the risks of misuse.

Recent social changes in Western society – increase in mobile devices and shifts in work habits to mention some – contribute to easing the widely held stigma of adults playing games. Games have become an important element of everyday life for a significant part of the Western population, to the extent that the 21st century is being referred to as the *Ludic Century* (Zimmerman, 2014).

In the discipline of Game Studies (Mäyrä, 2008) scholars from numerous and disparate fields dialogue with each other and with the designers who deal with the creation of games in the Game Design sub-branch.

Over an immeasurable period of time, games were born out of a continuous process of evolution, reaching us through mutations that were rarely documented and remain unknown; ancient games bring us testimonies and echoes of the cultures of origin to which they were closely linked: «the study of game origins remains important, not for the purpose of reconstructing history, but for the purpose of illustrating the continuity of human nature» (Avedon and Sutton-Smith, 1971, p. 161).

Theoretical and practical research during the 20th century explored games and gameplay, contributing to the rise in attention to and awareness of Game Design. Starting between 1960 and 1970, with the rapid expansion of videogames, Game Design has grown to become a discipline cognisant of its methods, tools, potentialities and criticalities, and capable of providing interpretative keys useful for contemporary research on social issues. An ethical dimension surfaces when looking at games as means for communication and persuasion in connection with results from cognitive and behavioural sciences. Designers would benefit from a better understanding of what Game Studies can reveal about motivation, communication, users' loyalty and even addiction.

To that end, it is necessary to understand what is meant by *game* and *play*, given the many lexical ambiguities accompanying such terms. Game Studies has dealt with shaping definitions for a couple of decades, several of which can be found in literature (Salen and Zimmerman, 2004; Juul 2005).

For the scope of this chapter, a suitable definition of *playing games* – be they digital, analogue, competitive, cooperative or other forms – is the one proposed by philosopher Bernard Suits ([1978]

2005): «playing a game is the voluntary attempt to overcome unnecessary obstacles» (p. 55). Such obstacles are defined by the rules of the game with the goal of preventing players from using the most effective and efficient means to achieve ludic goals; this therefore results in stimulating inventive creativity and strategic-tactical skills. The game of *Golf* is a useful example for understanding the concept. *Golf* players have the goal of inserting a small ball into a specific hole in the ground. Rules require this to be done by launching the ball while being at a large distance from the hole – often even without direct sight – and by hitting it in a certain way with a specific kind of club. Rules, therefore, impose limitations to actions: the most efficient method to achieve the ball-in-the-hole goal would be to go to the hole and manually insert the ball in it, but by doing so players would not be respecting the rules and therefore would not actually be playing *Golf*. Limitations to action are in fact *obstacles*, as in the definition above; players decide to submit themselves to such limitations because otherwise they could not play.

The core of a game is its ruleset, which limits players' freedom of action, but that is not enough to define what a game is. A game can be considered as an artefact composed of several elements, which are well outlined by the *Elemental Tetrad* proposed by designer Jesse Schell (2008, p. 41). According to this representation system the structure of a game is made of four components: *aesthetic* (what is perceived through the senses); *narratives* (the story and narrative elements); *technologies* (the tools and materials used for its creation and functioning); and – the most interesting for the chapter – *mechanics*. The restrictions on players' freedom –rules of the game – define which actions are allowed while playing, and mechanics constitute the complexity of allowed actions, possibilities and variables composing the procedural dimension of the game, i.e., its essence. Taking inspiration from the work of designers Geoffrey Engelstein and Isaac Shalev (2020), who collected and described more than two hundred board-game mechanics, we can abstract the concept, separating it from specific types of playful artefacts: *mechanics are the building blocks of a game*.

They also contribute in different ways to players' motivation in playing a game and are a central element for the discourse on con-

temporary connection between games, life and habits.
It is nowadays established in Game Studies that the rules of a game and their implementations as mechanics constitute a powerful motivational engine that can be effective in different ways.
Two are of notable interest from the perspective of the design field: the meaningfulness of procedural rhetoric (especially in a specific kind of games designed to foster change); and the effectiveness of mechanics based on human features such as physiological responses and biases with the issues it raises.

## 7.1 Meaningfulness of procedural rhetoric

Games have a specific and characterising factor that is missing in traditional communication media: actual *interactivity* (Ryan, 2006; Bogost, 2007; Crawford, 2013). During the playful experience players must interpret, analyse and evaluate elements, states and circumstances in order to establish the most effective actions (among those allowed by rules) for best achieving the ludic objective. Players take tactical-strategic decisions and act on them. Game designers establish framework and conditions for game events to potentially happen, but these can occur by virtue of players' actions alone. If no one plays a game, none of the designed events ever happen. Whoever plays is thus personally responsible – given the designed game – for the outcomes of the experience, which results in being characterised by a sense of extreme involvement making it stand out in comparison with experiences generated by non-interactive works.

Games employ traditional rhetorical systems such as texts, sounds or images, but they also work through a special interactive rhetorical system called *procedural rhetoric* (Bogost, 2007).
The set of possible actions that can occur in a game can be seen as a set of *possible procedures* defined by the rules to be followed to reach the game goal.

Games can express meaning not only through texts or images but also and especially through the actions – the procedures – they allow players to perform.
This peculiar rhetoric has been explored during the recent decades,

to understand how it works and can be fully employed. Among these research cases, Games for Change (G4Cs) are the most interesting ones for designers: they are games designed not only to be good and fun-to-play, but also to be capable of fostering attitudes and awareness towards critical topics of social relevance; soliciting a change of perspective or habits in players; fostering new points of view and inviting reflection on specific topics; and encouraging a growth in awareness, to facilitate dialogue among diversities (Isbister, 2017; Bertolo, 2022).

To understand how G4Cs work it is necessary to look at the transformative features of game experience. Since the first years of the current century, Game Studies scholars and researchers have been exploring the several ways games can act as change triggers (Salen and Zimmerman, 2004; Bogost, 2007; Flanagan, 2009; Bertolo and Mariani, 2014; Isbister, 2017; Antonacci, 2020; Antonacci and Bertolo, 2022). Play activity is and has been part of every human society, intertwined with rites and cultural elements. Historical, anthropological and sociological research agree on games having an important role in the various human cultures of the past. They have served a sacred function, important both for individuals and for communities; a biological function; and in the meaning they contain and carry, the spiritual and social bonds they can create, as observed in 1938 by Johan Huizinga in his seminal work, *Homo Ludens*, considered to be the starting point for the Game Studies discipline. By taking part in games, players among human societies have been unifying factors of their community, and participating in transmitting and keeping alive a sense of continuity and belonging. It was only during the changing times of the Industrial Revolution that playing games, emptied of collective and shared meaning, was relegated to childhood and considered a waste of time when practised by adults. Such diminishing notion has been fading out since the second half of the 20$^{th}$ century, thanks to a complex of social and economic changes including reduced working hours; the emergence of the videogame industry; and the spread of computers and mobile devices (Juul, 2010).

Research in fields such as anthropology, psychology, sociology, pedagogy, and Game Studies confirms that playing games can contribute in communicating shared values and ideas, and that, through

games, it is possible to transmit information, contribute to teaching processes, and foster change. Such a proficiency is connected to the structural similarities games share with rites, in particular with rites of passage (Huizinga, 1938; Turner, 1982; Van Gennep, [1909] 2019). In games and in rites of passage, participants enter a three-step process which temporarily suspends them from reality. Ordinary rules and roles are suspended at the beginning of the game or the rite, to be substituted by those of the gameplay/rite, and then to be returned to normality when the experience ends – a normality now enriched by the memory of what participants have been through. Such three-step structure can be observed in other activities, such as in reading novels, watching movies or attending shows. Games, however, thanks to their interactive features, can directly and personally involve players, leading to a feeling of personal responsibility in regards of play events and outcomes, as described above. At the end of the play experience, players return to reality, but they carry over the memory, not only of watching events but also – and especially – of having taken an active part in making them happen. This intensifies the efficacy of games as mediums of communication and transformation. Contemporary research on games refers to this phenomenon by viewing games as a medium capable of giving players occasions for practising their *agency* (Nguyen, 2020; Ciancia, Piredda, Bertolo, 2024).

When entering into a game of any kind, a person cannot be considered a neutral, detached and impartial being. Players bring into play a system composed of their own character, the memory of previous experiences, and most importantly their own moral and ethical values (Sicart, 2009). It is through this complex and extremely personally unique system that they would accept or refuse to act in the game – because, as previously said, to play is a free and voluntary activity which cannot be forced – and interpret its contents and rhetoric. Additionally, when players suspect or realise that an attempt is being made to change their mind on any subject, they are very likely to react by actively resisting.

In accord with these observations, research has shown that the *invitation to play* can be difficult for G4Cs. Not only do players meet the game through the lens of their personal ethics and values, but they are also unlikely to be tempted to play if the experience is going

to tackle sensitive and problematic issues or even attempt to somehow change their minds. There is an evident contradiction between critical topics usually treated by G4Cs and the desire to have fun and get away from reality which characterises the interest towards the play experience (Fink, 1968).

To design a game capable of reaching players with a goal of meaningful change in habits or awareness it is necessary to consider such criticalities. The *embedded design approach* (Flanagan and Kaufman, 2015) has been proven to be extremely effective in this purpose: game elements related to critical topics can be mixed with less sensitive ones, distracting players' attention from the game goal or making it more approachable; or metaphors can be used to mask the actual game contents during gameplay.

The design of a game requires more than the usual competences designers possess: designers usually work to make users more at ease, to facilitate their usage of systems, objects and tools, while *game* designers have to make users' experience difficult, to create obstacles that are balanced to be challenging enough, but not too much.

When the game is a G4C, as seen, designers must also be aware of an additional set of issues, criticalities, tools and procedures. Finally, it is not enough to evaluate a G4C by observing that it's fun and players liked it. To make sure that it is working as an agent of change and fulfilling its goal, it is also necessary to evaluate its efficacy by observing the experience; evaluating players before and after gameplay; asking them to fill in questionnaires; interviewing them; and, in general, using experience evaluation tools (Isbister and Schaffer, 2008).

To briefly summarise, the whole process of designing a G4C requires:

- a precise definition and understanding of the goals and topics it addresses;
- a clear identification of the intended target, which has to be described not only by the usual user-centred-design means, but also by games-related profiling tools;
- the knowledge of normal Game Design methods and of those typical of Games for Change;
- the creation of the game, through the iterative process of play-testing a prototype and applying changes accordingly to the test results;

- the design of the efficacy evaluation protocol and system, and the training of individuals who would put those in practice before, during, and after gameplay;
- the analysis of the collected data and information.

## 7.2 Effectiveness of mechanics based on human features

Observation of how games and G4Cs function helped to identify several mechanics and specific systems capable of effectively involving and motivating players. Results obtained by G4C research and Game Design experiences are nowadays being paired with findings from cognitive and behavioural sciences revealing several mechanisms guiding the way we think and make decisions (Kahneman, 2011; Wendel, 2020), making it possible to create more effective communication and motivation artefacts through a number of design techniques; to explore them all is outside the scope of this chapter, and three of them are described here as representative examples.

The play experience has an important place in the well-known work of psychologist Mihaly Csíkszentmihályi, who in the 1970s set up a research group to verify under which conditions people declaring themselves satisfied with their lives would perceive well-being and happiness (Csíkszentmihályi, 1990). An interesting aspect of his discoveries is that such perception does not depend on *exogenous* factors, such as wealth, type of work, etc. but is instead related to the ability of autonomously (in game terms: *voluntarily*) involving oneself in exciting and immersive activities of various kinds. Results show that significant recurrences emerge around specific conditions allowing or facilitating access to an *optimal state* of experience, also known as *flux*: a feeling of focus in an activity, with high levels of enjoyment. Such a state is more easily reached when the activity: i. has clear goals; ii. provides feedback to actions; and iii. remains challenging. Such conditions are easily found in several human activities, including gameplay, and are incorporated into normal good game design process. As thrilling as these results can be, they should be closely examined by the design community. The state of flow is extremely

enjoyable and the conditions facilitating it are known, and easy to design and include in games and other kinds of interactive systems. However, when this happens, artefacts can result in the misuse of research results to captivate users and induce them to spend in such systems more and more time – and money (Soderman, 2021; Antonacci and Tubaro, 2022).

A second example of how psychology and neuroscience join design in the association among game rules, mechanics and players' motivation is in the *challenge-satisfaction cycle*. When a person undertakes to face obstacles that are difficult enough to create a challenge but not so difficult as to be insurmountable (as it is the case in games that are designed that way) and succeeds in the task, their body generates substances providing a pleasant sensation of satisfaction (Koster, 2005; McGonigal, 2011).
According to game scholar Raph Koster, the fun of playing games can in fact be traced back to a physiologic gratification mechanism which, over the course of evolution, has been developed as a reaction to the risks of facing real challenges. Instead of (or in addition to) getting scared and giving up when facing obstacles, we also experience the expectation of the gratification we know, by experience, we will feel once we have overcome them.
Gratification in games can occur in several forms, and the challenge-satisfaction cycle is easily exported into non-playful artefacts as a means of motivation.

The third example is the phenomenon of *loss aversion*: «the prospect of losing something weighs more heavily in our decision-making than the prospect of gaining something» (Engelstein, 2020, p. 6). Loss aversion is a profound aspect of human psychology, widely employed in games to lead players during their decision-making process, often in situations connected with the monetizing system.

These and several other structures of the ways we think and operate have been largely used in ludic artefacts over previous decades, somehow making games a powerful testing system to evaluate their efficacy and reason on how to apply them in non-play situations. *Gamification* (Zichermann and Cunningham, 2011), the practice of using motivational triggers and mechanisms affecting decision-making in settings such as work environments and com-

merce, is nowadays firmly established and widely in use.
In conclusion, the study of games provides scientific evidence of how play experience and its mechanics can be a stimulus for change and has the power to motivate players. In combination with the results from cognitive and behavioural science reveals how the psychological mechanisms underlying human decision-making and motivation can be put to work and directed. Knowledge of these results is crucial both for those who play and for those who design.

Today's designers have at their disposal methods and tools that make them capable of influencing users even beyond their acknowledgment, a capability which must be considered with caution as it raises significant ethical concerns (Walz and Deterding, 2014; Soderman, 2021; Hon, 2022). The first step towards using such results appropriately in design is in gaining knowledge of how they work and of the potential risk of misuse.

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# 8. The mutual impact of contemporary challenges and design transitions: perspectives on product development

Silvia D. Ferraris

The brief history of industrial design has witnessed several turns during its evolution. A long time has passed since design was about finding the correct language for machine-made mass products, and balancing the form with the function. In those times, the debate was about the role of designers in a world that was optimistic about progress and keen to believe the most significant design impact would be to drive innovation. In a few decades, design gained world-wide recognition for its effectiveness in helping businesses succeed by interpreting new technology in user-friendly ways, adding value, and successfully communicating it. During this time, designers and researchers made efforts to represent the process applied in design to develop new products, and such representations helped define the discipline approach, reflect on it, and explain it to others. These efforts evolved and diversified into many versions, but today, no single scheme is agreed upon and shared by the design community. Yet, looking at their evolution, it is possible to see how they developed with the discipline and adapted to change. Indeed, designers widened their work's scope and started to question its meaning and impact on

a larger scale, involving people and communities, aiming at social innovation, setting sustainable goals, and transitioning into new design approaches. While the awareness of being part of a larger scheme is not new, the urgency of today's challenges is affecting he whole design community. From this perspective, the design process should reflect the mutual impact of contemporary challenges and design transitions. This paper describes an overview of the design process representations from an evolutionary perspective, focussing on product development. An insight into the phases of the design process is offered to see where the newest technologies – AI in particular – are merging with design and, possibly, collaborating through the transition.

## 8.1 The evolution of design process models

While the history of industrial design goes back to the development of new skills and professions necessitated by the Industrial Revolution, design as an academic discipline has gained recognition in the last 50 years. To reach such a step, scholars researched and developed concepts of design methodology to formalise industrial design into a scientific discipline (Archer, 1979; Cross *et al*., 1981; Schön, 1983; Bürdek, 2005). One of the outcomes was to represent and formalise the industrial design approach into a model of its process, as by Archer (1968), Schön (1983), Bathany (1996), Valkenburg and Dorst (1998), and Cross (2000), to mention a few. The references can be traced back to the '60s when several models were created. The first model series referred to the product development process typical of industrial manufacturing companies. These were derived from engineering models and presented a structure of consecutive phases, passing through which it was possible to make a new industrial product.

Later, design started to widen its application field, including areas such as human-computer interaction, business strategies, private and public services, and new approaches such as user-centred design and participatory design. The representation of the design process started to emphasise the iterations of the design phases – by cyclical structures and extra phases.
Also, starting in the '90s, design organisations and design consult-

ants mainly developed their representations to explain what design is, what value would be added to a company's business, and what outcomes to expect. Some of those models have also been adopted primarily in the academic context, such as the Double Dimond by the Design Council (2004) and others by the design consultants IDEO (2008, 2012) and Frog (Bobbe *et al*., 2016).

The literature review shows that a tension exists between analysis and synthesis in all models. In various models, analysis involves breaking the problem into parts – a divergent process of dividing it into sub-problems. Meanwhile, synthesis entails reassembling these parts in a new way – a convergent process that moves from details to the general (Cross, 1984; Banathy, 1996). However, this can also be the opposite, where analysis leads to agreement and convergence, while synthesis is developed into greater detail and divergence. Nigel Cross (2021) suggests that the design process is predominantly convergent but punctuated by periods of divergence. One interesting notion is that researchers applying a scientific process separate analysis from synthesis, while several design models merge analysis with synthesis since designers tend to diverge and reframe problems while solving them (Akin, 1986; Dubberly, 2004).

The academic debate about design processes is lively and demonstrates a considerable interest. In this chapter, a limited collection of the models is organised as a timeline (Figure 1). The formation of the timeline is based on the literature review, in which three publications were instrumental: Dubberly's (2004) collection of over 100 models developed from 1964 to 2004; the comparison of design process models from academic theory and professional practice (Bobbe *et al*., 2016); and a study of models as metaphors in the educational context (Bravo and Bohemia, 2021). The scope of the timeline is not to present a complete list but to show a selection representing the main aspects of the evolutionary path of design process models.

Dubberly's collection clusters the models in *Academics Consultant*, *Software development*, *Complex linear models*, and *Cyclic models*; thus, it mixes the context of development (academic consultant, etc.) with the structure (linear, cyclic, etc.). Such an approach does not facilitate the generalisation of understanding, although the collected works are rich and valuable for anyone approaching the subject.

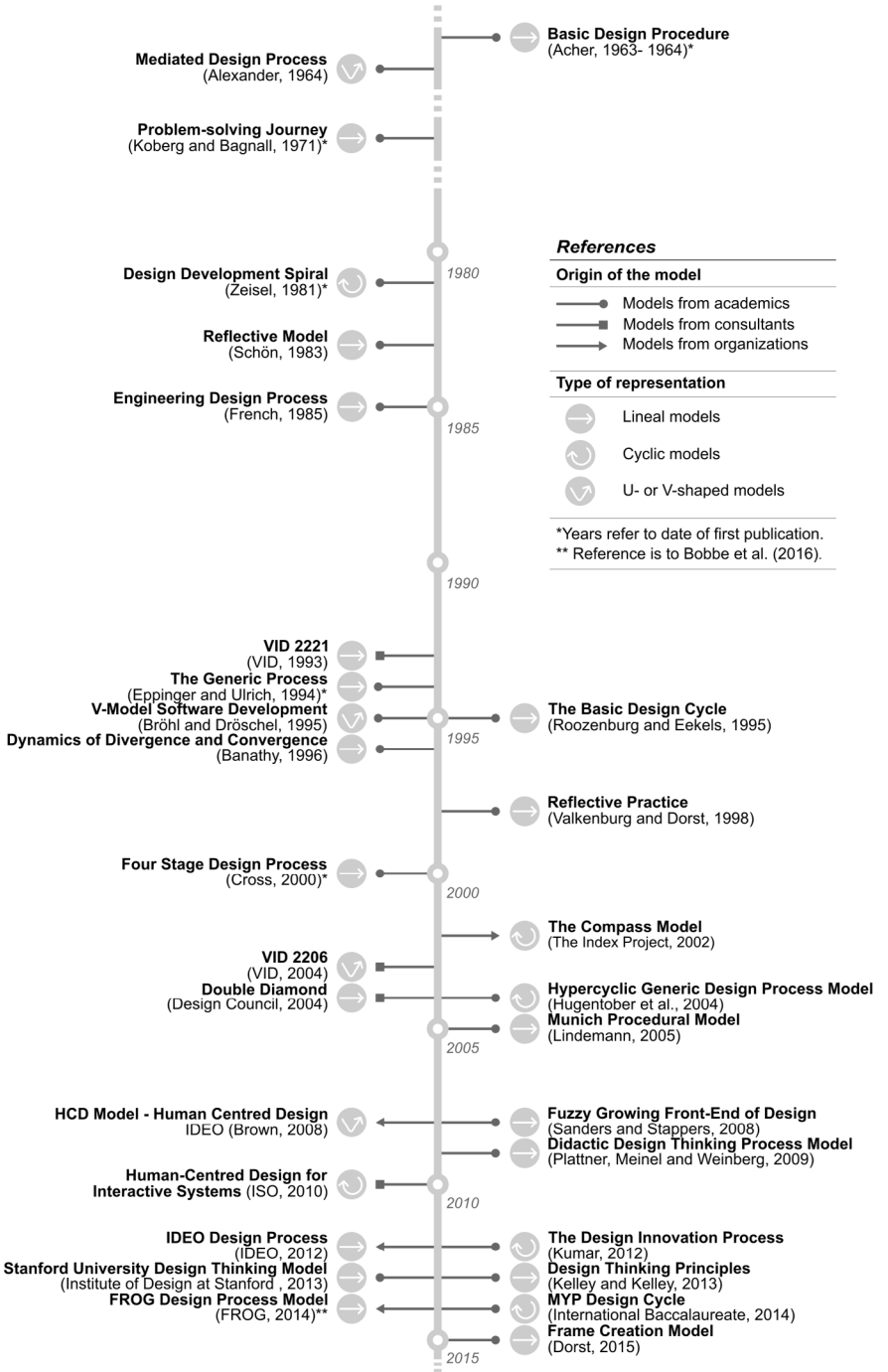


Figure 1.
Timeline of design process models.

Bobbe, Krzywinski, and Woelfel (2016) aimed to identify a typical structure from different design process models focussing on industrial and engineering design and comparing models from academia, professional organisations, and design consultants. This way, they point out the heterogeneous input and interest in the subject. Such a different origin is highlighted in the timeline, too. The study of Bravo and Bohemia develops metaphors to explore the models and their use in design education. However, this chapter focusses on their collection of models rather than on the metaphors, cf. 8.2.

By looking at the evolution of the models, it is possible to notice that there are common structures and graphical notations as described below.

The first generation, prominent until the 2000s, was characterised by linear and rational models, often represented as mathematical procedures. These models involved an input, a transformation process, and an output. Over time, these processes became more detailed, adding phases and associating them with activities and methods. These processes emphasise progression and incorporate phases that might be iterative but subordinate.

In other cases, linear models are shaped into V or U models where the phases follow a path with the form of such letters. They highlight the iteration among phases of the two sides of the process (i.e., VDI 2004).

Later, circular or cyclic models were developed for human-centred design for interactive systems (i.e., ISO 2010) and spread to other fields. Cyclic representations emphasise the iterative nature of design processes.

Similarly, spiral models are like cyclic models, where the process repeats a series of activities at different levels of the design process, showing a progression. Both cyclic and spiral models highlight the presence of feedback loops, tests, and evaluation phases that aim to improve the result. Although some of these models appeared in early design history, most were developed from the '90s and flourished in the early 2000s.

Nevertheless, it must be noted that the development of new structures does not imply the disappearance of previous ones. Indeed, most new models are still linear with extra details, such as steps, gates, etc.

In the timeline, design organisation and consultant models started to be formalised in the '00s, when academic ones also increased – this progression and increase of models aligned with design developing as a practice and discipline. On the one hand, it highlights the professionals' need to communicate their expertise to stakeholders involved in the process. On the other hand, it shows the scholars' work in developing synthetic representations that are useful in education and research. Furthermore, the specialisation of models such as *human-centred design*, *design thinking*, or *service design* models, highlights the developing of new areas of design application in line with the evolution of the discipline.

Indeed, while design process models in academia focus on formulating, validating, and assisting students in understanding the design process and guiding them through the project, changes in business organisations and services offered by companies have led to the creation of models to communicate and illustrate their approaches:

> **[…] As a recent phenomenon, many design studios changed their operative scope to full-service from analysis and ideation to detailing, modelling and production planning, at the same time offering hardware, software and service design from a single provider. Since the portfolio of these companies has diversified, it becomes relevant to explain the competencies and practices (Bobbe *et al*., 2016, p. 1206).**

A further in-depth survey would be necessary to validate the timeline, which suggests some preliminary observations: in the last decade, no new models have reached widespread popularity, and those that are available do not have specific new features to face today's challenges. These traits might depend on whether the timeline collects product/industrial design process models or does not analyse them in depth. So, further investigation could be conducted in other design domains, or the selected models could be examined more deeply. In this chapter, the second approach is presented, along with a description of the phases of the design processes. Such a study allowed a comparison of the models beyond their structures (linear, cyclic, etc.).

## 8.2 The phases of design process models

Looking at the design process models in detail, it is clear that all of them are articulated in phases that represent a progression, sometimes including loops, gates, and dynamically diverging and converging phases. However, even if those phases are organised in different structures (linear, cyclic, etc.), they can all be reconstructed into a linear sequence of four/five phases. Indeed, Bobbe, Krzywinski, and Woelfel (2016) compared a set of process models based on a linear reference structure. They fit fifteen models (4 by academics, 5 by organisations, 6 from consultants) in a linear sequence of five phases: Analyse, Define, Design, Finalise and Implement. From their reading, all design process models appear to have at least the first four steps in common. Indeed, those that do not need to include the Implementation phase are mostly academic ones. Bravo and Bohemia (2021) also analysed ten design process models and synthesised them in four phases: Observe, Interpret, Ideate/explore, and Implement. In their study, they focussed on the adaptation of the models in design education. For that context, they added two subsequent phases: Evaluate/Improve and Share.

The two systems are shown in Table 1. The naming might be confusing; for instance, *implement* appears in the fourth and third phases. Different names are given to phases with similar activities in the process. For clarity, a renaming for the four phases is proposed:

1. The Research phase includes all designers' activities to understand the user and context. Here, designers are *observers*. It is a divergent phase aimed at gathering data, understanding the users, and discovering new paths.
2. The Definition phase requires analysis and synthesis of the collected information to formulate a design proposal. In this case, designers are *interpreters*. Here, the methods enable convergence toward a solution.
3. In the Development phase, designers ideate several solutions and test them in a very iterative process that diverges again from the design definition towards many possibilities. Here, designers are *creators*.
4. In the Delivery phase, designers converge on a final design

and detail it for realization. Here, synthesis is where designers are *achievers*, using methods and tools to make their ideas real.

The synthetic list of phases represents the essence of the design process: a path to find innovative solutions through a series of activities that inform and activate the following ones until reaching the realisation. The design models are valuable tools for communicating among people of the same community to be aligned on their work, to communicate to others the role of design, and to teach students different design approaches.

Such a synthetic representation of the design process helps take an extra step in the analysis. That is, to investigate the consolidated methods used in each phase by designers to reach their goal and check for new contemporary methods that represent the latest way designers are tackling today's challenges.

| ***Phases*** | **1.** | **2.** | **3.** | **4.** | **5.** | **6.** |
|---|---|---|---|---|---|---|
| Bobbe et al. (2016) | Analyse | Define | Design | Finalise | Implement | |
| Bravo and Bohemia (2021) | Observe | Interpret | Ideate/ Explore | Implement | Evaluate/ Improve | Share |
| Proposed naming | **Research** | **Definition** | **Development** | **Deliver** | | |

Table 1.
Synthesis of the list of phases.

## 8.3 The methods used in phases of product design

From the literature review, a limited selection of references focussed on product development. The methods mentioned by four authors were collected (Kumar, 2012; Ulrich and Eppinger, 2016; Cross, 2021, Isgrò, 2021) and organised in the four phases of the design process (Table 2). Each author presents a similar distribution of methods across the various stages. In the table the methods are distributed among the four phases and clustered by scope (observation, user, research, context research, mapping, definition, idea generation, project representation, project development evaluation, and communication).

Looking through the list of methods, a few aspects of each phase are of particular notice.

The Research phase presents the most significant number of methods. This stage supports analysis and has a divergent nature that contains methods adopted and adapted from other disciplines, such as ethnographic interviews, focus groups, SWOT analysis, etc.

The Definition phase synthesises the previous research and thus focusses on analysing user research (personas, profiles, user journeys, etc.); mapping (includes matrixes and maps that facilitate decision-making); and defining (consists of all methods to converge towards a design brief).

The Development phase emphasises idea generation and project development while including some evaluation and communication methods. Here are the most typical methods of design, such as brainstorming, concept generation, prototyping and storyboards.

The Delivery phase is the least extensive in terms of the number of methods used. It focusses mainly on project development but also includes communication and evaluation.

Table 2 shows a decrease in the number of methods as the process progresses, with only a few methods for the Delivery phase. Therefore, as the design process progresses and converges, the diversity in methods also decreases.

In general, this list of methods shows the significant presence of tools for in-depth research that enable the users in the process and a mix of qualitative and quantitative data to be considered. Also, it shows how designers offer a large amount of expertise in areas ranging from analysis and creation to detailing, modelling, and production planning.

The collection of consolidated methods shows a lack of methods conceived to directly tackle today's complex and wicked problems. Most likely, it is necessary to step beyond this design area to find insights and proposals on the subject (cf. 8.5).

On the other hand, product design evolves with technological advancements, which influence how products are designed and manufactured, and includes updated tools and methods in the process. For instance, computer-aided programmes optimise many steps of the process and enable previously impossible shapes. Then, additive manufacturing techniques accelerate the process by anticipating the testing by working prototypes and, again, allowing new shapes

that were previously impossible to make. Now, we are living with the advent of Artificial Intelligence and discovering what to do with it as it happens. Looking at it from an optimistic perspective, AI-enabled research and design methods might support the transition designers must make to tackle today's contemporary challenges. That is why understanding where AI will intervene in the design process is essential and must be widely investigated. This chapter provides insight into how AI-based methods (later called *tools*) are used in the design process phases from an evolutionary perspective in product development.

## 8.4 AI presence in product design process phases

Presented here are state-of-the-art AI-based tools mapped and organised in a four-phase design process (Isgrò *et al*., 2021) that has been recently updated (Croce, 2024). Although both studies offer interesting insights into how AI is being adopted in the design process, the focus here is limited to the number of methods and their distribution in the process.

Table 3 (Isgrò *et al*., 2021) maps the collected 37 tools, divided into two categories depending on the level of development: still in the research or prototype phase (29) or commercially available (8).

Table 4 (Croce, 2024) shows 66 commercially available tools. Some of these represent the evolution of tools still in their prototype phase in 2021.

Such a greatly increased number of tools to appear on the market in only a few years shows a massive implementation of AI in design. Also, from a comparison of the tables, it is noticeable that while most of the tools were used for the development phase, they are now largely present in the research and delivery phases.

The design process evolves quickly by adopting new methods (tools) in each phase. This phenomenon is ongoing, and extra study will be required to evaluate the mutual impact of AI-enabled methods in design practice and discipline. So far, AI appears to be blending into the typical design process model without the development of new models.

| *Research* | *Definition* | *Development* | *Delivery* |
|---|---|---|---|
| **Observation** | | | |
| Field Visit | Observations to Insights | | |
| Video Ethnography | Focus Group | | |
| User Pictures Interview | | | |
| Experience Simulation | | | |
| Field Activity | | | |
| Observing product in use | | | |
| Etnography | | | |
| Shadowing | | | |
| Task Analysis | | | |
| People Objects | | | |
| Environments Menssages | | | |
| Services | | | |
| **User research** | | | |
| User scenarios | User profiles | | |
| User trip | Personas | | |
| Interest Groups | User Observations | | |
| Discussion | Database | | |
| Questionnaire | User Response Analysis | | |
| Research Participant Map | User Observation | | |
| Research Planning Survey | Database Queries | | |
| Focus group | Compelling Experience | | |
| Observe users in action | Map | | |
| Five Human Factors | Semantic Profile | | |
| Ethnographic Interview | User Groups Definition | | |
| Cultural Artifacts | User Journey Map | | |
| Image Sorting | Persona Definition | | |
| Remote Research | Customer Statements | | |
| Study Customers | Focus Group | | |
| Interview | | | |
| User Diaries | | | |
| Being your user | | | |
| Personas | | | |
| Empathy Map | | | |
| **Context research** | | | |
| Buzz Reports | | | |
| Popular Media Scan | | | |
| Key Facts | | | |
| Trends Expert Interview | | | |
| Keyword Bibliometrics | | | |
| Popular Media Search | | | |
| Publications Research | | | |
| Analogous Models | | | |
| Industry Diagnostics | | | |
| Consider Implications of Trends | | | |
| Imitate, but Better | | | |
| Product Segment Map | | | |
| Quantitative Surveys | | | |
| Trend Analysis | | | |
| Technology Research | | | |
| Historical Analysis | | | |

| *Research* | *Definition* | *Development* | *Delivery* |
|---|---|---|---|
| **Mapping** | | | |
| Innovation Sourcebook | Function analysis | | |
| Value engineering | Trends Matrix | | |
| Ten Types of Innovation Framework | Convergence Map | | |
| | Initial Opportunity Map | | |
| Innovation Landscape | Offering-Activity-Culture Map | | |
| Eras Map | | | |
| Innovation Evolution Map | Insights Sorting | | |
| Financial Profile | ERAF Systems Diagram | | |
| Competitors | Entities Position Map | | |
| Complementors Map | Costumer Journey Map | | |
| Ten Types of Innovation Diagnostics | Symmetric Clustering Matrix | | |
| Contextual Research Plan | Asymmetric Clustering Matrix | | |
| Information Maps | | | |
| Product–Process Change Matrix | Tree/Semi-Lattice Diagramming | | |
| Technology Roadmap | Activity Network | | |
| User Research Plan | Insights Clustering Matrix | | |
| Mind Maps | Summary Framework | | |
| | Needs Statements | | |
| | Descriptive Value Web | | |
| | Venn Diagramming | | |
| | **Definition** | | |
| | Objective tree | | |
| | Performance specification | | |
| | Quality Function Deployment | | |
| | Design brief | | |
| | Intent Statement | | |
| | Value Hypothesis | | |
| | Mission Statements | | |
| | Target Specifications | | |
| | Costumer Requirements | | |
| | Design Specifications | | |
| **Idea Generation** | | | |
| From...To Exploration | Opportunity Mind Map | Brainstorming | |
| Compile Bug Lists | | Synectics | |
| Follow a Personal Passion | | Enlarging the search space | |
| Brainstorming | | | |
| Pull Opportunities from Capabilities | | Concept Metaphors and Analogies | |
| Mine Your Sources | | Ideation Session | |
| | | Morphological chart | |
| | | Role-Play Ideation | |
| | | Ideation Game | |
| | | Puppet Scenario | |
| | | Foresight Scenario | |
| | | Synthesis Workshop | |
| | | Concept Generation | |
| | | Moodboards | |
| | | Visual and semantic confrontations | |

| *Research* | *Definition* | *Development* | *Delivery* |
|---|---|---|---|
| | **Project representation** | | |
| Fast visualization | | Concept Prototype<br>Concept Sketch<br>Concept Scenarios<br>Partial/Full Product Representation | |
| | **Project development** | | |
| | Design Principles Generation<br>Analysis Workshop<br>Principles to Opportunities<br>Project Refinement<br>Project Managment<br>Project Spin-off<br>Initial Technological Approach | Establishing the Architecture<br>Concept Sorting<br>Concept Grouping Matrix<br>Morphological Synthesis<br>Prescriptive Value Web<br>Concept-Linking Map<br>Final Specifications<br>Behavioural Prototype<br>Physical Prototyping<br>Rapid Prototyping<br>Multidisciplinary work<br>Review and improvement<br>Morphological Analysis | Solution Roadmap<br>Material Selection<br>Strategy Roadmap<br>Platform Plan<br>Product Life Cycle<br>Strategy Plan Workshop<br>Implementation Plan<br>Competencies Plan<br>Team Formation Plan<br>Performance Capabilities<br>Related System-Level Design Issues |
| | **Evaluation** | | |
| SWOT Analysis<br>Workshops with “multivoting”<br>Web-based surveys<br>Real-Win-Worth-it (RWW) Criteria<br>Evaluating Fundamentally New Product Opportunities | Assessment Criteria<br>Information Analysis<br>Modeling and Simulation | Weighted objectives<br>Concept-Generating Matrix<br>Concept Evaluation<br>Solution Prototype<br>Solution Evaluation<br>Screening matrix<br>Concept Screening<br>Concept Scoring<br>Concept Testing<br>Design Assumptions Check | Feedback loops<br>Pilot Development and Testing<br>Learning Experiences<br>Product Performance Criteria |
| | **Communication** | | |
| Storytelling | Reflect on the Results and the Process<br>Scenarios | Concept Catalog<br>Solution Diagramming<br>Solution Storyboard<br>Solution Enactment<br>Solution Database<br>Storyboard | Vision Statement<br>Innovation Brief<br>Storytelling<br>Launch of outcome |

Table 2.
Design Methods organised in the four phases of the Design Process.

The list of tools shows that only one (n. 66) responds to the new challenges. It can assist the designers in their decision-making to choose environmentally benign design parameters for products. Based on an Artificial Neural Network (ANN) model, it takes life-cycle design parameters (i.e., size of product, density of material, manufacturing process, transport mode, and recyclability) as inputs. It provides the corresponding outputs regarding a product's *carbon footprint* and *life cycle cost* (Singh and Sarkar, 2023).

Thus, it appears that the integration of AI is limited to improving design methods and does not support product designers in facing contemporary challenges.

## 8.5 Further developments

The overview of the design process models highlights that although different people developed new models during the past 50 years, they all have similar structures describable by a progression of typically four phases.

Also, the timeline shows that no new models have been broadly shared in the design community in the past decades if looking for product design processes. Only a detailed analysis of the process phases and methods showed innovative features. Indeed, it was possible to find, for example, only one the application of a new tool that integrates the Development phase, supporting the transitions toward sustainability. Such a study indicates one path for design processes and contemporary challenges to develop from mutual interaction.

Nevertheless, more extensive research could be necessary since the focus on the product design domain produced a collection of models not explicitly featured to tackle contemporary complex and wicked problems. However, such an investigation might still not be sufficient. Indeed, some scholars point out that:

> **Traditional design approaches […] were inadequate for addressing this class of problem. […] Areas of design focus such as service design, experience design, design for social innovation, deep design, meta-design, and various ecological and sustainable**


Table 3.
AI-based tools in the design process (adapted from Isgrò *et al*., 2021).

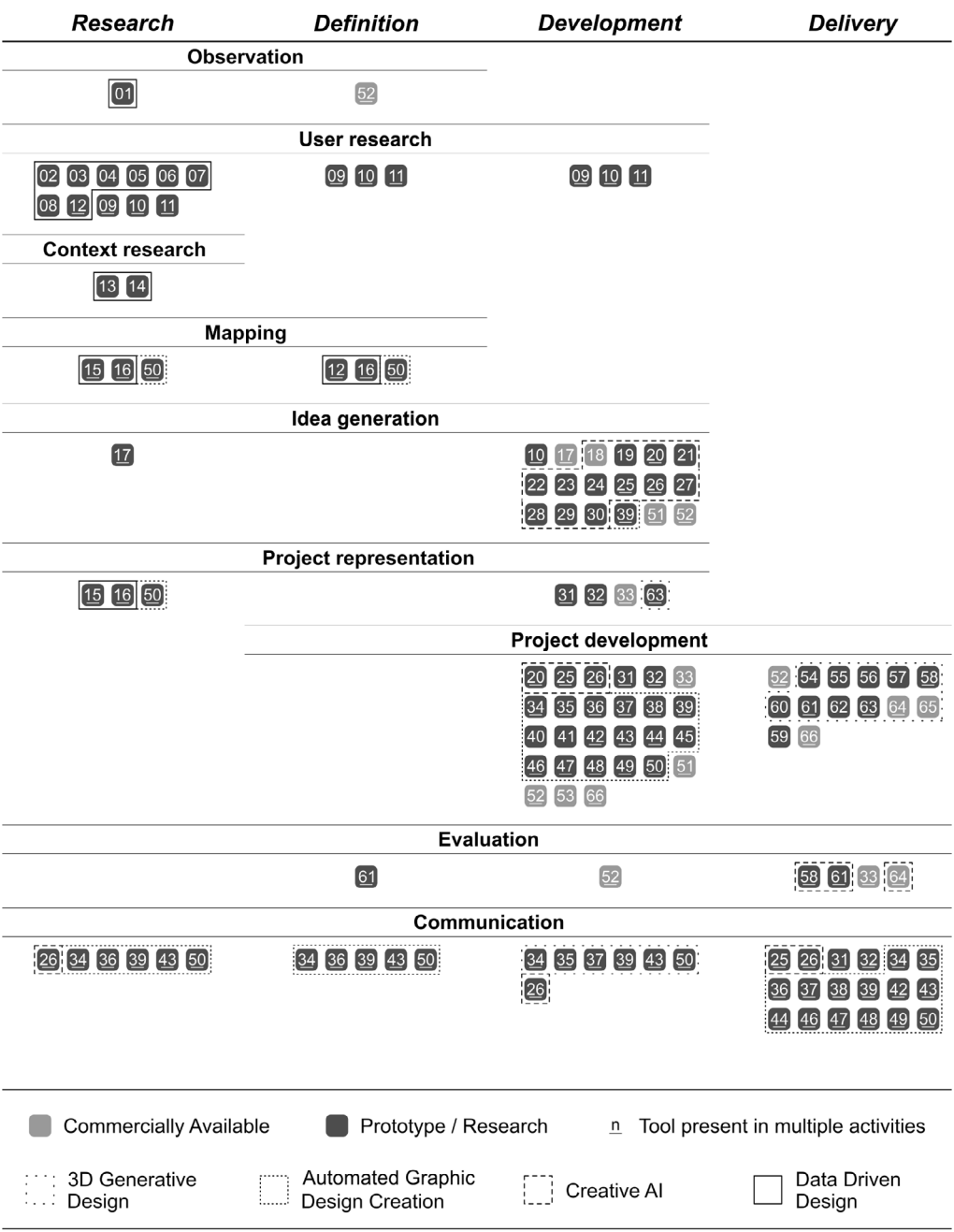


Table 4.
Updated AI-based tools in the design process (adapted from Croce, 2024).

### Data Research Analysis

1. Tableau AI
2. DataRobot
3. Determ
4. Brandwatch
5. Chattermill
6. ATLAS.ti
7. Birdeye
8. Brand24
9. Replika
10. Chat GPT
11. Synthetic Users
12. QoQo
13. Crayon
14. YouScan
15. Piktochart
16. Kroma
17. Miro Assist

### Creative AI

18. Collaborative Ideation Partner (CIP)
19. Stable Diffusion
20. Midjourney
21. DALL-E
22. Microsoft Bing image creator (Designer)
23. Jasper.ai
24. Leonardo.Ai
25. BlueWillow
26. Let's Enhance
27. Artiphoria.ai
28. AutoDraw
29. Vizcom
30. Prome AI
31. Magic studio
32. Flair
33. Towards a Co-creative System for Creating, Suggesting, and Assessing Material Textures for 3D Renderings During Design Reviews in Industrial Design

### Graphic Design Tools

34. Adobe Firefly
35. Adobe Sensei
36. Remove.bg
37. Movavi
38. Fronty
39. Walling
40. Canva
41. Designs.ai
42. Adobe Express
43. Visme
44. Sketch2Code
45. Deep art Effetcs
46. Uizard
47. Fontjoy
48. Looka
49. Decktopus
50. Figma
51. A Predictive and Generative Design Approach for Three-Dimensional Mesh Shapes Using Target-Embedding Variational Autoencoder
52. Co-Design with Myself: A Brain-Computer Interface Design Tool that Predicts Live Emotion to Enhance Metacognitive Monitoring of Designers
53. OwnDiffusion: A Design Pipeline Using Design Generative AI to preserve Sense Of Ownership

### 3D Generative Design

54. Fusion 360
55. Creo generative design
56. nTop Platform
57. Siemens NX Shape Optimization
58. MSC Apex Generative Design
59. Rhino + Grasshopper
60. CATIA Generative Design Engineering
61. Solidworks Simulation
62. NETVIBES One Part
63. NVIDIA OptiX™ AI-Accelerated Denoiser
64. Design Target Achievement Index: a differentiable metric to enhance deep generative models in multi-objective inverse design
65. A Novel Self-Updating Design Method for Complex 3D Structures Using Combined Convolutional Neuron and Deep Convolutional Generative Adversarial Networks
66. An artificial neural network tool to support the decision making of designers for environmentally conscious product development

Table 5.
List of tools in the design process (adapted from Croce, 2024).

> design processes take a more systematic approach in addressing complex problems. However, they still tend to frame problems within relatively narrow spatio-temporal contexts and do not offer a comprehensive approach for identifying all stakeholders and addressing their conflicts. A more holistic approach is needed to address problems that will take dozens of years or even decades to resolve (Irwin, 2018, p. 969).

To conclude, while new areas of design were developed to address problems with a more systemic approach, product design was developed by adding features to typical design process structures. These phenomena will likely continue, while only new comprehensive approaches could eventually let us tackle today's complex problems. So, the contemporary challenges will impact how design transitions into new domains or develops new processes, approaches, methods, and tools. In contrast, design will take part in the change, sharing its way of tackling problems.

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PART 3

# Design practice for supporting transformation

# 9. An exploration of meta-design and a reflection on its actualisation for fostering inclusivity

**Venanzio Arquilla, Federica Caruso**

The world is shaped by design, and this is evident in every aspect of everyday life and social constructs; even elements perceived as natural bear the imprint of human influence (Norman, 2023). Recognising the interconnectedness of all beings within this complex system, where any alteration can impact the whole, requires a fundamental change in how humans exist on Earth (Norman, 2023).

The awareness of design's influence on societal structures is growing, leading to discussions on designers' skills (D'Ignazio and Klein, 2020; Berry *et al*., 2022 ). It is increasingly evident that all designs inherently embody bias, influenced by the subjective perspectives of their creators and the historical milieu in which they originated (Holmes, 2020). Whether acknowledged or not, this subjectivity permeates the design process, incorporating biases into the surrounding artefacts and materials (Del Gaudio and Chopra, 2023).
When the design is finally available to the public, the inherent biases in the product feed the world and social consciousness and are reinforced (Prochner, 2014). Following this line of thinking, prejudices, norms, and stereotypes are embedded in many artefacts, and design

has the potential to strengthen them (Prochner and Marchand, 2018). This awareness catalyzes a profound shift in design consciousness, acknowledging the non-neutrality and power dynamics inherent in the field (Collins, 2017). Calls for greater awareness and accountability in addressing designer biases, privilege and positionality reverberate through the design literature (Goodwill *et al*., 2021).

This chapter examines two key concepts: meta-design and inclusive design. It explores how integrating an inclusive approach into meta-design can enable designers to raise awareness and address biases early in the design process. This alignment resonates with the overarching theme of redesigning design processes to adapt to a rapidly changing and uncertain world, emphasizing the central role of inclusivity and systems thinking (Hara, 2007; Costanza-Chock, 2020). The aim is to reflect on the need to prioritise inclusive design and generate discussions. In this, design education holds great promise as the training of new design generations encourages experimentation with these issues (Costanza-Chock, 2020; Berry *et al*., 2022).

## 9.1 Meta-design: a gateway to innovative design process

Originating from the intellectual discourse surrounding art, culture, and media, the term meta-design has found application across various practical domains, intertwining theoretical with practical implementation (Giaccardi, 2005). Since the term was first defined in industrial design in 1965 (Van Onck, 1965), different research approaches have been used, from the biological approach (Maturana, 1997) to the techno-social approach (Fischer *et al*., 2017). Historically, the term has always investigated the dimension of *designing the design* (Bentz and Franzato, 2017). Meta-design seeks to turn complexity into an opportunity to define new forms of innovation (Wood, 2022).
From this perspective, meta-design promotes cultural development that can investigate new design spaces (Fischer *et al*., 2017). It extends traditional design to include a process of co-adaptation between people and broader design systems, in which users become part of the process itself (Giaccardi and Fischer, 2008; Bentz

and Franzato, 2017). Therefore, meta-design is finding the meaning behind the design idea (Arquilla *et al*., 2019) and what is meaningful to design to meet users' needs.

Rooted in the Greek prefix *meta*, the term signifies a change in place, order, or nature (Giaccardi and Fischer, 2008), encompassing concepts of reflection and transformation. In contrast to traditional design approaches, meta-design encourages exploration and adaptation, and embraces participation (Fischer *et al*., 2017).
Three key aspects or *declinations* of meta-design emerge from the word *meta*:

> **1) "Behind" involves designing design processes, generative principles, and tools. 2) "With" empowers users to act as designers. 3) "Between/among" includes designing spaces of participation and relational settings (Giaccardi, 2005).**

Meta-design is a successful strategy for tackling complex design challenges (Ehn, 2008) because extending designed systems beyond their original nature enables an iterative process in which stakeholders become co-designers (Fischer and Scharff, 2000). It suggests a shift from designers controlling the design process to involving users (Fischer and Scharff, 2000). The meta-design process facilities change and involves three stages: 1) Seeding, 2) Evolutionary growth, and 3) Reseeding (Menichinelli and Valsecchi, 2016).

## 9.2 Meta-design and design research

An overlap in the definition of design research can be observed from previous discussions. Goldkuhl and Lind (2010) introduced a conceptual framework illustrating the relationship between meta-design and its interaction with design practice and research. While their representation simplifies the complex dynamics of design research and practice, it is valuable for explaining their respective roles and outcomes (Figure 1). Since design research involves the creation of diverse artefacts and generating design knowledge, without producing abstract knowledge, design research would lack scientific rigour

and resemble purely practical design endeavours (Goldkuhl and Lind, 2010). Therefore, design research represents a fusion of design practice and meta-design, wherein practical design informs meta-design and vice versa (Goldkuhl and Lind, 2010).

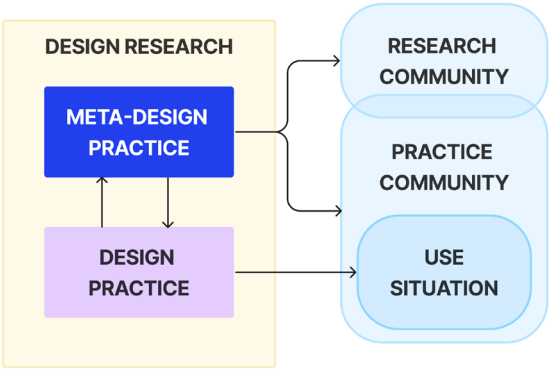


Figure 1.
Design research as meta-design and design practice. Author's elaboration (Goldkuhl and Lind, 2010).

Design research is segmented into two layers of activity:

1. Design Practice: encompasses the generation of situational design knowledge and tangible artefacts.
2. Meta-Design: produces abstract design knowledge and fulfils three main functions:
   *Preparatory Activity*: Before executing the situational design.
   *Continual Activity*: operates alongside design practice, offering continuous insights and guidance.
   *Synthesis activity*: summarizing, evaluating, and abstracting results outside the studied design and use practices.

In conclusion, meta-design emerges as a dynamic and multifaceted approach that transcends traditional boundaries, intertwining theoretical discourse with practical implementation.

## 9.3 Meta-design value in the design process

Design process models and their representations have been developed to teach design principles, particularly in educational settings (Bravo and Bohemia, 2019). These models encapsulate concepts and ideas about design, serving as didactic materials (Bravo and Bohemia,

2019). However, one risk associated with using such frameworks is promotion of an illusion of linearity and cause-and-effect mechanisms. While models are valuable for visualizing complex processes, they must be applied critically and iteratively (Dubberly, 2005).

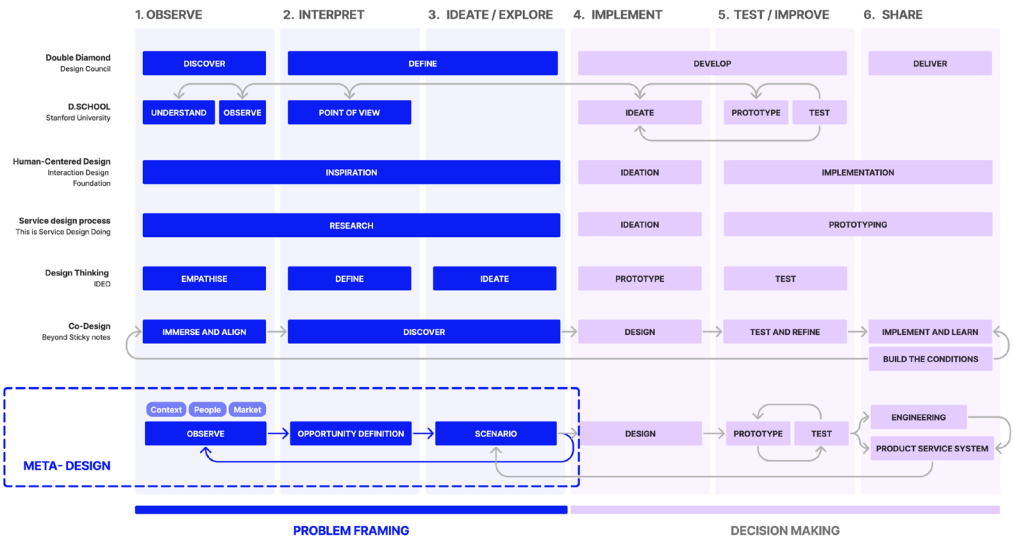


Figure 2. List of design process models inspired by Bravo and Bohemia (2019). Meta-design acts as a problem-framing that is compared with other design processes.

Drawing on the research conducted by Bravo and Bohemia (2019), a comparative analysis was performed on meta-design in visually representing design processes. The objective was to highlight how meta-design facilitates and illustrates problem-framing dimensions within the design process (see Figure 2). In their research, Bravo and Bohemia (2019) compared design processes by identifying common stages, understanding the characteristics of these representations, and determining which elements are consistent across the models. In the review presented in this chapter, the design process is divided into two phases: problem-framing and decision-making, with meta-design identified throughout the preliminary part.

Meta-design is a methodological learning approach in design education that redefines the design brief or problem-framing (Deserti and Celaschi, 2007; Deserti and Meroni, 2018). Problem-framing helps designers define issues they want to focus on; it is a critical component of all design processes involving recognizing assumptions and rediscovering the design problem (Schön, 2017). Research has indicated that how designers frame a problem significantly impacts

the outcome and subsequent progress (Dorst, 2018), underscoring the critical importance of this stage in delineating the problem space.

The meta-design part is identified in Figure 2, which starts with carefully observation of the context, people, and market to identify an opportunity area to build various possible design scenarios.
This is an iterative process because observation and research can be repeated after identifying a design opportunity or scenario.
In this view, the meta-design approach acts as a *generator* of design actions, setting constraints and offering guidelines for emerging scenarios (Fischer *et al*., 2017). It represents a distinctive approach, proposing open solutions rather than delivering finalized ones (Nold, 2022). The meta-design process outlines essential elements for development in the design phase, establishing the *Rules and Grammar of the project* (Giaccardi, 2005; Nold, 2022) and acting as a catalyst for design actions. Therefore, meta-design in the educational framework contributes to achieving meaning-driven outcomes by involving users in the process and directly observing the context, learning and designing for and with people (Arquilla *et al*.,2019; Arquilla *et al*., 2021).

## 9.4 Overview of inclusive design and new prospects

In this chapter, the literature on inclusive design explores the shift from a *one-size-fits-all* approach to a more comprehensive understanding that necessitates redefining inclusivity to encompass diversity beyond visible traits (Buckley, 2020; Kille-Speckter and Nickpour, 2022; Place, 2022).

As defined by Clarkson and Coleman (2015), inclusive design was traditionally developed to encompass designing for disabled and elderly individuals. Known as *Design for All* in Europe and *Universal Design* in the US (Clarkson and Coleman, 2015), inclusive design was initially coined in 1994 (Clarkson and Coleman, 2015), though Maeda (2021) suggests that the roots of inclusive design practices can be traced back to the 1950s. During this period, designs for individuals with disabilities, like typewriters and telephones, were mass-produced. Initially targeting specific needs, these innovations benefitted

society due to the broader industrialization (Tauke *et al*., 2016). After World War II, inclusive design evolved, contributing to social and political justice and establishing welfare states in the UK and other nations (Clarkson and Coleman, 2015).

Additionally, the experiences of wounded veterans from both World Wars led to a growing demand for accessibility accommodations in the field (Kille-Speckter and Nickpour, 2022). Nevertheless, around the same time, Henry Dreyfus published *The Measure of Men*, which emphasized the importance of anthropometry as an indispensable tool for designers (Holmes, 2020). This notion is grounded in the idea that measurable average characteristics are essential to support industrial projects (Holmes, 2020). Diversity and variation in human beings were treated as degrees of error from the perfect. Dreyfus's ideas influenced the development of *one size fits all*, catering to the average person while marginalizing those who deviate from norms (Holmes, 2020).

All the approaches currently emerging in inclusive design challenge this principle (Bianchin and Heylighen, 2018; Luck, 2018; Donahue and Gheerawo, 2021) and build a *one-size-fits-one* to fit people who address the significant exclusions of using the designed solutions (Costanza-Chock, 2020; Donahue and Gheerawo, 2021). Contrary to inclusion, exclusion occurs when the object does not meet somebody's needs and creates a mismatch between them and things, physical or digital (Holmes, 2020).

To better frame the evolution of inclusive design, reference is made to Dong (2020), who investigates its trajectory across four overarching phases beginning in the 1990s and extending across three decades. These phases encompass products, interfaces, experiences, services, and systems. Additionally, Dong (2020) introduces the concept of inclusive design 4.0, reflecting new approaches in contemporary design practices. Starting with a focus on physical attributes, this evolves into a procedural and reflective dimension, prompting a re-evaluation of the entire system.

This chapter has attempted to summarize the principal approaches to inclusive design (Figure 3), building on the groundwork laid by Kille-Speckter and Nickpour (2022) in delineating the design milestones for disability. Select milestones relevant to approaches and

frameworks were included, omitting theoretical concepts. In addition, new approaches have been included in the literature that align with the trajectory towards inclusive design 4.0 (Dong, 2020).

Two essential conditions have emerged from the analysis of these emerging approaches, which are changing the landscape of inclusive design:

1. Growing awareness that «good intentions cannot be enough» (D'Ignazio and Klein, 2020; Del Gaudio and Chopra, 2023) recognizes how unconscious biases influence decisions (Wachter-Boettcher, 2018; Costanza-Chock, 2020). Unconscious biases are learned, natural, instinctive, unintentional preconceptions so deeply rooted that they quickly affect a person's behaviour (Canlı, 2018; Lillegård *et al*., 2021). «Exclusion happens when we solve problems using our biases» (Holmes, 2020). Designers must recognize their biases and be open to questioning their perspectives to avoid tokenistic attempts at inclusivity and shifting to community-driven approaches instead of the traditional power dynamic (Place, 2022).
2. The literature highlights the need to expand the definition of exclusion, *moving beyond traditional accessibility* concerns (Lillegård *et al*., 2021; Szlavi and Guedes, 2023). While issues like ageing have received attention, there is a growing imperative to address other critical issues and steer research towards a more holistic direction (Donahue and Gheerawo, 2021). Inclusive design should consider characteristics like race, gender, social status, sexual orientation, and others, acknowledging *intersectionality* [1]. This concept, introduced by Kimberlé Crenshaw (1989), recognises interconnected forms of oppression. Intersectionality and the matrix of domination (Collins, 2017) help us understand how privilege and oppression are interconnected. A privileged view will also likely inform beliefs, assumptions, and norms that shape many design decisions made throughout design projects. If designers become more aware of and sensitive to how privilege and oppression (including their own) function in their designing contexts, they can make decisions to challenge status quo inequities and patterns of oppression produced (Goodwill *et*

**Note 1.**
**Intersectionality coined by Kimberlé Crenshaw in 1989 for understanding how groups and individuals' social and political identities result in unique combinations of discrimination and privilege. These factors include gender, caste, sex, race, ethnicity, class, sexuality, religion, disability, height, age, weight, and physical appearance. These intersecting and overlapping social identities may be both empowering and oppressing.**

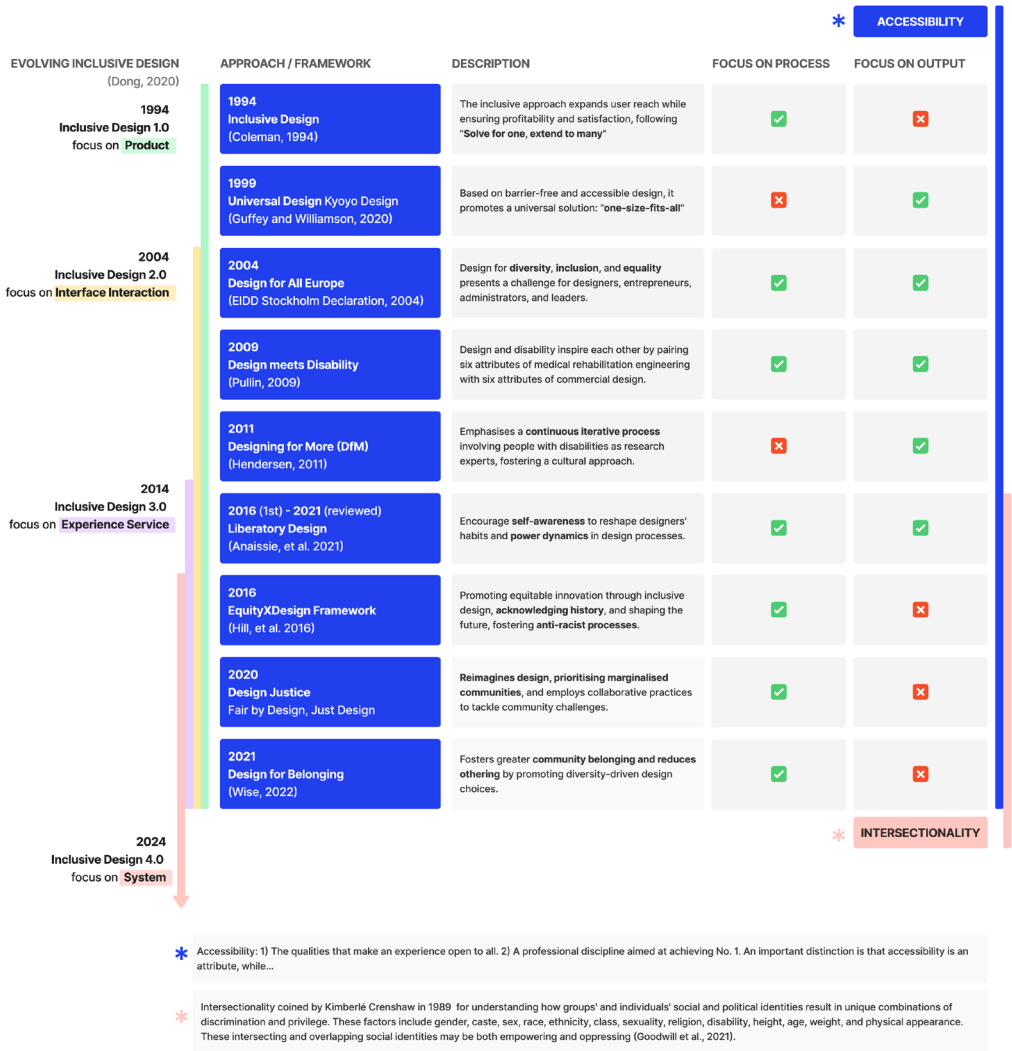


Figure 3.
Inclusive design approaches inserted into the evolving inclusive design framework developed by Dong (2020). The approaches considered come from the timeline proposed by Kille-Speckter and Nickpour (2022). In addition, other emerging approaches have been included that go beyond accessibility as a condition of inclusion.

*al*., 2021).

Figure 3 frames inclusive design's milestones about the evolution (Dong, 2020), highlighting how approaches initially emerged to address accessibility but have now evolved to consider diversity across multiple axes of identity, known as intersectionality. Furthermore, the analysis categorises approaches based on their emphasis on either process or output, with the latter being more focused on describing the qualities of a final project. Conversely, process-focused approaches delve into how designers reach their final designs.

This initial analysis suggests that inclusive design processes increasingly emphasise carefully examining the design process. However, it also critiques that snapshots of the theoretical landscape often need to align better with real-world practice (Luck, 2018; Kille-Specketer, 2022). Thus, there is a need for a balanced consideration of both practice and theory to fully appreciate the real-world impact.

## 9.5 Emerging approaches in inclusive design: practice awareness as a foundational phase

When comparing the previous analysis of design processes with emerging approaches in the literature on inclusive design, such as Design Justice and Liberatory Design, we observe the introduction of an additional phase not present or omitted in other approaches. This phase involves raising awareness before taking any action (Figure 4). This aligns with three essential concepts:

1. Reflection on Positionality: Stressing the importance of questioning one's perspective, without which design efforts may reinforce existing power structures (Buckley, 2020).
2. Embracing Diverse Perspectives: Considering diverse viewpoints addressing power imbalances (Bianchin and Heylighen, 2018; Noel, 2022)
3. Revisiting the Role of the *Design Hero*: Shifting from a saviour design mentality to a community-driven approach (Place, 2022).

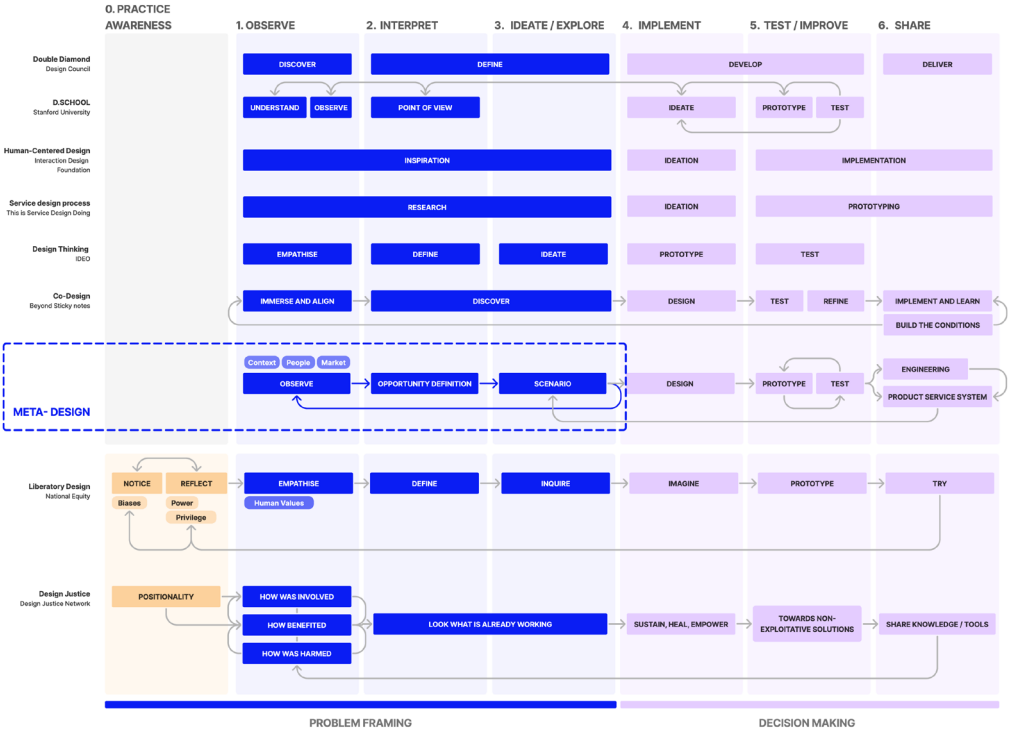


Figure 4. Builds upon the previously discussed design process, two additional design processes, Design Justice and Liberatory Design, have been included to demonstrate how they introduce a preliminary stage called *practice awareness* facilitates reflection on privilege and power dynamics, awareness of biases, and acknowledgement of one's positionality. The design process is iterative, with practice awareness emphasized initially to anticipate and address these issues.

Reflecting on privilege and oppression, including their own, is essential for individuals to create a solid foundation to build on (Goodwill *et al*., 2021). This involves recognising that before seeking new design solutions, it is crucial to understand what is already working within communities (principle 10 of design justice). Additionally, embracing the principle that everyone is an expert based on their lived experiences (principle 6 of design justice) highlights the importance of valuing diverse perspectives and contributions in the design process. By fostering awareness, designers can improve the effectiveness and relevance of their design work (Costanza-Chock, 2020).

## 9.6 Opportunity to integrate inclusive design within meta-design

The literature review highlights six key concepts of meta-design, which could be opportunities for a broader discourse on renewal.

These concepts succinctly capture the essence of meta-design and offer insights into integrating it with an inclusive approach, thus prioritising inclusive design.

Figure 5 below summarises these six key concepts and demonstrates their alignment with inclusive design principles. Hence, reimagining problem-framing through an inclusive lens and actualising meta-design to promote inclusivity appears feasible and relevant. Nowadays, inclusive design is usually at the end of the process (Donahue and Gheerawo, 2021). Early engagement with awareness during the design phase presents a chance to steer clear of tokenism[2] solutions (Costanza-Chock, 2020; Holmes, 2020).

Thinking about inclusive design at the level of meta-design is an opportunity to prioritise it within design education through its integration into meta-design. Research on problem-framing, which influences decision-making, can be significantly biased, leading to token efforts to promote inclusivity (Holmes, 2020). Early in the design process, addressing awareness, power dynamics and biases is crucial so that prejudice does not influence proposed solutions (Costanza-Chock, 2020). Due to poor prioritisation, inclusive design often needs to be revised to expand its principles and incorporate additional attributes that extend the exclusion criteria (Donahue and Gheerawo, 2021). Moreover, although intersectionality is gaining momentum, a gap in design education is emerging. More research is needed into how students handle intersectional biases (Berry *et al*., 2022), and educators need more practical guidelines to teach these concepts beyond theory (Costanza-Chock, 2020). Incorporating an inclusive approach in meta-design could bridge this gap, thereby promoting the training of designers to prioritise inclusive design while considering intersectionality (Figure 6).

In conclusion, recognizing the essential role of design is crucial in tackling today's dynamic challenges. Emphasizing the importance of research, the meta-design dimension underscores the imperative for an inclusive cultural perspective integrated right from the onset of the design process. This approach aims to address biases, promote coherence in future initiatives, and encourage critical evaluation of current cultural and economic limitations. With products increasingly intertwined with services, there is a pressing need to assert their

**Note 2.**
**Tokenism is the practice of making only a perfunctory or symbolic effort to be inclusive to members of minority groups (Kahneman, 2017).**

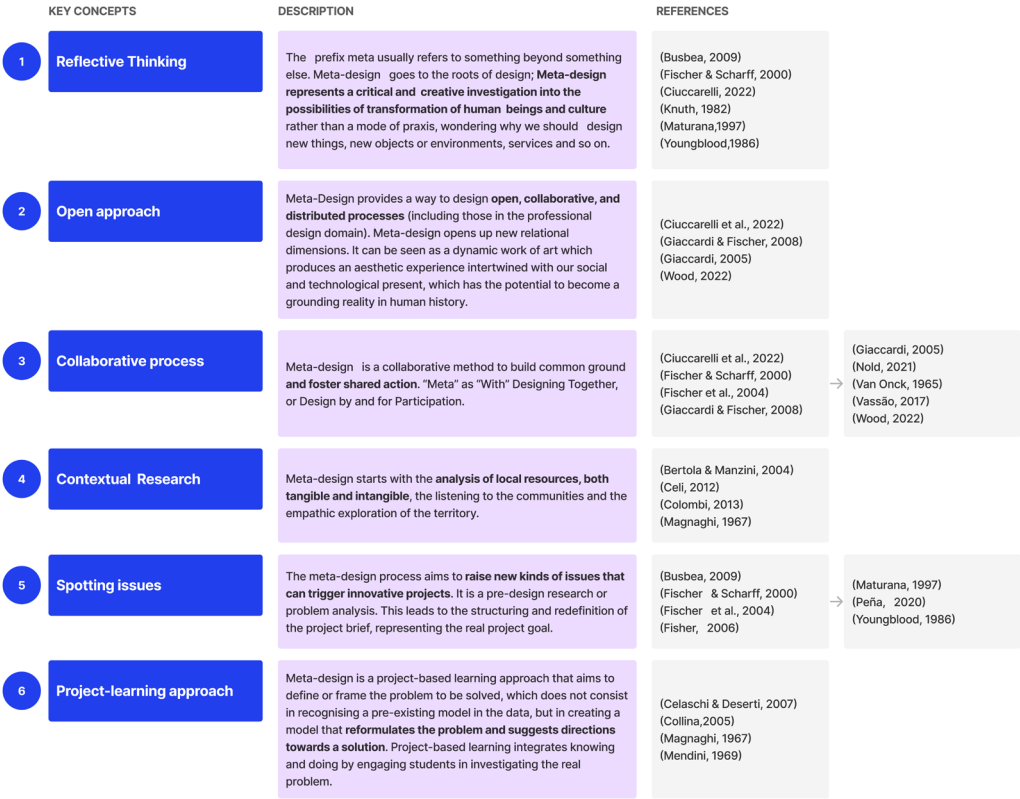


Figure 5.
Overview of Meta-design Definitions: this figure presents a compilation of literature-related definitions. These concepts offer a foundation for contemplating the reformulation and modernization of the approach.

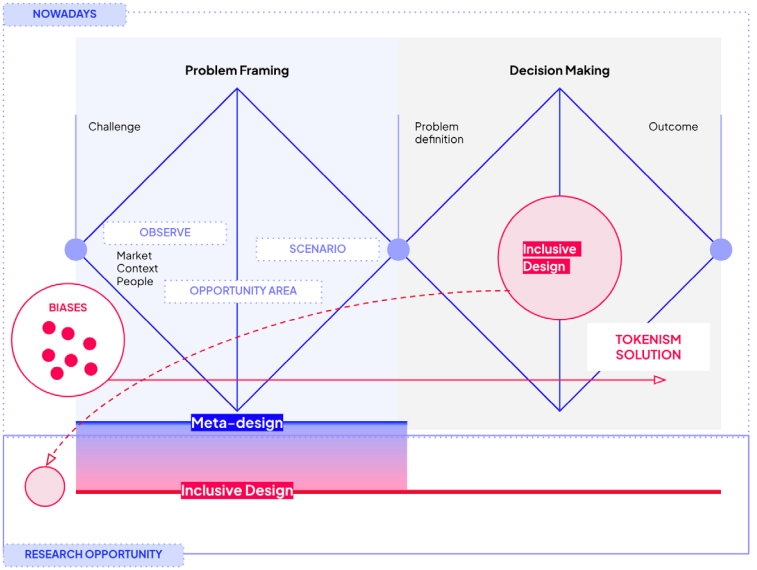


Figure 6. Representation of Research Phenomena and Opportunity. The evidence from the literature suggests that biases highly influence problem-framing; moreover, nowadays, inclusive design is usually at the end of the process. Ideally, every new project should consider inclusive design from the very beginning (Holmes, 2020). For this reason, working on awareness early in the design process is an opportunity to reduce bias.

value consciously and to redefine norms. Integrating these insights shapes foundational principles for the next generation of designers, which is essential for navigating our evolving world's complexities.

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# 10. Design in transition / Designing transitions. Insights from conversations with design experts

**Carla Sedini**

The most innovative cultures have marked periods of redefining and comprehending the challenging circumstances of their time (Koestler, 1975; Hall, 1998). Simultaneously our globalized world has been characterized by the idea that the future is unpredictable and unmanageable (Reith, 2004); counterintuitively, this uncertainty created the willingness for people to still engage with the future even though it is difficult, or even impossible, to anticipate (Reith, 2004).

Because of its proactive nature, Design can act in the *space of possibility* shaped by dark times, as defined by Arendt. According to Cross (1982), design challenges are typically characterized as *wicked* due to their lack of clarity and organisation, which is common when it comes to societal challenges (Sedini, 2020). The commitment of designers is partially due to the recognition that Design has contributed to the creation of our contemporary unsustainable world (Monteiro, 2019; Papanek, 2022; Norman, 2023).

This chapter will explore how Design, as a discipline, adapts to and drives systemic change in the face of unprecedented uncertainty. In order to answer the broad question *How does Design deal with*

*complexity?*, this contribution synthesizes insights gathered from interviews with prominent Italian design experts.

## 10.1 Design and transition

The concept of Transition Design emerged from the 2008 crisis, in strict correlation with the multi-composed concept of sustainability, with the transition towards more desirable futures as the main goal (Kossoff, 2011; Irwin, 2015). Transition Design was developed as an evolution of Service and Social Innovation Design as a future-oriented practice; however, it can be seen as a serendipitous idea that was further developed and integrated into other theoretical and methodological design evolutions, such as Systemic Design (Jones, 2014). This idea of transition is central to the (co)evolutionary idea of Design, especially to the *matter* of Design (Tonkinwise, 2015). For this reason, in this contribution, it was decided to use the term without necessarily making reference to Transition Design tools and methods. Moreover, it is possible to state that human beings, whether aware of it or not, constantly live in co-transition with other species and contexts; therefore, it would be wrong to state that we are only now living in transition times.

The present moment we are all experiencing has not been the first period of uncertainty in history (Hall, 1998). Also, due to time-space compression, the future becomes an extension of the present (Nowotny, 1996), and in this sense, risks already exist and distributed all over our globalized world (Beck, 1992, 2009). The emergence of the concept of risk has been strictly connected with the notion of future and has had a central explanatory role in the indeterminate world of late modernity (Reith, 2004).

Risks can be more or less successfully overcome thanks to local economic, technological, and political benefits. Koestler (1964) uses the concept of *ripeness*, which involves maturity and the development of solutions at the right time in the right place. In general, periods of crisis, characterized by climate change, conflicts, and pandemics, have potentialities for being creative in responding to critical situations and events. These uncertain periods have been called *post-normal times* (Sardar, 2010; Montuori, 2011); in particular,

the concept of post-traumatic growth has been used to address periods of recovering from difficult times both at an individual and collective level (Tedeschi *et al*., 1998; Fredrickson *et al*., 2003; Fuentes, 2017; Staszowski and Tassinari, 2020).

Since Design involves creating something new or transforming a less desirable situation into a preferred one, and building a more humane world (Simon, 1998; Margolin, 2007), it is particularly important to make desirable representations of the world and find possible answers to face uncertain times and periods of crisis.

To conclude, as Manzini (2015), commented on Transition Design, another (design) discipline is not needed; however, scholars and practitioners should look at how Design changes in transitory times and how Design it can address our ever-changing societies, which is the goal of this contribution.

## 10.2 In conversation with Design experts

The concepts of transition and complexity are deeply intertwined, with each influencing and shaping the other in complex and dynamic ways. Understanding the relationship between transition and complexity is essential for designing effective strategies and solutions that account for the interconnected, non-linear, and emergent nature of the systems and phenomena we encounter in the world.

The following pages will be the first phase of a wider research carried out in collaboration with the Massachusetts Institute of Technology (MIT) and Design Group Italia, involving three main countries: the US, Italy and Japan. The goal of this contribution is to provide a preliminary positioning to answer the research question *How does Design deal with complexity?*. To do that, the researchers decided to start from the essential pillars of Design, such as the definition of the discipline; the discussion on problem-framing and problem-solving design phases; and the identification of design impacts on society. The focus of this contribution will be exclusively on the Italian data collected through twelve semi-structured interviews with prominent Design experts. An expert interview is a type of qualitative interview that follows a thematic guide and focusses on the expert's knowl-

edge, which is often defined as particular expertise in a specific field or topic (Bogner *et al*., 2009; Döringer, 2021 ). The interviewees' selection was guided by the intention to provide a comprehensive exploration of the diverse possible contributions of Design.
The interviewees came from both professional and academic domains, including different generations of product and service designers, as well as Design historians and journalists. The interview guide was developed in collaboration with the MIT and Design Group Italia teams, and it was composed of about twenty open questions.
All the interviews were conducted online by the author in 2021, lasted one hour on average, and were recorded and fully transcribed. The analysis was conducted using the manual labelling method with the support of Chat GPT.

Table 1.
Interviewees list.

| Name/Code | Design Discipline | Gender |
|---|---|---|
| i.1 | Design historian / Academic | M |
| i.2 | Design professional | M |
| i.3 | Design professional | F |
| i.4 | Design historian | F |
| i.5 | Design professional | M |
| i.6 | Service designer / Academic | M |
| i.7 | Metadesign manager | F |
| i.8 | Design journalist | F |
| i.9 | Design professional | M |
| i.10 | Design professional | F |
| i.11 | Strategic designer / Academic | M |
| i.12 | Service designer | M |

In the next section, the interviewees reflections and opinions will be collectively presented; it was decided not to use quotes since all participants are involved in writing and discussing these topics in academic and public contexts, and being anonymized could lead to a lack of recognition of their original thoughts. The discussion is organized according to four main topics: regarding the definition of Design: the Design approach to problem-framing and problem-solving; the focus on Design Culture; and Design's impact on society.

### Design in transition

The first part of the interview was dedicated to providing a definition of Design, including the elusive notion of *good design*. Design is considered complex to define because of its multifaceted nature.
The evolution of the definition of Design towards greater complexity and incorporating the concept of transition reflects the dynamic nature of our societies. Design encompasses not only the creation of physical objects but also of services and systems. It involves understanding the transitions that individuals, communities, and organizations undergo and designing solutions that facilitate these transitions effectively. This evolution in the definition of Design empowers designers to create solutions that are not only innovative but also meaningful and transformative. A composed definition that emerged from the different experts involved is provided in the following pages.

Design is a form of creativity applied in various ways (i.6): to create and imagine things that make more sense (i.11), combining resources and constraints to achieve a satisfactory result with minimal energy (i.12).

Looking at the transitory nature of Design, it has evolved from simpler, spontaneous projects to be a more articulated, multifaceted process, also expanding its scopes (i.2) beyond product-centric views to include social roles (i.6) extending to relationships, behaviour, and rituals (i.7). It is consistently seen as a process involving creativity, problem-solving, and an intersection of form and function.

It is already very apparent in this first discussion how culture plays a critical role in providing a framework for Design, including different perspectives of understanding. Design has been depicted as a connective sea between different areas of knowledge (i.2, i.9). Moreover, the relationship and potential overlapping between *Cultura del Progetto* (Design Culture) and design, was highlighted already in the definition of the latter (i.4). At the same time, Design has been described as a globally creative discipline (i.7).

The so-called democratization of design has emerged since it has been presented as an attitude towards life (i.8) and even a collective act (i.6).

Most experts strongly challenge the notion of absolute criteria when asked about their interpretation of what *good design* is today. As far as the product design market is concerned, *good de-*

*sign* is defined as the combination of functional, sign[1], and poetic values (i.7). However, in the contemporary context, the *goodness* of Design results from the interactions of artefacts within a system (i.6); this means that *good design* needs relative assessment based on contextual factors, such as historical conditions, market responsiveness, and innovative impact (i.1).

As we are going to discuss later, the definition of *good design* is very much connected with the question of the impact of Design on society judged on criteria like sustainability, justice, and societal progress (i.6); moreover, *good design* is defined as educational and devoted to the improvement of the quality of life (i.2). In general, it seems that *good design* is possible as far as a *good designer* is involved in the process; indeed, even if the characteristics of a good design product might change, what stays the same is the importance of a cultural awareness, curiosity, capability to listen without preconceptions, and storytelling abilities of the designer (i.4, i.8).

**Note 1.**
**According to Baudrillard (1968), the value of an object in a system of objects is known as its sign value.**

### Problem-framing and problem-solving

The interviewed design experts pointed out an intricate correlation between problem-framing and -solving, challenging traditional boundaries and blurring the lines between analysis and action. In particular, the problem- framing process empowers designers to redefine the current drive towards a change of perspective in Design by providing them with tools and methodologies to tackle complex challenges more effectively, empathetically, and innovatively. It enables designers to move beyond surface-level solutions and create transformative change that positively impacts individuals, communities, and society at large. Indeed, problem-framing involves defining a system, often leading to a radical change in the system itself (reframing). Framing, and especially reframing, are crucial for contributing to sustainability (i.6, i.11). However, in general, the majority consider problem-framing to be of the greatest importance, especially in the current Design landscape, which deals with complex problems (i.1, i.6, i.11, i.12).

The ability to frame issues correctly is highlighted as a key skill, with an emphasis on addressing latent needs or desires (i.9), and, according to some, analysis is already a crucial step for/of problem-solving (i.12); indeed, some interviewees rejected the idea of

problem-solving as a late-stage action, emphasizing the relevance of problem-posing (framing) moments (i.5). However, some interviewees stress the fact that Design has to provide a solution, which means that the design process cannot be considered as completed if the problem-solving phase is not carried out (i.3, i.10). Looking at the issue from a different perspective, questioning the applicability of Design to problem-framing and problem-solving processes, it was highlighted that Design is applicable to both phases, but its efficacy depends on the designer's strengths, such as openness, creativity, and an exploratory attitude (i.8). It is interesting how the designer's capabilities, values, and positioning are considered important in this specific case.

The question on the problem-framing and -solving design phases emphasised a relevant and common negative opinion, almost a resentment, toward marketing and the impact this discipline has on Design. In large part, the interviewees, more or less explicitly, stressed the limits of Design Thinking, especially in the subjugation of Design to market dynamics (i.4, i.5, i.11, i.12). In particular, the market culture was distinguished from the Design Culture, where the latter is idea-driven (i.5). When talking of Italian Design Culture (*Cultura del Progetto*) the idea-driven approach seems to be crucial since Italian (design) companies are considered to be more capable of transferring the knowledge, understanding that a valuable solution for a particular issue can be used to address a different one; and this is a specific characteristic of the Italian non-positivist approach (i.9), as will be discussed in the following section.

### Design Culture

Cultural influences on Design are dissected, with specific attention paid to the Italian Design Culture (*Cultura del Progetto*), highlighting the centrality of cultural contexts in shaping design philosophies. As Zurlo (2019) stated, depicting the current Italian Design panorama, the Italian-born *Cultura del Progetto* identifies Design as a cultural act and research for meaning in a systemic vision, useful to engage the listening skills and critical anticipation, and able to interpret society's problematic issues and translate them into objects and services.

Similarly, the interviewed experts stressed how cultural background influences design perspectives, with distinctions made, for

example, between Mediterranean and Calvinist-Protestant Europe (i.9, i.12). The importance of history and tradition was raised (i.1, i.4), in some cases, even in a protectionist sense (i.3).

In Italy, the way of doing Design is different from other ways because it has been primarily influenced by art, uses an anthropological approach, and the signifier becomes signified (i.8). However, some of these primary elements have been lost over time, perhaps because Italy has looked increasingly at Anglo-Saxon cultures, and Design became a marketing/market tool, as discussed in the previous section. However, the strong relationship between Design and industry was identified as the uniqueness of Italian Design Culture because of the collaboration between small- and medium-sized enterprises and designers (i.1, i.2, i.3, i.8, i.10). This relationship, even if it happened for the market, was idea-driven (more than market-driven) (i.5) and positively influenced by the lack of internal marketing research which led to the development of culture through objects (i.1). The fact that Italian Design is rooted in objects influenced non-experts' general perception of Design as often associated with expensive, aesthetically driven objects (i.8); but in light of the changes in the discipline, as previously discussed, a new narrative of Italian Design should emerge. The distinction between experts and non-experts is also relevant when talking of Design Culture (i.10), identifying the importance of education and Design schools in accelerating experiences and transferring (implicit) knowledge (i.6), and providing new designers with interpretive skills (i.12). Going back to the humanistic culture, designers (especially those who studied and practised in Italy) are *technology humanizers* (i.10) because they are capable of integrating technical and technological aspects with philosophical considerations.

**Design's impact on society**

Design has a pivotal role in shaping both material culture and societal values, impacting primarily but not exclusively on consumer behaviours (Latour, 1992). That Design has an impact is already clearly manifested, and for this reason, the interviewees considered not only the positive impacts but, more especially, the negatives, showing the importance of foreseeing and designing the solution impacts and providing reflections on how to pay attention to them. In connection with

the topic of Design education, some experts stressed the qualitative and interdisciplinary nature of Design in distinction from contemporary societies, which measure themselves through quantitative data (i.1). If we look at Design from a market-driven point of view, impacts on societies have been negative; also, when dealing with immateriality, the effects have been tangible, such as in the case of Digital and Service Design in which companies like Airbnb had unintended (and undesigned) side effects (i.8). This is why all the interviewees stressed the need for reframing and contributing to a shift from traditional capitalism to a circular economy and sustainable societies (i,2, i.8). To do so, the challenge designers should take is to put aside the prevailing user-centric approach, changing therefore not only the design process, but *who* and *when* designers design for (i.11). The need for taking into consideration a more extensive system (not only the user), and a moment in time in the future, stresses again the importance of engaging with different stakeholders and experts from different fields to address complex problems (i.1, i.6, i.9). At the same time, it was a warning about participatory processes that are only carried out to be compliant with political processes, and thus compromising the critical perspective (i.10). Some others expressed scepticism about the current narrative that places Design at the centre of historical achievements (i.12). Design's strengths include its effectiveness for futile things, its ability to address soft values, and its enduring impact on consumer behaviour.

## 10.3 Conclusion

The initial research question, *How does Design deal with complexity?* cannot find a neat answer from such limited research. Being aware of the complexity of the question, researchers understood that an overview of Design and its practices was needed.

First of all, Design is complex itself because it involves a multitude of applications. Evolving alongside technological advancements, the Design landscape undergoes a continuous metamorphosis, shifting from products to relations, contributing to the building of sociotechnical organizations. Design's systemic and strategic role

has been revealed, extending beyond product resolution to encompass broader dimensions.

Dealing with complexity requires meticulous activity in acquiring knowledge, information, and data, as well as elaborating insights and defining goals. In light of this, even if problem-framing has been defined as the most crucial design phase, looking at reframing as a central moment for understanding the system and already looking for non-conventional solutions, the interviewees pointed to the original Design purpose of projecting solutions. Commenting on this, if we rely on System- and Complex-Thinking (Ackoff, 1994; Bijl-Brouwer and Malcolm, 2020) because of their reflective nature, they do not always lead towards the quick generation of creative solutions; however, they are capable of equipping designers with the tools needed to comprehend the multifaceted interplay of elements within an existing system.

Going back to solutions, these might also respond to futile needs since Design does not necessarily engage with urgent societal issues. Paraphrasing what Molotch said in the early 2000s, the issue is not stopping doing what we like but doing it in a more responsible, sustainable, and ethical way (Molotch, 2005; Monteiro, 2019; Papanek, 2022; Norman, 2023). Italian Design Culture, which is continually evolving, is recognised among Design experts, but the lack of knowledge about the discipline's complexity and potentiality among the general public and – especially – relevant stakeholders (such as policymakers) results in its simplification and a lack of recognition.

The designer's stance and positioning emerged strongly in the conversations with the experts. Designers have to take on a sense of authorial responsibility, considering the long-term impact of their work, moving away from a profit-oriented user-centric approach towards a more meaningful, circular, and future-oriented Design philosophy. For this reason, Design has to be intended as a political act (Monteiro, 2019) defining what and how needs to be designed, and for and with whom. This stance seems to redefine what is considered *good design* today. Its definition concurs with the inclusion of other relevant stakeholder, humans and non-humans, shifting therefore from human-centredness to community-driven design (Manzini and Meroni, 2017), humanity-centred design (Norman, 2023) and even planet-centred design (Talgorn and Ullerup, 2023).

The limited scope of the research presented here strongly influences the typology of results; indeed, a new conceptual framework is not provided in this contribution because the research mainly addressed the foundations of the discipline, reframing them in the light of contemporaneity. The focus on Italian Design experts potentially limits the findings, especially in regard to other cultural and political contexts or design communities. Moreover, in the future, it might be interesting to interview young designers who have recently started their careers to fully capture the latest developments or emerging trends in Design theory and practice.

Designing transitions means looking at Design as a timeless practice, forever changing yet anchored by enduring technical qualities with soft skills, reflecting on the dynamic interplay of creativity, cultural nuances, and societal transition. It refers to the process of intentionally and strategically shaping changes (reframing) within systems, organizations, or societies toward more desirable futures. In order to do that, collaboration within the system is crucial; designing with other stakeholders (policymakers, businesses, civil society, and other academics) has not to be a formal duty but must promote mindset shifts, behaviour change, and the adoption of new norms and practices. And to begin with, a fundamental question needs to be asked: what kind of future do we want?

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# 11. The role of design (thinking) in facing complexity and generating innovation in the entrepreneurial world

**Gianluca Carella, Francesco Zurlo, Svafa Grönfeldt**

## 11.1 The role of startups in the innovation landscape

The consequences of the recent global economic crisis, together with the ongoing effects of the Fourth Industrial Revolution, have led governments of both developed and developing countries to acknowledge innovation as the main driver of competitiveness for their economies (Baumol, 2002). Indeed, the significance of innovation in socio-economic terms, such as enhancing the living conditions of the general population, offering advantageous new solutions, and generating employment opportunities, is widely recognized. Currently, innovation is regarded as the primary catalyst for regenerating and expanding economies, particularly in a globalized and highly interconnected business environment.

In this panorama, entrepreneurship, and particularly the cluster related to startups, play a crucial role. Startups are central to continuously bringing forth new and creative ideas, and introducing new products and services developed by startups into markets

is an important driver of innovation. Startups are widely recognized as key drivers of technological innovation, economic agility, and job creation (Luger and Koo, 2005). Indeed, the notion of a startup has been conceptualized as a type of organizational structure that facilitates innovation processes, particularly in contrast to innovation that arises from existing firms (Freeman and Engel, 2007). Prior to the mid-1990s, the term *startup* typically referred to the initial phase of any commercial activity (Cockayne, 2019). Over time, the term's definition became more specific, specifically referring to establishing new enterprises in the semiconductor and high-technology sectors.
These enterprises were typically situated and saw remarkable expansion in highly developed industrial regions, primarily Silicon Valley.

However, what justifies attention to startups is perhaps the element that most characterizes them as an entrepreneurial phenomenon: their fragility. While the startup model has been recognized as a reliable means for achieving significant innovations, it is also very vulnerable to failure. The Global Startup Ecosystem Report of 2019 reveals that the success rate for entrepreneurs in launching their own businesses is only one in twelve, which aligns with the well-publicized data indicating that 90% of startups eventually fail.

The failure of new venture enterprises can be directly attributed to the fact that these organizations often operate in highly uncertain settings. Entrepreneurs frequently have the challenge of creating something innovative with limited resources, and the belief they have in the quality of their product may not align with market preferences. Effectively promoting a novel product or service necessitates proficient expertise and the swiftness essential to outperform rivals. Ultimately, founders must also possess the ability to persuade investors, acquiring evidence of the feasibility of their business concept as expeditiously as feasible (Rancic Moogk, 2012); and without taking into account the intricate and unpredictable obstacles that can arise along this journey.

## 11.2 The role of Design Thinking in boosting innovation

In view of the two-way bond between entrepreneurship and innovation (Drucker, 1985), academics' and practitioners' interest shifted over time as well to innovation management approaches and their applicability in the context of innovative startups in order to reduce the most consolidated problems. One of the methodologies that seems able to make a significant contribution to the startup world is Design Thinking. Although the breadth of its definition is central to academic discussions around the topic (Micheli *et al*., 2019), we can refer to it as «a human-centered approach for innovation, which is grounded in the ways of thinking and working common to the design profession» (Klenner *et al*., 2021, p. 2). As a relatively new concept in the entrepreneurial area, Design Thinking has gained popularity in the management field since the late 2000s. It is known for being effective in situations with much ambiguity, encouraging innovative problem-solving methods (Micheli *et al*., 2019). Design Thinking (DT) has been widely recognized by academics and professionals as a powerful driver of innovation and transformation (Brown, 2008; Martin, 2009; Liedtka, 2015; Sheppard *et al*., 2018). It has evolved continuously, transitioning from its use in product development to its application in managerial practices for addressing strategic challenges (Martin, 2009; Kelley and Kelley, 2013; Dell'Era *et al*., 2020). Based on a range of research (Brown 2008, 2009; Carlgren *et al*., 2016), Design Thinking is an effective approach that involves a collection of approaches, methodologies and tools to help managers tackle and solve various complex challenges.

In recent years, the fundamental framework of Design Thinking has experienced several changes, including collaborations with LSAs (Large-Scale Assessments), with the aim of applying the principles of this approach to startup development (Dell'Era *et al*., 2020). Together with its unique culture, mindset, and practices, DT has long been recognized as a significant catalyst for innovation (Hassi and Laakso, 2011; Johansson-Sköldberg *et al*., 2013; Carlgren *et al*., 2016; Elsbach and Stigliani, 2018; Micheli *et al*., 2019). Its value in the management field, and more broadly in the business realm, is widely

recognized for its ability to generate new business opportunities by identifying emerging trends and socio-cultural models (Verganti, 2008, 2009). It also facilitates the innovation of business models in established industries (Fraser, 2009; Holloway, 2009); the creation of unique meanings for products and services (Verganti, 2009); the development of market conversations around new value propositions (Nielsen *et al*., 2017); and the adaptation of interactive patterns and user experiences based on continuous feedback from the marketplace (Gruber *et al*., 2015).

## 11.3 How Design Thinking can support entrepreneurial activities

While there is a lot of enthusiasm and attention surrounding Design Thinking in the business world, the same cannot be said in relation to its role in entrepreneurship. The enthusiasm generated in the field of management is not mirrored in the entrepreneurial literature. Even if Design Thinking has been recently advanced as a relevant asset for startups and entrepreneurs (Klenner *et al*., 2021), scholarly accounts lack substantial evidence about the contribution this approach can deliver along technology startups' evolution and growth. In the past, design was commonly employed in startups as a supplementary instrument to technology, mainly as a means to facilitate and enhance the utilization of technology in order to maximize the spread of new innovations (Eisenman, 2013). Only recently has literature emphasized the specific implications of Design Thinking for startups. Mansoori and Lackéus (2020) explore its unique contributions to the field of entrepreneurship in comparison to other techniques. Klenner *et al*. (2021) demonstrated the alignment between Design Thinking approaches and entrepreneurial cognitive principles.

Other studies investigate how the design process, techniques and tools might be advantageous for entrepreneurship.
Design Intech's 2016 research, which ranks startups with a valuation of $1 billion or more, states that having a designer as part of the founding team is considered an asset.
Dimov's (2016) research marks a significant milestone in the entrepre-

neurship literature, since it establishes design as a central element in the entrepreneurial process (Zhang and Van Burg, 2019). Dimov (2016) therefore aims to reopen the discussion, arguing that the recognition of entrepreneurship as a form of design not only invites questioning of the logic and methods by which academics have conventionally conducted research in entrepreneurship, but also provides an opportunity to address a problem related to the apparent incompatibility between practical relevance and scientific rigour in entrepreneurship as a field of study (Berglund *et al*., 2018).

Another important issue to consider is the practical integration of design techniques into entrepreneurial processes (Nielsen *et al*., 2017). In this case, the *Design Thinking* to which Dimov refers corresponds in fact to the connotation that design assumes in the business realm, where entrepreneurship literature views «Design Thinking as an approach to problem-solving, innovating new products and services, and to innovate business models».

Some authors suggest that Design Thinking is an effective way to introduce and establish innovation-focussed strategies and culture in small businesses. They emphasize the significance of equipping entrepreneurs with the necessary tools to redesign their businesses (Ward *et al*., 2009; Malins, 2011; Ingle, 2013). Simultaneously, multiple authors propose a revitalization in the instruction of entrepreneurship, emphasizing the significance of providing aspiring entrepreneurs with the mindsets, abilities, and methodologies derived from Design Thinking (Neck and Greene, 2011; Von Kortzfleisch *et al*., 2013; Fixson and Rao, 2014; Nielsen and Stovang, 2015). In Nielsen, Christensen *et al*.'s (2014, 2019) exploration of the relationship between design and entrepreneurship practices, they highlight that design and entrepreneurship focus on different aspects of the innovation process. However, they also propose that combining these two domains can lead to the creation of new innovations and business ventures.

Martin (2009) argues that designers have a distinct mindset, in which the limitations of an issue are not perceived as barriers, but rather embraced as opportunities to challenge preconceptions and explore novel avenues for innovative solutions. Tackling complex problems requires integration of a different logic of thought, typical of design: the abductive logic. It is important to reflect not only on

*What is?* and *What should be?*, but it is crucial to embrace the *What might be?* perspective. Design Thinking combines induction and deduction with abduction, analytical thinking with creative thinking. For Martin, this perspective should be addressed in studies of different disciplines. He emphasizes the significance of incorporating the design approach into management education, as it may not be sufficient to tackle modern problems. Martin also argues that Design Thinking should be placed at the core of management training, emphasizing that business professionals should not simply aim to comprehend designers better, but rather strive to become designers themselves (Dunne and Martin, 2006). Specifically, this would involve incorporating principles from Design Thinking, such as user-centredness, involvement, visualization, prototyping, iterative experimentation, learning, and multidisciplinary cooperation.

To succeed in the entrepreneurial environment, it is essential to embrace a do-then-learn approach rather than a learn-then-do one. Design Thinking enables active experimentation and learning to be the focal point of the innovation process (Beckman and Barry, 2007; Liedtka and Ogilvie, 2011). Fixson and Rao (2014) analyze how the methods of concept visualization and prototyping, as well as iterative experimentation and learning, form a compass that guides entrepreneurs in the process of building prospects. The combination of divergent and convergent thinking, along with the capacity to visualize and envision hypothetical new products and services that are not currently in existence, has the potential to generate innovative and imaginative ideas that entrepreneurs can utilize to initiate new business endeavours (Sarooghi *et al*., 2019; Val *et al*., 2019).

Nielsen and Stovang (2014) specifically examine the role of Design Thinking as a creative method for solving problems. In their study they support previous assertions made by Dunne and Martin (2006) and Neck and Greene (2011), suggesting that combining practical entrepreneurship education with the open and human-centred approaches of Design Thinking can empower aspiring entrepreneurs to systematically discover innovative solutions and shape an uncertain future (Nielsen and Stovang, 2015).

This approach involves actively engaging with people and gaining a profound understanding of their needs and perspectives.

Nielsen and Stovang (2015) argue that traditional entrepreneurship education fails to prepare students to engage with users effectively. It tends to focus on quantitative market research and segmentation based on social, psychological, and demographic categories, whereas in Design Thinking, the primary focus is to establish direct and intimate interaction with users. This involves intently observing their behaviour, tracking their actions, and attentively listening to their thoughts. The objective is to gain a comprehensive understanding of how people engage with a particular problem space.

## 11.4 Why Design Thinking should play a central role in entrepreneurship

In an entrepreneurial landscape where most startup innovations have for a long time been technology driven, thanks to all the characteristics expressed above, design has slowly assumed a key role in the creation of new ventures. It is no coincidence that one of the main reasons for the failure of startups is attributed by CB Insights' annual rankings to the lack of a need for the particular product or service. Technological startups very often come up with radical innovations but do not find a need to satisfy and consequently do not find a space in the market.

For a comprehensive understanding of this premise, it is crucial to refer to the CBInsights study, which examined 378 businesses (as of June 2021) and identified twelve primary causes cited by founders for the failure of their startup ventures. From the different founders who took part in the poll it was discovered that the two principal failure causes are:

1. Ran out of cash: the initial phases of the startup process are marked by a persistent lack of resources. Nevertheless, even if entrepreneurs successfully acquire funds for their business startup, they still require additional funding to support the expansion of their startup. The primary cause of startup failure, mentioned in 38% of cases, is the lack of available cash.
2. No market need: it is frequently identified as the primary issue by professionals, consultants and researchers.

> What matters for a startup is not trying to solve a problem that is interesting per se, but finding a problem that actually matters to many people. Not by chance, the motto of YCombinator, founded by Paul Graham, is *make something people want*. In 35% of cases, entrepreneurs admitted tackling a problem or need for which ultimately there was no market. Moreover, an additional cause of failure is represented by the launch of 'unuser-friendly' products and services. In other words, the startups are failing to identify the urgent needs because of a lack of direct user engagement in their development process.

An earlier study by one of the authors (Carella *et al*., 2023) analyzed the importance of Design Thinking principles in the entrepreneurial journey of people with a non-design-related background who were faced with a design-driven path to create their new startup. Table 1 is from the cited study and shows the importance of the different Design Thinking principles for the participants. Participants were asked to rate from 1 to 5 the importance they perceived in the different principles at the end of the training course, with reference to their possible use in the development of new business ideas.

The study showed that *diverging and converging* is one of the characteristics of Design Thinking that is most interesting for aspiring entrepreneurs who do not have a design background. The reason for this is that the Design Thinking process involves a phase of exploring unconventional ideas, known as the divergence stage, followed by a phase of selecting and developing the most promising ideas, known as the convergence stage (Brown 2008). The Design Thinking application sets itself apart by effectively integrating intuition and rationality to integrate knowledge patterns that are recognized through a deliberate assessment of their relevance (Stephens and Boland 2015).

| Diverging and converging | Human centred design | Creative reframing | Learning by doing approach | Visualization | Holistic approach |
|---|---|---|---|---|---|
| 4,13 | 3,77 | 3,77 | 3,51 | 4,29 | 3,51 |

Table 1.
Importance of Design Thinking principles during a design-driven course made for participants with non-design related background (Carella *et al*., 2023).

Design thinkers consistently and actively manage the balance between options and limitations in order to create alternative and unique solutions to important problems (Liedtka, 2015).
Another essential aspect that consistently arises is the concept of *human-centred design*. The fundamental premise of Design Thinking is human centredness, which means that the starting point and focus of the entire Design Thinking process are the users and stakeholders, and considering their needs and preferences. The method used to implement this idea is empathizing with users: empathy, as defined by Connell *et al*. (2015), involves taking into account the perspectives, perceptions, physical and emotional needs, desires, and values of others. Design thinkers can envision solutions by taking a *people first approach* and by doing so they can shift their point of view to address expressed and unexpressed challenges (Micheli *et al*., 2019). As seen above, one of the most common causes of failure for startups is *no market need*. If we think about the characteristics of Design Thinking, and in particular *diverging and converging* and *human-centred design* by reference to the above, it is evident how Design Thinking can be a valuable asset to avoid the occurrence of one of the biggest problems in the entrepreneurial world. Design (thinking) allows us to start from the user, from understanding his or her needs (both explicit and latent), placing the problem the user is facing at the centre of the process. The logic of need-oriented work gives us the possibility of often finding in advance a market space in which to position ourselves later, because recognizing the need implies that there is a need to find a way for our user to solve it. This is even more amplified by the mix of *human-centred design* with the logic of *diverging and converging*. This gives us the possibility of generating different options that allow us to evaluate more alternatives and provide a more careful response to the starting problem. Furthermore, we have seen how another cause of startup failure relates to the *run out of cash*.
Over time, we have seen how this also has to do with mismanagement of funds. Startups often arrive into the market and have to create their own space, thus spending more money trying to position themselves. Once again, knowing the problem well, the related need, and the type of user manifesting these needs can enable the development of targeted actions that can reduce uncertainty.

The last cause of failure that was mentioned earlier concerns the *unuser-friendly* products and services. The lack of direct user engagement and testing also results in difficulties accessing and even using the solutions. This translates into poor understanding of the users' willingness or ability to pay which impacts the startups' pricing strategies. All of which impacts their cashflow and ability to sell their products (running out of cash more quickly impacting their need for more funding). The Design Thinking way of proceeding can be very beneficial in avoiding these causes.

It is evident how the use of Design Thinking and its properties can take on a fundamental role within the entrepreneurial process. If we were to schematize what happens typically in the *classic* entrepreneurial process, founders start with an idea, on which they concentrate all their forces to proceed with development. However, when they arrive at the end of the process they encounter various problems that make it difficult to reach the market.

A *design-driven* entrepreneurial process, on the other hand, reverses this logic, putting the *chaos* at the beginning of the process, in order to search for the best possible solution that responds to the identified problem and meets the identified needs. By the time they

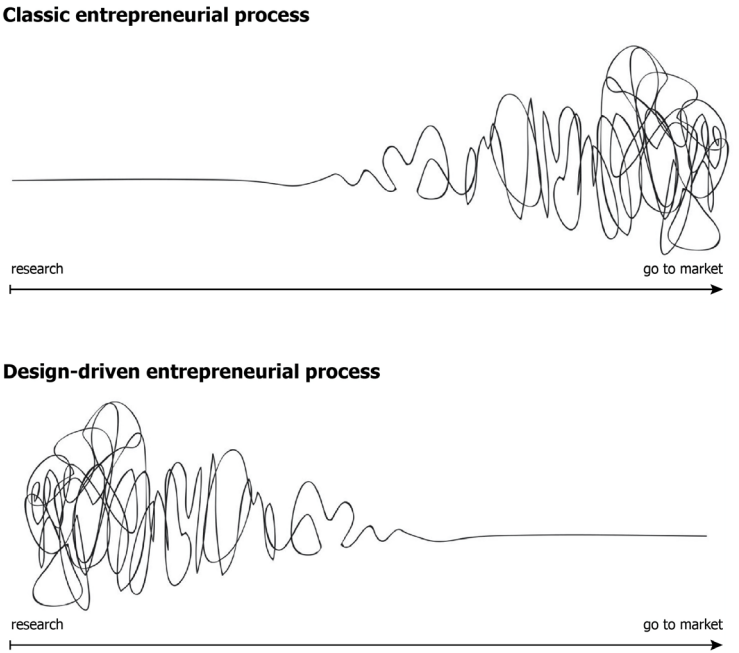


Figure 1.
Different perspectives on the linearity of the process between the *Classic* entrepreneurial process and the *Design-driven* one.

reach the market, the process presents far fewer problems, with a much higher chance of success (Figure 1).

Given the importance of innovation for the development of different countries, discussed at the beginning of the chapter, design (thinking) should be a major lever in transformation and innovation plans. Indeed, the characteristics of design (and Design Thinking) highlighted here are not only valid within the boundaries of the entrepreneurial world. There are numerous studies (see, for example, the 2018 McKinsey Quarterly study – *The Business Value of Design*) that show how using design-driven methodologies within organizations can lead to significant competitive advantages. Design Thinking has been shown to have positive benefits on organizational change and innovation (Brown, 2009); better decision-making (Liedtka, 2015); client orientation (Kumar and Whitney, 2007); and competitive advantage (Martin and Martin, 2009). There is considerable evidence to suggest that design should increasingly play a central role within different types of organizations to offer more definitive and customized solutions and enable them to position themselves effectively in the market, bringing differential value.

In a global landscape characterized by uncertainty, design-led transformations can therefore help focus innovation efforts, and reduce efforts and energies that are often unfocussed and do not lead to meaningful change.

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# 12. Social innovation: from incubating to envisioning. Recovering the strategic dimension of design in supporting social innovation

Marta Corubolo

Cities and urban environments hold a central position in discussions surrounding ongoing transformations, actively involving themselves in the exploration of strategies to navigate the inherent uncertainties of the future. These uncertainties manifest not only in the generation of social, environmental, and economic tensions but also provide an avenue for experimentation with initiatives utilizing participatory methodologies and innovative democratic processes, and the promotion and support of widespread creativity in society (Landry, 2006; Meroni, 2007; Manzini, 2015). If we look at projects implemented by cities in the recent decades, we encounter activities such as participatory budgeting, community-driven development projects, participative and creative placemaking initiatives. These underscore the critical role of cities as laboratories for experimentation and adaptation, where participatory methodologies and democratic processes are contributing to address pressing concerns while aiming at fostering creativity and resilience to change.

Such examples can be considered cases of social innovations with impacts on a cultural and social transformation, where the transform-

ative potential emerges both in the outputs as well as in the collaborative process that generates them (Avelino *et al*., 2019; Ravazzoli *et al*., 2021). Indeed, while acknowledging the debate on a shared definition of what social innovation is (Murray *et al*., 2010; Howaldt *et al*., 2018), we are here referring more to the strategies and actions that contribute to the creation of a social innovation ecosystem (Howaldt *et al*., 2018; Moulaert and Van den Broeck, 2018; Meroni, 2019) defined as a locally rooted combination of conditions, stakeholders, people, relationships, and resources working together to achieve a shared purpose and generate public value (Selloni, 2024).

This allows for a more systemic dimension and multifaceted debate around social innovation's rise, growth and potential impact, where actions of technical empowerment are coupled with cultural ones (Meroni *et al*., 2017) and where the clear-cut distinction between top-down and bottom-up is overcome in favour of meeting trajectories and hybrid dimensions (Dees *et al*., 2004; Westley and Antadze, 2010; de Bruin and Stangl, 2013; Westley and Antadze, 2013; Gabriel, 2014).

Indeed, while social innovation is commonly linked to bottom-up, grassroots projects and activist movements, there has been a significant increase in the involvement of institutions in promoting and supporting initiatives and policies. If we turn our look back to the urban context, we can see how cities and public administrations have promoted various incubation-like programmes for grassroots, citizen-led initiatives, with the shared objective to encourage citizens, informal networks and organizations to generate and develop ideas that explore innovative ways of living in uncertain times.
See, for example, the experiences of Bologna, Turin, Naples, Brindisi and Milan as the latest in the Italian context. Born as temporary programmes, all these initiatives have experimented with diverse ways and processes to attract, scout, support, and fund projects proposed by people and third-sector organizations.
These actions, on the one hand, make it possible to intervene promptly, intercepting the proactivity of individuals or small groups. On the other hand, they could benefit from a more strategic and structured action of constructing a vision of the future, not only linked to the modes of active and democratic participation of citizens (and thus to processes), but also with respect to new ways of living in a more

sustainable and inclusive way (and thus the contents). Individual agency alone is not sufficient; on the contrary, it is deeply connected with and dependent on existing artefacts, infrastructures, norms, regulations, laws, and institutions, but also on a shared sense of awareness, trust, and confidence to act in the social sphere and, more importantly, on the capacity to envision sustainable futures (Dorado, 2005; Shove *et al*., 2014).

This chapter aims at presenting a critical reflection on a social innovation incubation process, named The School of the Neighbourhoods and promoted by the Municipality of Milan, and to discuss the role of design in guiding and nurturing a social innovation supporting policy at a city scale.

Design, and more specifically design for social innovation, has been widely recognised as a discipline and an approach that can support the emergence and scaling of socially innovative initiatives. These actions refer to mainly service and strategic design.
The first is widely used by expert designers in supporting social innovators moving from the conception of an idea to the details of the experience, focussing on refining processes and interventions as well as prototyping solutions. Conversely, strategic design involves a broader perspective that encompasses sense-making as well as envisioning new possibilities and futures involving multiple stakeholders. This, together with codesign, acquires exponential importance when incubation-like programmes to support social innovation, as the one presented in this chapter, aim at exploring ways to leverage on a diffuse creativity in solving problems (thus fostering activism) and imagine alternative futures.

## 12.1 The School of the Neighbourhoods

The School of the Neighbourhoods (La Scuola dei Quartieri, 2018-23) is a programme initiated by the Municipality of Milan (co-funded by the European Union, as part of the Metropolitan Cities Operational Programme 2014-2020) and involving the Polimi Desis Lab in its design and delivery. The aim of the school is to stimulate and enable social innovation initially within fragile districts, and then on a city-wide

scale. The innovative element of the programme is the low entrance barrier (an innovative and useful intuition responding to local needs is enough) that encourages people to propose solutions aiming at prototyping new ways of living the neighbourhoods while generating public value: e.g., original models of aggregation; sustainable food-related services; alternative forms of care; and accessible and inclusive cultural initiatives. In the last 5 years, the School created a safe environment for education, experimentation, and incubation of ideas proposed by citizens that was able to attract more than 250 proposals, and to select, support and fund 56 of them with a grant up to 30,000 euros each.

The structure of the programme is organized into 4 main cycles of public calls, scouting and incubation, each lasting about one year and comprising 3 phases:

- the first phase consists of scouting activities: a free and open series of designed encounters to let needs and opportunities expressed by the neighbourhoods emerge, and to meet and guide prospective social innovators in the participation in the call;
- the second phase, named *advanced training* is about supporting selected ideas to tackle challenges and invent innovative responses and solutions while developing entrepreneurial skills;
- the third phase of prototyping and accelerating solutions provides personalized coaching, support to become a not-for-profit venture, and a project grant to co-finance the first year of activity;
- transversal actions worked to build a community of the participants and strengthen their relationships and networks with local communities and stakeholders.

What we propose here is to look back at the process of the School of the Neighbourhoods to reflect on the different applications of strategic design and the envisioning moments in the various project phases. Beyond the existing structure of the school being divided into 3 phases, it seems more meaningful to consider the process as taking place around the moments when ideas are selected.
This turning point is pivotal in distinguishing between an initial phase that is open and public, aimed at the entire city, and subsequent sec-

ond and third phases dedicated to the selected ideas, yet permeable to the context. In reconsidering the design actions in their strategic aims and how this goal can be interpreted and adapted to the various moments of the process, we will use *ex-ante* to refer to the activities prior to the selection of the ideas, i.e., actions for attracting and engaging citizens in proposing ideas, and *ex-post* to the activities that occur after the selection point, and therefore belonging mostly to the second phase and the transversal actions of networking and community building. However, it's important to note that the boundaries between *ex-ante* and *ex-post* tend to blur within iterative processes that unfold in cycles, as the one presented in the school.
This overlapping mechanism can be beneficial to the infrastructure of the ecosystem but also seems to be promising in terms of improving, refining, and reinforcing the emerging visions.

If we consider ex-ante actions, the range of designed forms of encounters can be grouped into:

- meetings and presentations to let the innovators be inspired by existing social innovators: e.g., *open lectures* from the neighbourhoods and a series of *Good Stories* from the communities, in the form of existing initiatives, projects and practices that can be ascribed as social innovations;
- tools to support participants in getting into contact with local communities (e.g., *Explore the Neighbourhood*, designed as an online pocket guide), and to explore existing assets and resources as well as criticalities and needs of the districts (e.g., a series of *On-site and Virtual Walks* of the neighbourhood);
- convivial events such as *The Ideas Festival* to celebrate creativity and proactivity of citizens as well as to scout prospective ideas and participants for the school (Figure 1);
- design tools to stimulate, improve and detail the idea of prospective participants, such as *The Fortune-Teller of Ideas*, a set of cards to generate ideas, a *What if…?* exercise to increase social sustainability, and *The Compass of the Ideas*, a tool to navigate the design of a service.

When we consider ex-post actions, we refer to a second group of activities dedicated mainly to the selected ideas and to the participants of the different cycles with the aim of building a supportive



Figure 1.
The Ideas Festival celebrates the creativity of citizens.

and widespread community. Indeed, parallel to the actions related to training social innovators, the school organized:

- a series of encounters in the form of peer-to-peer events among participants and alumni of the school;
- a series of *neighbourhood meetings* with local organizations and actors with the aim of connecting and reinforcing the local network and rely on existing assets;
- a number of public presentations to present the ideas to the public, amplifying the innovative features and thematic areas proposed by the selected ideas.

This range of activities made it possible to modulate the training process on the basis of the participants, the skills they possessed, their degree of knowledge of the neighbourhood; the thematic areas; and the varying degree of maturity of the proposed idea.

## 12.2 Envisioning as a strategic action

In the following paragraphs we propose a reflection on the strategic dimension of the activities listed here, and specifically on the envisioning dimension, related to feeding and nurturing social conversation around future visions, in order to imagine a necessary complementarity with activities more related to empowerment and training.

**Ex-ante: envisioning as exploring, stimulating and inspiring.**
The actions taken prior to the selection had two main objectives: first, to attract people and support them with their ideas in applying to the programme; and second, to achieve this goal by designing encounters that empower individuals to imagine solutions and become active, thereby nurturing their capacity to act. This approach undoubtedly represents the adoption of a strategic perspective, where the envisioning phase is crucial when connected to exploring existing resources and detecting needs, criticalities and desires.

Figure 2.
Peer-to-peer events, *neighbourhood meetings* and public presentations.

Additionally, it stimulates the ability to shape alternative models and inspires them through existing promising stories and cases.

What emerges is a tradeoff between the individual dimension – linked to personal needs, intrinsic and extrinsic motivations related to the programme, and creative capacity – and the collective dimension, which encompasses an imaginative vision of the future linked to the neighbourhood scale and has a longer transformative horizon.

While the actions undertaken were undeniably successful in engaging people and ideas, the envisioning process was only partially built from the exploratory and narrative phases. It did not produce a clear, structured, shared and coherent set of visions in the initial phase, even if still open and debatable. Conversely, it proceeded in driving and sustaining the creativity of the individual and informal groups, being prompted by their intuition.

Moreover, this preliminary work was partially facilitated at the beginning of the programme by limiting the territorial scale to a few neighbourhoods, while it became even more complex when envisioning futures at the city level. The design of a set of visions could have strengthened both the aspirational aspect and the connection to existing resources and actors while maintaining an innovative, even radical, character. We can assert that in the case of the school and its ex-ante actions, the individual agency dimension prevailed over the collective one, supporting through design tools the effort of the social innovator to synthesize needs, resources, and opportunities, and to project them into the design of a solution.

**Ex-post: envisioning as connecting and reinforcing.**

Reflecting on the actions conducted ex-post, while succeeding to engage local stakeholders and initiate a community of the school, they worked mainly on explicating possible connections among peers and with organizations, in reinforcing the technical skills and solving practical needs.

If we look at the 56 ideas in the 4 cycles of the school, we can observe how common and coherent interpretations of alternative ways of living emerge, both thematically and territorially. For instance, we can refer to the theme of food and its relationship to care and proximity (Corubolo and Meroni, 2023), or to projects that envision a precise

vocation of a neighbourhood in caring for the natural environment by relying on existing infrastructures. This initial action of connecting the seeds of *sense* expressed by the ideas of the school could formulate again an envisioning process able to reinforce and sustain change, as well as reducing the risk of the dispersal of efforts into isolated projects lacking thematic and spatial cohesion, and capacity to scale.

Indeed, the potentiality of adopting strategic design lies in the ability of expert designers to carry out a more robust interpretative work that connects, reformulates, reframes, and reinforces contents and thematic areas emerging from the selected ideas and transforms them, for example, into alternative scenarios that resonate with a broader audience.

Embedding a more consistent envisioning phase not only *ex-ante* (with a scouting objective) but also *ex-post*, could have benefitted both the ideas and the social innovators, as well as the overall programme which involves neighbourhoods, organizations and policy makers. On the level of ideas, this could have nurtured the scouting phase of subsequent cycles, supporting the creativity of future social innovators to generate more refined and innovative proposals. Additionally, it could have strengthened potential synergies between existing and new ideas, thereby encouraging an incremental as well as exploratory approach to innovation. Here, *incremental* aligns with the concept of creating contexts for experimentation where peers, innovators and neighbourhoods benefit in a shared and reciprocal way, especially in cyclical processes. Adopting such an approach could have led to broadening the conversation at every cycle, engaging stakeholders in a wider codesign and coproduction action around the future of a neighbourhood. Moreover, it could have contributed in shaping policies that could support and sustain the transition proposed by the visions through this process.
This could bridge the short-term and present perspective of the ideas and their prototyping approach supported by the school to the long-term view of an ecosystem able to sustain a transformation and embed a systemic dimension.

We can say that the 56 ideas of the school potentially «exemplify systemic changes at the level of everyday experiences» (Meroni and Sangiorgi, 2011), where the values embodied by the social innovations

must be recomposed in a strategic perspective. The emerging promising practices, while certainly proposing changes at the neighbourhood scale, does not have the social and political strength to mobilise public policies capable of sustaining large-scale systemic changes. The role of the designer here is to contribute to set in place a structured and recognizable envisioning process able to link the niche level with the broader one.
Indeed, this creative leap between the two levels is a skill and sensitivity inherent to expert designers which refers to the sense-making capacity of connecting, interpreting, translating, and projecting, together with the ability of contributing in an infrastructuring process, as a continuous process of building relations with diverse actors to foster social innovation (Hillgren *et al*., 2011). Moreover, when we refer to the cultural role of design, we must also include the need to nurture a critical view towards visions composed of values, new relationships, infrastructures (including cultural ones), and existing or prospective policies. Using the words of Manzini (2015), recovering the strategic dimension means to adopt a design culture «which is what is needed to feed both a critical sense (of the current status of things) and a constructive attitude (proposing values and vision in which to imagine the new)».

In this phase, especially in the Milanese context, we are witnessing a shift from temporary programmes to stable policies.

When supportive processes for the initiative of individuals and small groups become continuous and iterative, it is even more necessary to balance technical empowerment with strategic visions and contents; the fruition of incubation-like tools and programmes with a process of shared construction of meaning; a series of actions dedicated to a number of selected idea with a broader conversation within an ecosystem able to elicit opportunities and evolution, thus broadening the scope and duration over time, while consolidating emerging results.

## 12.3 Conclusions

As discussed in several arenas, social innovation is a key element in creating more resilient societies. In fact, from a design perspective in particular, social innovation is a process that, at the same time, implies and results from empowering people to overcome difficulties by using creative thinking and problem-solving, looking at problems as opportunities, and becoming open to change.

Moving beyond the more technical and incubation-like support provided by methods and tools of service design, this chapter proposes the recovering of the strategic role of design as a fundamental element in increasing the impact and the generation of public value and to support the transformative potential of social innovation. Such a process of 'thinking together about the future' is a way to support participants and society at large through the imaginative power of design, developing the *public imagination* (Selloni, 2017) and refocussing on the contents alongside the process.

A design-driven envisioning process not only attracts coherent solutions but also facilitates their mutual reinforcement, the sharing of resources, the establishment of local networks of stakeholders, and the growth of a vocation for the neighbourhood. Moreover, the initiatives emerging from a scouting phase, guided by a strategic vision, open up space for experimentation for innovative, often thematic and vertical, forms of policies, crucial to sustain the change over time and to scale up from a local neighbourhood dimension.

For design to maintain a central role, it must reclaim its capacity to shape future visions that not only captivate interest but also elicit proactive engagement from diverse stakeholders. Without this strategic dimension, design risks relegation to a more technical and less culturally impactful position, limiting its capacity for intervention to a less systemic and less influential role in fostering lasting and transformative change.

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The volume presents a series of studies and reflections on how design is approaching the transition towards more uncertain futures. Starting from a shared understanding that we are facing radical transformations of our physical and social world, all the authors embrace a systemic perspective to position the role of design in addressing these challenges.
The chapters present novel ways of integrating new disciplines such as data analysis, artificial intelligence, neurosciences into practice and theory and explore the extension of design processes to develop new frameworks for tackling major societal and environmental changes.
One of the main conclusions of the book is that the complexity of the challenges, and the systemic approaches needed to address them, mean that the efforts can only be collective and multidisciplinary. No single project or single design group can take on board the range of transformations, collectively, however, each project can contribute to creating elements which become components of innovation that in turn can be mobilised by other systems.

FrancoAngeli
La passione per le conoscenze