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FUTURE SCENARIOS



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SCENARIOS**

Design Technology Practice

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BACKCASTING THE XXI CENTURY

Digital culture and tacit knowledge for the future of Architecture

DOSSIER

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Introduction

Technological change and its social implications have in recent years become a topic of intense interest and fierce debate. Human actions are driven by cultural, economic and political forces that have unforeseen consequences and side-effects, as we have recently noticed.

Climate related risks for natural and human systems (drought and precipitation deficits; sea level rise; species loss and extinction; health risks, livelihoods, food security, water supply, human security, and economic growth) are reaching higher and higher levels (IPCC, 2019) and we are asked to rethink and redesign ourselves as users of life in close and interrelated familiarity with the environment.

This scenario overwhelms us with a sensation of uncertainty, of accelerated times, of technological transformation and rapid social changes that create concern and profound expectations at the same time.

This paper will focus on the architectural project as the center of a new debate, able to build complex scientific, social, political and cultural point of views, in a period where the downturn of anthropocentric perspective is radically changing our approach to design, technology and materials given their impact on resources.

The question we will try to answer along this paper is mainly: How can we direct our knowledge today so that – as designers – we can re-balance our impact on the planet and literally ‘build’ our future?

Of course, there’s no linear and obvious answer.

Backcasting XXI century: the European Green Deal

“What is to come” is not a new question. As humans, we’ve always adapted our being in the

world through artifacts and tools, building spaces to give a (precise) shape to the image of the future environment in which we will live.

In the field of futuristic studies, the traditional forecasting approach is still dominant, where the idea is to make previsions on mainstream trends.

However, in complex systems like the human habitat, this approach will hardly generate solutions that could be long lasting: the premises change fast and subjectivity of action doesn’t allow a unique direction.

In Architecture, a more interesting approach is backcasting, intended as a method to analyze the future with the focus on a preferable scenario.

The fundamentals of this approach were outlined by John B. Robinson in the nineties in his famous paper *Unlearning and backcasting* (Robinson, 1988), where he stated that to change

the present it’s hard to use forecasting previsions, as their success depends on the correctness of the hypothesis, which usually are present related. Backcasting deals with the implications of a specific scenario, and thus does not rely only on the accuracy of the prevision but more on the policy and path that can be set in order to reach a preferable scenario.

This approach is still meaningful today as it is less concerned with a possible, plausible or probable future (as futurists are) and more with the construction of a progressive knowledge, a set of skills and policies for a feasible scenario that runs from a future end-point to the present (thus ‘backcasting’).

In this perspective, Architecture can give a real contribution to the debate on cities and dwellings in a variable and multi-cultural fast-changing society. The question is not to anticipate the future but to build socio-technical scenarios that are relevant and have the capacity to shape our built environment.

In a backcasting perspective, new processes, production methods, construction systems, advanced materials and experimental technologies have to consider environmental protection, social equality and people’s health and well-being as priority goals. In this domain, the European Commission presented at the end of 2019 the “The European Green Deal” for a fair economic transition, which is expected to help facilitate the path to climate neutrality by 2050.

The objective is to protect, conserve and enhance the EU’s natural capital and mitigate environmental risks at the same time, while making this transition just and inclusive. Moreover, construction is considered one of the resource-intensive sectors, like textiles, electronics and plastics (The European Green Deal, 2019).

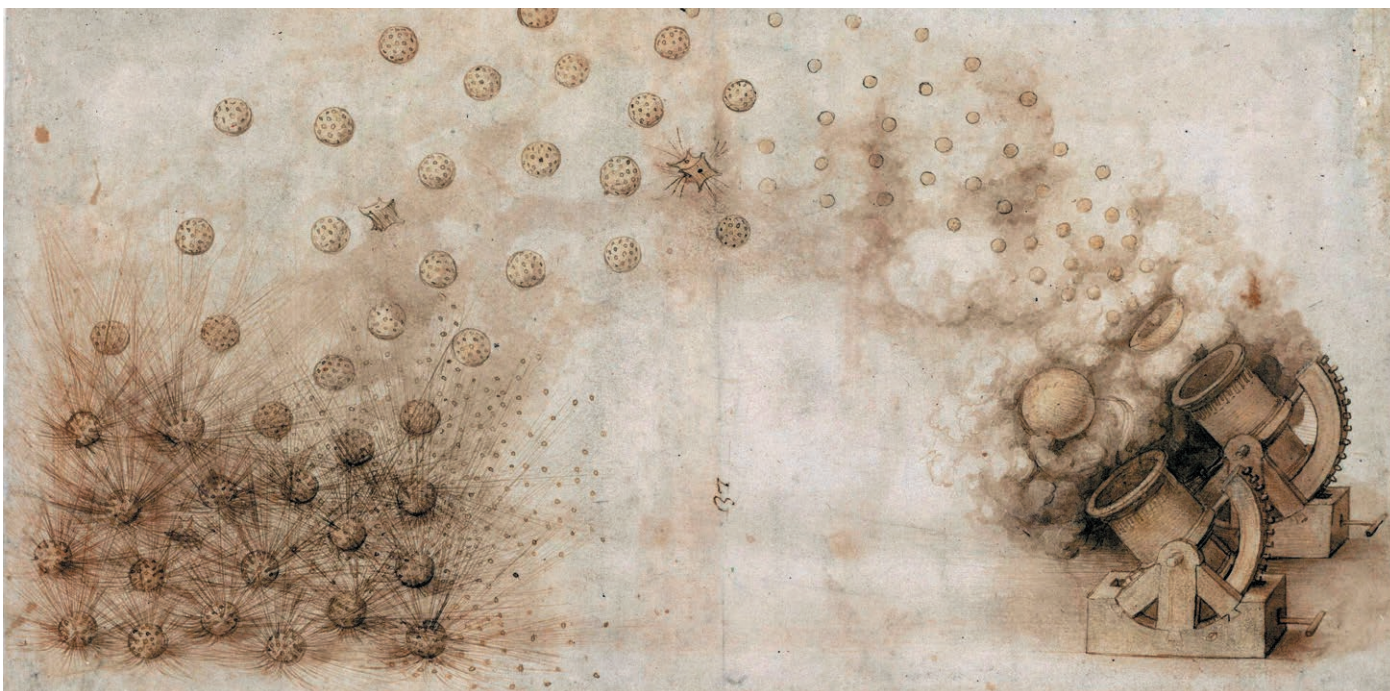
In the document, at least three aspects should be underlined in a backcasting perspective as they have a peculiar relevance for architecture and the built environment.

The first is the consciousness that there are no borders. The recent events are very clear in this direction: it is not possible to think that environmental impact can be bound to a European context only.

If buildings are efficient only for some specific northern cities in Europe, the risk is to have carbon leakage, meaning just shifting carbon production somewhere else.

And somewhere else means in countries where environmental regulations are loose or not respected. The fatal mistake is widening the “waste divide” between rich “clean” countries and poor or unregulated ‘dirty’ ones. This is not acceptable from the point of view of a collective responsibility.

The second is the growing relevance of circular design and waste management.



01 | Leonardo da Vinci drawing

This drawing expresses the tentative to fix the lines of movement, striving to see the network of forces that arise from a bomb blast. As the world is rapidly changing, increasingly interconnected and linked through networks, this image is evocative of the constant correlation of cause and effect, we should never forget
Marini, P. (2009), *Fortezze, bastioni e cannoni: disegni di Leonardo dal Codice Atlantico*, De Agostini, Novara, p. 58

One of the targets related to construction is to reduce potential waste significantly, and where waste cannot be avoided, its economic value must be recovered and its impact on the environment and on climate change minimized.

«More specifically, waste in architecture is simultaneously the interhuman fabrication of the absence of value, a misreading of the laws of nature, and a condition which denotes worth, isomorphically, by means of both its own existence and nonoccurrence. The idea that something can be worthless» (Osseo-Asare *et al.*, 2019). Here is a first suggestion for our 'backcasting approach'. Thomas Rau has written a 'material universal right chart' focusing on the idea that waste is nothing other than a material without identity (Rau, 2018). If we can keep value as long as possible, we can avoid any material system being left behind. In this scenario, circular design can become a common methodology and guidance principle to prioritize reducing and reusing materials before they become waste (if any).

The aim of the Green New Deal is to try to give possible scenarios of cooperation among different figures that can really foster a roadmap to change, thinking about who, what and how. Designing buildings and spaces is more and more an activity that involves different figures, including – from end to end – final users and policy makers.

So here stands the third important aspect: the need to identify forerunners.

The Deal is quite attentive in trying to identify forerunners that could bear the economic, cultural and social responsibility of innovating with its high risk and low initial revenues. This is a critical issue: if the socio-economic environment has no advantages to foster innovation, all the action will remain on paper. Who are the forerunners in architecture?

Two entangled aspects will be touched on, before giving an answer, to enable the change we are looking for: how digital tools will impact design and its way of pushing creativity and how tacit knowledge, a crucial part of design research and practice, can boost a novel visionary ability to direct transformation.

Digital culture and design

The introduction of digital technology in practice has allowed contemporary architects to work embedded in a speed, scale, and level of complexity previously only dreamed of. While traditional demands of real estate placed on practice have remained relatively constant, the means by which those expectations are fulfilled, and the conditions they play out within have changed. Contemporary collective assets of information technology, artificial intelligence and computational tools however allow an unprecedented background knowledge.

Algorithmic advancements enable designers to perform multiple configurations in a relatively short time without iteratively requiring changes until they satisfy all the relevant criteria and are economically efficient. A proliferation of expertise has been facilitated by many tools that render this array of knowledge operational. Developed primarily for purposes of efficiency and accountability, these work platforms slowly become a space and possibility for self-reflection, judgment and design.

In a world going towards a higher degree of automation, algorithms are already replacing repetitive tasks and augmenting human creativity in the design process. The human-machine collaboration is reducing the time spent on routine work, enabling designers to focus on more complex tasks that require more cultural and technological skills.

But at the same time, automation, especially when linked to optimization can become a “soft cage”. Even if the risk of degenerating into aesthetics (as the sixties’ Debord’s sharp idea of “Society of Spectacle”) is already outdated, a true data connection between phases should be pursued – intended as information passing along models without any need for rebuilding – generating unexpected connections and breaking boundaries where new competences arise (Cache, 1999).

Thus rooting form generation into decision making processes seems to be a key in the networked society of information, where the time needed for architectural design to arise can suffer from a difficult pace of change typical of many contemporary processes. It seems that while data evidence is increasing, it is crucial to set the boundaries of its use and responsibility. How much are we favorable to sharing information where it has crucial economical value? If open access is a preferable path, the management of data becomes even more important where artificial intelligence, and in particular machine learning, enters the field of Architecture.

Filtering and shaping data ethically becomes the crucial issue.

These suggestions come from a scenario where designers work with data coming from a digital environment interacting in a network of relations that is not explicit and not only individual. The digital affects each decision we make as a new ‘invisible’ but not immaterial environment with which to implement research and practice.

Machine learning, with its neural networks, has so far introduced a new form of “distributed” knowledge founded on the collective experience represented by big data. Floridi states the boundaries between life online and offline break down, and we become seamlessly connected to each other and surrounded by smart, responsive objects; we are all becoming integrated into an “infosphere” (Floridi, 2014). The enormous ‘cloud’ to which we gift our precious data and memories is a new habitat with no friction and limits.

Tacit knowledge as an anticipatory (creative) tool

Dimension (Polanyi, 1983), it describes human knowledge not only as verbalized and theorized, but also as intuitive, experiential and physiological.

It is important to emphasize that tacit doesn’t mean only “implicit” but has more complex implications, such as the physical implication of gestures, the link with materiality and intentionality of behavior, the relation with the environment through body language.

The typical example is the apprentice who observes the carpenter

and by watching his hands internalizes the fine knowledge and expertise.

In Architecture, tacit knowledge refers to what is called ‘research by practice’ or the ability to develop innovative content through design activity. The project is understood in its pro-iecto etymology, which means to throw forward, allowing to imagine innumerable possibilities.

Many argue that tacit knowledge is linked to personal practice – praxis, that is to say a mix of experience and expertise acquired in one’s own cultural context, and to habitus as Alain Bourdieu stated, the way in which individuals perceive and react to the social world that surrounds them (Bourdieu, 2010).

However, the contemporary socio-technical scenario has blurred borders. Already in the seventies the idea was that: «technology/biology, pure/applied, internal/external, subject/object and technical/social are some of the dichotomies that were foreign to the integrating inventors, engineers and managers of the system- and network-building era. [...] the dichotomies would promptly evaporate» (Bijker *et al.*, 1987).

We can build our path to the future thanks to an instinctive approach that goes beyond the spoken and beyond the mere practice activity, and enhances the designer’s anticipatory capacity. This capacity is fostered by different tools overlapping: hand sketching, digital or physical modeling, imagining, making, in an entanglement of means and meanings.

This direction defines a new typology of tacit knowledge today in Architecture.

This tacit knowledge is not something outside us, not only a way of interiorizing some knowledge from practice, but it is literally “through” us: thanks to the pervasive digital culture and its prosthesis (tools to design, data set, “clouds” of our memory everywhere) a new way of learning and creating is being shaped. We are nearer to competence without comprehension, in a similar way to the ubiquitous life of bacteria, hunting and animals than to a structured rational reaction to the environment.

Gestures here are intended as “reflection-in-action” not only through imitation but through novel cooperation between analog and digital technologies. Matter is no longer the primary wellspring of creativity where a form is applied but it is extended by its immaterial twin, which increases its power.

Our mimicking movements in a digital realm allow a non-verbal rise of knowledge that influences us at an unbelievable level.

As an example we can take the case of google glasses: if we start looking at the built environment with such a device, or even, design it, which images will come back to us? As creativity comes from the imaginario we have inside ourselves, this breaking new process starts, stops, ebbs and flows dynamically and continually.

02 | Leonardo da Vinci drawing

A complex mix of representation of reality, of visionary ideas, of techniques and disciplines, of lines moving one into another without interruption. There is no waste, no discard, nothing to exclude to build a common responsibility. Saggio delle opere di Leonardo da Vinci, tratti dal Codice Atlantico, Ricordi, Milan, 1872, tavola XVIII

03 | Leonardo da Vinci drawing

This drawing has different languages in the same paper domain. It reminds us that imagination, nature, artificial and language are an unicum able to really build unexpected scenarios opening paths for innovations to come. Il codice di Leonardo da Vinci nella biblioteca del Principe Trivulzio di Milano, Angelo della Croce, Milan, 1891, tavola 3A

It can be banal, but if we think of it, everything that is built around has been first imagined.

‘How then can tacit knowledge, and with that digital continuum, gain a degree of command while remaining open and free within the medium being worked? (Bardt, 2017).

One more step. “Tacit knowledge is not only influenced by moral, cultural and scientific authorities, but is also first realized within the social boundaries generated by them” (Mareis, 2012). This means that creativity and innovation have to incorporate our vision of present and future and orient our purpose in the backcasting perspective of an equal society with a carbon-neutral, sustainable and clean environment. This scenario needs a collective engagement, which becomes the new way of acquiring knowledge and incorporating social issues. The worrying times request a common ground of values that can support a sovereignty that walks on crutches (Bauman, 2016).

Forerunners

So what is the roadmap to reach the scenario we have drawn in a back-

casting perspective for a sustainable society and environment?

We think that it is the construction of a socio-economic context that allows the experimentation of new design practices, innovative data driven processes, experimental material systems as a privileged way to take the risk of innovations.

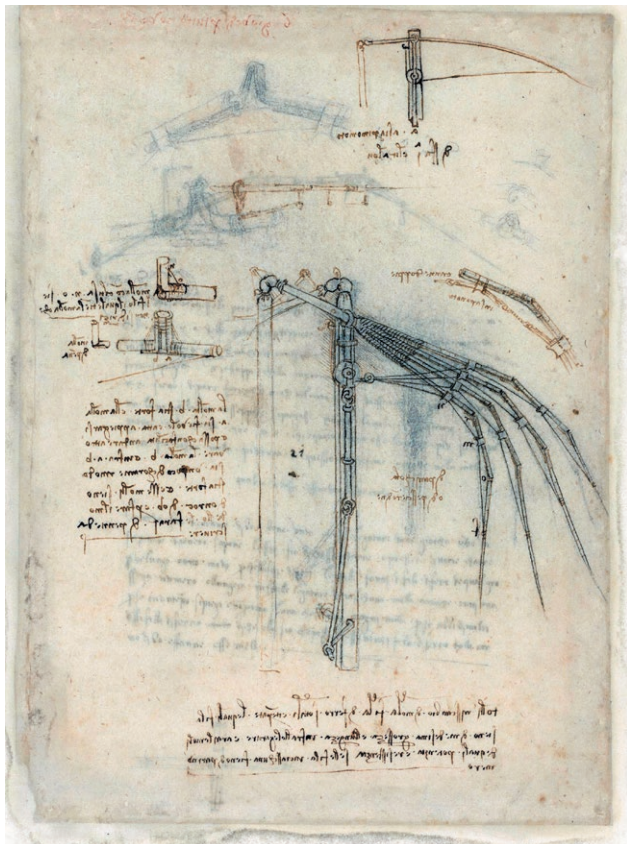
This challenge should not be frightening. Recognizing culture and creativity as assets for our future desire, and at the same time sustainable and inclusive growth, the conclusions we address are linked to design for different expressions of cultural enhancement, opening critical reflections on the role of architecture.

The recent events show us how vulnerable we are: viruses frighten us, climate change hits us and pollution requires us to change our habits and habitat. A habitat that is near to a novel Umwelt, which is a German word that means at the same time “environment” or “surroundings”, defining a domain of the space that is simultaneously material and immaterial.

At the same time, we are facing immense horizons of new knowledge that, while continuously influencing the rate of change, is the result of the new technologies and methods of information production and collation.

How can we thus be forerunners as this period is asking?

02 |

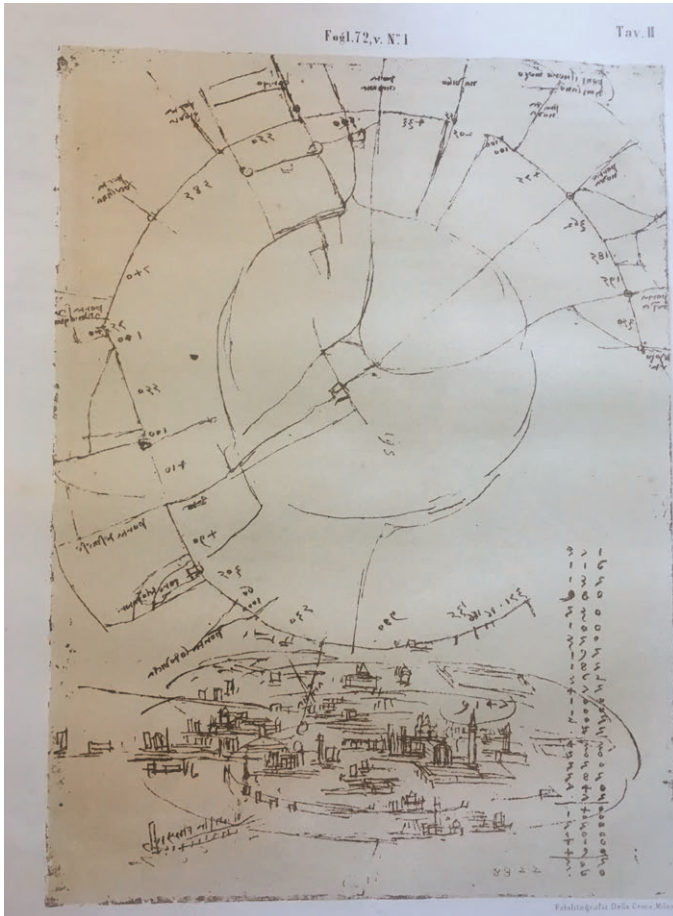


| 03

The city in plan and its blurring borders and interconnected relations are for Leonardo the most powerful tool we have, as humans, that is imagination. Imagination is – somehow – already, a way to build

Saggio delle opere di Leonardo da Vinci, tratti dal Codice Atlantico, Ricordi, Milan, 1872, tavola II

04 |



«Designers are, by nature, an opportunistic species. They work with and on problems, finding or creating openings from which to make things» suggests Ann Pendleton-Juliann.

The convincing hypothesis is that designers can drive forces and be effective in negotiating change. The entanglement between imagination and action can be the driver of new practices that are both responsible for, and a product of our emerging global society.

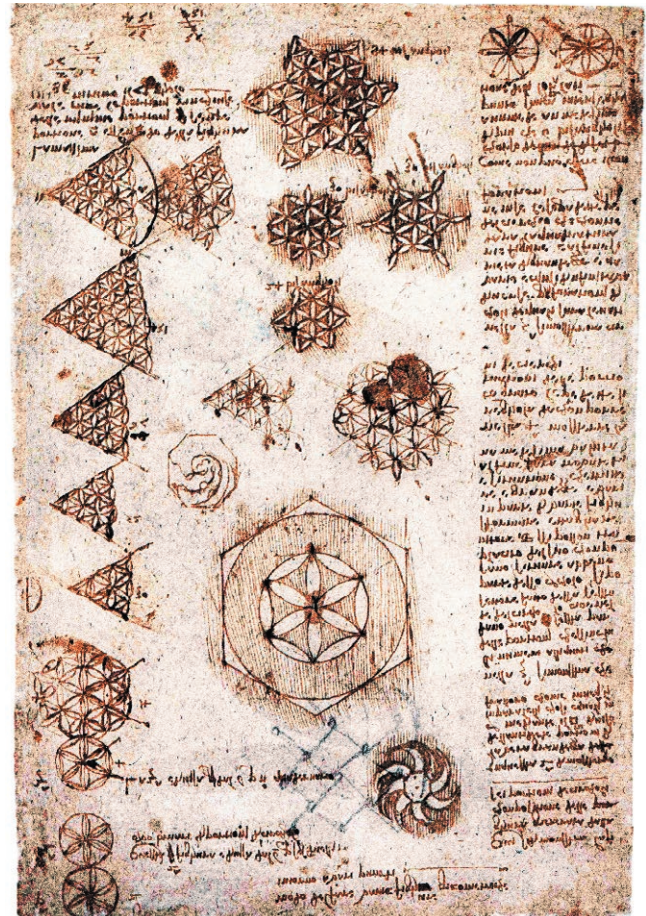
Agency becomes the deep understanding of an environment where the two ends (imagination and action) are not mutually exclusive and are both engaged in a mixed reality of digital and analog.

Within this dynamic, dialectical or polarized positions are not as productive as they once were. The paradigms of edge versus core, 'learning about' versus 'experimenting with', or, in our case, research versus practice blurs in the concept of overlap, transition or gradient. Consequently, architectural designs are the result of complex and occasionally conflicting sets of requirements

In the geometrical structures related to the ornamental structure named today "Flower of Life", bottom and top are reversible and parameters become a pattern. A contemporary way of composing and computing form and meaning

Codice Atlantico, folio 459r - https://commons.wikimedia.org/wiki/File:Leonardo_da_Vinci_%E2%80%933_Codex_Atlanticus_folio_459r.jpg

|05



that can only be reconciled through processes of negotiation between different disciplines and different fields of knowledge.

Every activity of a designer, like sketching, drawing and model making, merges imagination, techniques, languages – either physical or digital – in a unicum able to really build unexpected scenarios and open paths for innovations to come. It's a renewed collective tacit knowledge that empowers architects, as forerunners, of a bigger responsibility towards societal changes and environmental issues.

«In this zone of entanglement – this meshwork of interwoven lines – there are no insides or outsides, only openings and ways through. An ecology of life, in short, must be one of threads and traces, not of nodes and connectors. And its subject of inquiry must consist not of the relations between organisms and their external environments but of the relations along their severally enmeshed ways of life. Ecology, in short, is the study of the life of lines» (Ingold, 2007).

REFERENCES

- Bardt, C. (2017), *Material and Mind*, Mit Press, Cambridge, USA.
- Bourdieu, P. (2010), *Outline of a Theory of Practice*, Cambridge University Press, Cambridge, United Kingdom.
- Cache, B. (1999) *Projectile*, AA Publications.
- Debord, G. (1967), *Society of the Spectacle*, Bread and Circuses Publishing, U.S.
- Floridi, L. (2014), *The Fourth Revolution - How the Infosphere is Reshaping Human Reality*, Oxford Press.
- European Commission (2019), *The European Green Deal, Communication from the Commission to the European Parliament, the European Council, The Council, The European Economic and Social Committee and the Committee of the Regions, COM (2019)*, Bruxelles.
- Ingold, T. (2007), *Lines a brief history*, Routledge, London, United Kingdom.
- Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I., Lonnoy, E., Maycock, T., Tignor, M. and Waterfield, T. (2018), "An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty", in IPCC (Ed.), *Global Warming of 1,5°C*, Geneva, Italy.
- Mareis, C. (2012) *The Epistemology of the Unspoken: On the Concept of Tacit Knowledge in Contemporary Design Research*, Design Issues, Vol. 2, Mit Press, pp. 61-71.
- Pendleton-Jullian, A. (2009), *Design Education and Innovation Ecotones*.
- Polanyi, M. (1983), *The Tacit Dimension*, MA Peter Smith, Gloucester.
- Osseo-Asare, D. K. and Abbas, Y., (2019), *Files 76 - Waste.*, AA Files.
- Rau, T. and Oberhuber, S. (2018), *Material Matters*, Edizioni Ambiente, Milan, Italy.
- Robison, J.B. (1988), "Unlearning and backcasting: Rethinking Some of the Questions we Ask about the Future", *Technological Forecasting and Social Change*, Vol. 33, pp. 325-338.
- Bijker, W.E., Hughes, T.P. and Pinch, T. (1987), *The social construction of Technological Systems*, Mit Press, Massachusetts, USA.

