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Disrupting Geographies in the Design World

Proceedings of the 8th International Forum of Design as a Process

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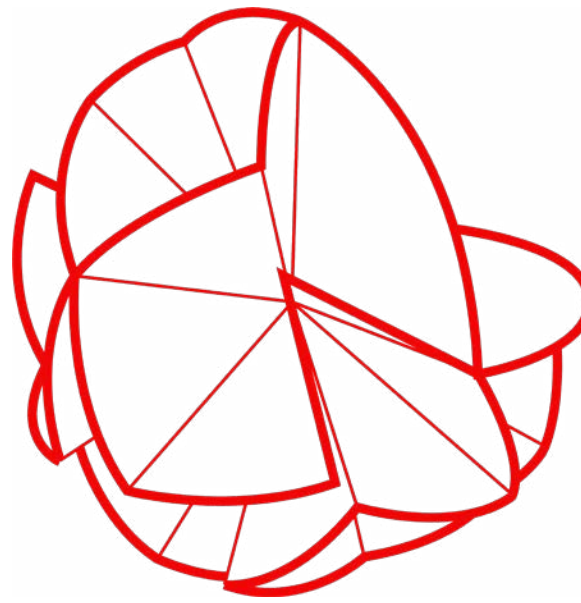

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IF THIS THEN THAT
Broken Linear Logic. Rethinking and Representing the Design Process

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Abstract
Since its origins, the discipline of Design has developed in close connection with technological progress, trying to adapt its processes, approaches and methodologies. What we are questioning is how much Design has actually been successful in converging towards a disciplinary model suitable to the most recent technological evolutions such as AI and data-driven approaches, and, first of all, how much the way of thinking of designers has changed in this direction. Through an evaluation of design approaches, methodologies and processes from an historical point of view, the aim of this paper is to surface the misalignment between contemporary design processes logic and the linearity of its common representations, due to recent technological advancements. In fact, the representation of a process affects the epistemology of the process itself. This contribution presents on-going research based on literature review and mapping of contemporary design processes structures and representations, in order to define some good attempts and practices useful for building more reliable representations of design processes able to deal with challenges in a highly-technologically advanced present.

Keywords
Design process representation
Artificial intelligence
Antidisciplinarity
Design thinking
Creativity

Introduction

This paper contributes to the topic of "Design and Responsive Technologies for Human Wellbeing," recognizing that technology, as the key element of this track, goes beyond practical applications on products and bodies. It fundamentally relates to the design process itself. Positioned within the broader context of the 8th Forum of Design as a Process, our contribution focuses on the overarching concept of Design as a Process. In our perspective, technological advancements have significantly influenced design processes and their representations, cutting across all the proposed tracks.

Before delving into the specific applications of responsive technologies for human wellbeing, it is crucial to reflect on the intricate relationship between technologies and the design process. Through an extensive literature review, we have identified gaps, particularly in the representation of design processes. Traditional representations often fail to align with contemporary design practices, characterized by inter/multi-disciplinary projects addressing complex and wicked problem spaces.

Recognizing that, we question the extent to which Design has successfully converged towards a disciplinary model suitable for recent technological evolutions, including AI and data-driven approaches. Additionally, we investigate how designers' ways of thinking have evolved in this direction.

The aim of this paper is to evaluate design approaches, methodologies, and processes from a historical perspective, shedding light on the misalignment between the logic of contemporary design processes and the linearity often portrayed in their representations. This misalignment can be attributed to recent technological advancements. The representation of a process significantly influences its epistemology. Drawing inspiration from the concept of "If This Then That" derived from coding culture, which describes a deterministic approach, we argue that contemporary representations of design processes should embrace non-deterministic and non-linear approaches. By doing so, we can positively influence the way we design in the contemporary context.

Through an exploration of various case studies, we analyze the historical progression of design process representations. From the conceptualization of Industrial Design and its alignment with mass production processes, to the subsequent shift towards user-centered and human-centered design models, we observe a gradual evolution. However, as design increasingly deals with complex and wicked problems, there is a notable lack of representation models that move beyond linearity.

The representation of the design process has gradually shifted towards depictions of the space and relationships in which projects are embedded. This shift acknowledges the need to move away from normalizing the designer's work and instead supports exploration and the surfacing of meanings. As complexity increases, design processes require non-linear logics, probabilistic dimensions, multidimensional and dynamic representation models, and integration of variables and multiple dimensions. By embracing these approaches, design can effectively navigate the complexities of the contemporary context and the underlying conceptual models that inform responsive technologies for human wellbeing.

A brief history of linearity in design processes representation

During the history of design as a discipline, design processes have been mainly represented through linear models. Starting from the conceptualization of Industrial Design, the discipline evolved at the same time as mass production processes (Celaschi et al., 2019), gradually distancing itself from the craft dimension of the project, in favour of a greater relationship with production systems. In this period, the linearity of the design process is attributable to production processes standardization, which characterised most part of the 20th century and led to the abstraction of design processes as a sequence of pre-determined phases during the 1960s (Vitta, 2011) Tab. I.

Since the 1980s, design processes have evolved due to the major diffusion of computer systems, which started becoming a commercial product that needed specific attention in designing ways of interaction with humans. In this context, the focus of design processes has progressively shifted away from the product and its production technology, in favour of design models centred on human beings, considered initially as "users", as in the case of User-centred Design, and then in "humans", as in the case of so-called Human-centred Design. The main difference between those two approaches is that in the first case the needs of humans are included only for what concerns the experience of humans as final users of a product, while in the second cases the concept of human needs is broadened and includes also other aspects of human life. Those new paradigms have made it necessary to re-think the design processes in order to include specific phases related to user and human research inclusion, but have mainly been represented through linear models, sometimes including iterations.

Gradually, design as a discipline started to deal with so-called *wicked problems* (Rittel & Webber, 1973; Tonkinwise, 2015), i.e. complex problems that are seemingly impossible to solve through traditionally tech-centred approaches as they are characterised by the interaction between different social spheres. For this reason, as a result of technological and environmental transformations, the concept of human-centred is relocating in favour of systemic approaches that consider the centrality of multiple subjects that include both human and non-human subjects (Forlano, 2017; Tironi et al., 2022). Moreover, global transformations, such as climate change or the covid-19 pandemics, cannot be addressed simply by using more resources or applying more control: Design needs to rethink its models and practices in order to respect different ways of knowing, understanding and creating the world (Escobar, 2018). Even in this context, there is a lack of design process representation which is not characterised by linearity.

COMPLEXITY	PROBLEM-ATIC FIELDS	DISCIPINARY FIELDS	APPROACHES	TECHNOLOGY PROCESS PUSH	MODEL
1 Complexity Factor Or Low Complexity Level	Artefact/Product	Engineering	• Process Tech Centred (1960s) • User Centred (Late 1970s • Human Centred (1980s)	Mass Production	Linear
<=2 Complexity Factors	Service	Engineering and Social Science	• Design Thinking (1990s) • Human Centred (1990s)	HCI	Linear but Iterative
<=3 Complexity Factors	Multistakeholder	Engineering and Social Science and Hard	• Systemic Design (2000s) • Participatory Design/Co-Design (2000s) • Speculative Design (2010s)	Web/Mobile	Linear but Iterative
>3 Complexity Factors	Wicked Problems	Engineering, Social Science, Hard, Environmental Sciences (And the Diffusion of Various Studies	• Systemic Design (2000s) • Transition Design (2010s) • More Than Human Design/Post Human Design (late 2010s) • Design for the Pluriverse (2018)	AI/ Ubiquitous Computing/ IOT	?

Tab. I
The table shows how with the progression across time, as complexity increases, the representation of the design process stops at linear models.

In an attempt to understand how, and if, the ways in which we represent design processes influence how we actually *do* design, we have systematized some of the above-mentioned approaches and movements into a matrix Tab. I. We have selected at least two significant *approaches* per decade, starting from the 1960s to the present. The lack of a representation model is immediately evident relating to clustered approaches in the last row of the matrix, i.e. what is marked with a question mark in the bottom right-hand corner. First, we matched the *problematic field* that went from artifact/product to service, then to multistakeholder and finally to wicked problems, a class of social system problems that are poorly formulated, where information is confused, where there are many customers and decision-makers with conflicting values, and where the ramifications of the whole system are completely confused (Rittel and Webber, 1973). So, wicked problems are those that recognize the complex interdependence of different factors and stakeholders, rather than simplistic and linear cause-effect abstractions that isolate the design product from its context.

For each approach, we have defined a main *disciplinary field*, noting a progressive difficulty in defining disciplinary boundaries. In this context, paradigm changes due to *technological pushes* have been considered, as they present a relation also with the definition of a disciplinary context itself. Then, we have defined different *levels of complexity* in order to group and classify each approach, starting from the principles defined by Coyne (2005)[1], who has defined wicked problems as problems characterised by three or more levels of complexity, and by a fundamental unpredictability and uncontrollability beyond a very limited scale of space and time.

This framework led us to understand that a growing technological process is related to a growing level of complexity, which lead to a major diversification in involved disciplinary fields and approaches. What is unvaried, is a tendency in representing design processes still with linear models.

1
Wicked problems persist and are subject to redefinition and resolution in different ways over time. Wicked problems are not objectively given, but their formulation already depends on the point of view of those presenting them. There is no definitive test of the validity of solutions to an evil problem. The testing of solutions takes place in a practical context and solutions are not easily invalidated.

Representation Gaps

The cure as metaphore of

> "A brain tumor. Very personal open data. An opportunity. We can change the meaning of the word cure. We can transform the role of knowledge. We can be human." (Iaconesi & Persico, 2016, p. 119)

In 2012, after finding out about his brain cancer, Salvatore Iaconesi decided to leave the hospital and make his cancer opensource, building in the network and with the network his Cure Fig. 1. It was in this way that Salvatore's medical file turned into a collective cure, a publicly open debate, a performance between human beings with the aim not only of finding a cure but of discovering how to implement a society where the well-being of the individual depends on the others. A cure which is defined as peer-to-peer and ecosystemic, a cure that is multidirectional, emergent, oblique, exploded, disseminated, non-linear.

Researchers, communicators, artists, activists, theorists of all kinds, experts in magic and esotericism, patients, ex-patients, hackers, scientists, doctors, entrepreneurs, startuppers, even conspiracy theorists, and so on towards an enormous international community that dialogued, generating in a very short time three hundred thousand e-mails, two hundred thousand messages on YouTube, half a million messages on social networks. (Iaconesi & Persico, 2016)

It is within this community that Iaconesi has built his cure, which has allowed him not only to build a customised one, but to build one that derives from collective intelligence, non-protocol, for a human and not for a number. A cure that in 2012 allowed him to recover for a few years from cancer.

We recognise in this event a structure and a dynamic not entirely different from that of disciplines, or the future of some disciplines. We recognise in words such as ecosystem, collectivity, non-linearity, opensource, part of the description of how to design in the field of Responsive Technologies for Human Wellbeing, of how to design in the field of Design in general.

We have a responsibility as designers to always ask ourselves, as we design, how we are doing it. But what we ask is: how can we think about explaining and representing a design process like The Cure through linear frameworks[2] as the Double Diamond?

2
Although an iterative approach is indicated for the use of these models, they remain grounded on a logic between consequential steps.

Fig. 1
"Rehersing at TEDGlobal 2013" by xdxd_vs_xdxd. Iaconesi during his speech at showing the dynamic representation of The Cure. Source: https://www.flickr.com/photos/xdxd_vs_xdxd/9051531749/, Licensed under CC BY-SA 2.0.

AI systems

Crawford and Joler's Anatomy of an AI System (2018) is a look at the hidden environmental and social costs of our current dependence on artificial intelligence. Through a detailed case study of a commercial AI system, they trace the many costs of this technology – from the energy used to power the system, to the carbon emissions generated, to the human labor required to maintain and operate it Fig. 2. Many different types of data, including text, images, and audio, many different types of materials, including plastic, glass, and metal. And there are many different types of human labor, including customer service, marketing, sales and contemporary mechanical turks (Buhrmester et. al. 2011).

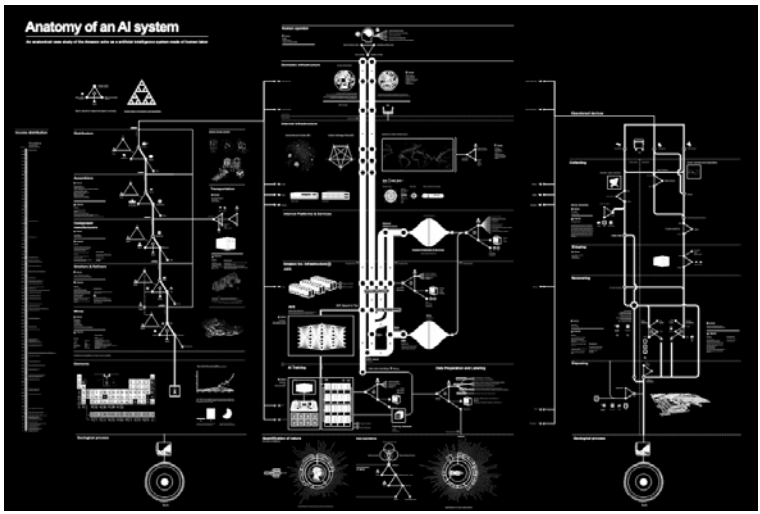

Fig. 2
"Anatomy of an AI System: The Amazon Echo As An Anatomical Map of Human Labor, Data and Planetary Resources" by Kate Crawford and Vladan Joler. Source: https://anatomyof.ai/img/ai-anatomy-map.pdf

All of these different types of data, materials, biodiversity and human labor are interconnected: customers' behaviors data are used to improve the marketing, which in turn improves the sales and then used to improve even the design of the device. These devices are the product of complex supply chain systems that take years to be mapped, and where the authors see an analogy to the global information network.

Linear design processes and their representations are insufficient to render this environment because they fail to take into account the complex, non-linear interactions between the different components of an AI system. These interactions are what give AI systems their unique capabilities and make them so difficult to design and manage. By ignoring them, linear design processes and their representations give us a false sense of understanding and control over AI systems.

The more complex an AI system becomes, the more difficult it is to integrate into existing disciplinary frameworks, they increasingly rely on a variety of specialized sub-disciplines for their development and operation. This trend toward greater complexity and reliance on knowledge that falls in the blank space among disciplines is known as antidisciplinarity (Ito, 2014). There are a number of reasons for this trend toward antidisciplinarity as AI systems become more complex: 1) they require more data and the use of multi-disciplinary knowledge, 2) they become more difficult to understand and control requiring the contribution of multiple experts in order to develop and operate, 3) they become more capable of autonomously generating new knowledge which often falls outside of the scope of existing disciplinary frameworks.

Good attempts

Designers have long been interested in understanding and representing the design process. With the increasing complexity of design problems, more interest has shifted towards non-linear representations of the design process. A few examples are provided as good attempts in this direction.

In 1969, the Musée des Arts Décoratifs invited some designers to participate in the exhibition, *Qu'est ce que le design?.* Participants submitted work responses to a series of questions about the nature of the design process. Among them Charles Eames (1969) presented a conceptual diagram of the design spaces. The design space is a multidimensional one in which the designer can move freely to explore different design options. The Charles Eames conceptual diagram of the design space is a useful tool for understanding the non-linear nature of the design process. The diagram shows the different levels of the design process, from the initial concept to the final product. The designer can move back and forth between these levels, making changes at each stage.

More oriented to guide designers through different levels of thinking despite a sequence of steps, the Heuristic Design Framework by Arnold Wasserman is an example of high-level framework (Scupelli, 2015). It provides a set of heuristics, or rules of thumb, that the designer can use to generate and evaluate ideas. The framework

is flexible and can be customized to the specific needs of the project. However, it may be too high-level and better serve a strategic intent than a design intent.

Neri Oxman (2016) in his contribution in the first issue of JoDS (Journal of Design and Science) titled 'Age of Entanglement' writing about the disciplines boundaries, introduces The Krebs Cycle of Creativity Fig. 3. Oxman's model is a theoretical model that describes the creative process as a cyclical process of knowledge creation. It's original in its perspective, entangling different fields of knowledge in the creative process. However, it is also highly theoretical and may not be applicable to all design situations.

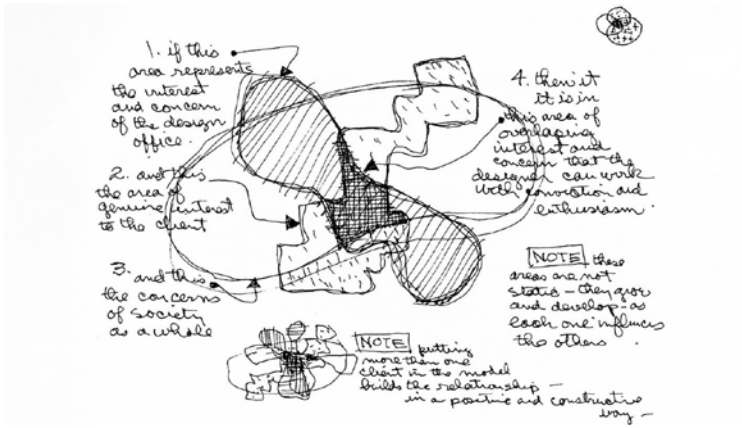

Fig. 3
"Krebs Cycle of Creativity" by Neri Oxman. Source: https://anatomyof.ai/img/ai-anatomy-map.pdf

Conclusion

As it emerges from the case studies the representation of the design process has progressively given way to the depiction of the space and relationships in which the project is embedded, implicitly abandoning the need to normalize the designer's work in broad terms, to support it more in the exploration and surfacing of meanings.

This suggests to us a strong resonance with the concept of data and its meaning in relation to the context in which it is generated, hinting that in complexity, design action also tends to escape codified and repeatable processual patterns, finding its most effective representation through the semantic and relational dimensions of the system in which it operates.

Likewise, this paradigm metaphorically represents – and in keeping with the new cultural directions of design tending to embrace multiple points of view and epistemologies – the abandonment of a way of portraying the design space from one's own unique point of view by decentralizing the perspective of representation as well.

Just as Iaconesi and Persico present "La Cura" space through a three-dimensional and dynamic model, Crawford and Joler include in their representation a system of ontologically very different and heterogeneous actors, generating a unique space of meanings of an emergent nature, just like the properties of a complex system that become apparent only in the relationship and never in the single component.

From the historical analysis, the elaboration of Table 1 and the different case studies, we can in conclusion, summarise that design processes representations should:

- embrace non-linear logics in order to deal and work with technologies such as AI
- exceed linearity in order to introduce probabilistic dimensions, needed to deal with highly complex problems
- introduce multidimensional and dynamic representation models, also by making them interactive, in order to manage the multiple variables required to represent a context characterised by complexity
- allow the integration of variables and multiple dimensions, accommodating a more layered thinking that must take shape from a multidisciplinary field, being able to become antidisciplinary while maintaining its representability.

Just as the technological architectures at the base of responsive applications - increasingly conceived through the use of meta-systems and the use of computation to build formal probabilistic models to handle multi-causality and the interaction between combined parts in a whole (Henriques, 2016) - the representations of these design spaces must find answers that satisfy the same level of complexity as the underlying conceptual models.

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DIGITAL SPECIAL ISSUE 1

The 8th International Forum of Design as a Process, themed "Disrupting Geographies in the Design World" was held in Bologna from 20 to 22 June 2022. The event was organised by the Advanced Design Unit of the Alma Mater Studiorum – Università di Bologna, Department of Architecture, in collaboration with two partner universities: Tecnológico de Monterrey (TEC) and Pontificia Universidad Católica de Chile.

The Forum engaged speakers from the Global Design community, expanding the original vocation of the Latin Network for the Development of Design as a Process to include researchers and designers of the Mediterranean Area, Middle East, IOR (Indian Ocean Region), and Global South regions. The goal was to share new perspectives on imagining design futures in a responsible and just perspective, at the forefront of change, while building strategic partnerships and creating accessible knowledge.

Structured around three pillars — seminars, workshops, and exhibitions — the Forum hosted meetings, reflection opportunities, networking activities. It involved designers, scholars, young researchers, design entrepreneurs, in an experimental format.

Speakers' contributions not only inspired the practices of the designers' community, but also resonated with students and the broad audiences. The presentations explored intersections of materiality and culture, post-coloniality, decoloniality, gender studies, and other areas of human thought and action which seek to analyse, question and challenge the disruptive geographies in the world, today.

The papers submitted to the five tracks proposed are published in the Digital Special Issue 1 of *diid. disegno industriale – industrial design*, celebrating during those days its 20th anniversary and serving as the fourth partner of the event.

The Editors
Erik Ciravegna, Elena Formia, Valentina Gianfrate, Andreas Sicklinger, Michele Zannoni

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