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(Re)positioning uncertainty in design processes: How to address the complex challenges we face.

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Abstract: This article is part of a research that tries to analyse how different attitudes towards uncertainty in design processes are influencing the evolution of the discipline itself —*its raison d'être*— and the role that designers are acquiring as managers of uncertainty, as facilitators of unconventional approaches, with the ability to address complex and systemic challenges, in short, as agents of change helping to make better decisions. We bring together prior works on uncertainty perception in the design and management literature, focusing mainly on new approaches, and we map different design attitudes towards uncertainty, detecting two main approaches a) reducing it *versus* b) taking advantage of it. We analyse how the attitude towards uncertainty allows us to (re)define the role of design at the present time in terms of its ability as a discipline to address complex and systemic challenges.

Keywords: uncertainty, design processes, design thinking, decision making, design management

1. Introduction

We are currently in a moment when the rules of the game are changing, nothing is what it used to be, uncertainty is a constant in our lives and the transformation of the world as we know it is a reality that we are seeing first hand. The simple seems to be a thing of the past and we are learning by leaps and bounds to move among many complexities. In this novel and rather diffuse context, it seems difficult to make predictions about future outcomes and plans for implementing goals, which makes decision-making increasingly difficult.

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According to the International Monetary Fund, global uncertainty reached an unprecedented level at the beginning of the outbreak of COVID-19 and remains high. The Global Uncertainty Index –a quarterly indicator of global economic and policy uncertainty covering 143 countries– shows that while uncertainty has declined by about 60% since the peak observed at the onset of the COVID-19 pandemic in the first quarter of 2020, it remains about 50% above its historical average between 1996 and 2010.

McKinsey (2023) says we are in times of disruption and great uncertainty, structural supply chain issues, rising interest rates and sustainability challenges are just some of the conditions that have become the new normal and have critical implications for business models. When times get tough protecting what we have by waiting for everything to return to normal is not enough, it is necessary to open up new avenues that look to the future.

There is no longer a linear path forward in a world where up to 65% of school-age children will be working in jobs that do not even exist yet. It seems entirely necessary to rethink the way we do things, and with this in mind, in early 2021, Ursula von Der Leyen, president of the European Commission, surprised the world with the presentation of the New Bauhaus project, a creative and interdisciplinary initiative at European level that opens a meeting space to design future ways of living and stands at the crossroads between art, culture, social inclusion, science and technology.

The initiative brings the Green Pact to the places where we live and calls for a collective effort to envision and build a sustainable, inclusive, and beautiful future for the minds and souls of all. In her speech on January 19, 2021, the president asks how to put design at the service of all this.

The COVID-19 pandemic, climate change, geopolitical tensions, socioeconomic inequalities, technological changes, the irruption of Artificial Intelligence are factors that are interacting with each other making the environment complex and insecure, not only unstable and uncertain, which requires constant decision making to successfully adapt to change.

Characteristics such as ambiguity, complexity, uncertainty, instability are aspects that define the environments in decision making. Carreño (2019) frames these concepts in his doctoral thesis "Modelling uncertainty in design processes" as follows:

- **Ambiguity:** the environmental situation may give rise to different interpretations, making it easier for doubts to arise since cause-effect relationships are not sufficiently clear;
- **Complexity:** the environmental situation is composed of many different elements that may be connected to each other, as well as influenced by many variables;
- **Uncertainty:** the environmental situation is such that there is no sure and clear knowledge of it. Therefore, insecurity is produced since there are undefined conditions;
- **Instability or volatility:** the environment is characterized by a lack of stability, meaning it consists of mutable or changing situations that are not long-lasting;

Frank Knight, an American economist at the University of Chicago, distinguished the concepts of risk and uncertainty in his work entitled “Risk, Uncertainty, and Profit”. "The key to the whole tangle”, according to Knight, "will be found in the notion of risk or uncertainty and the ambiguities it conceals”. For Knight, "risk" means "in some cases a quantity susceptible to measurement" "while at other times it is something that clearly does not have this character”. He called this last description uncertainty (now known as *Knightian uncertainty*), which "is not susceptible of being measured and therefore of being eliminated”. Knight (2012) defines three different states:

1. **State of certainty:** the data are known in a clearly determined way and there is certainty or evidence about the outcome. There is neither chance nor uncertainty, since good decisions produce good results. It is a deterministic model because you get exactly what you expect to get;
2. **State of risk:** the knowledge of the data does not respond to a deterministic model, since they follow a probability distribution. In global terms, there is no clear evidence or certainty about the outcome. The model is probabilistic;
3. **State of uncertainty:** there is partial or total ignorance of the data, either because they are ambiguous, because there is no agreement on what is known, or because they are incomplete. Because of this situation, the results are totally unknown;

A characteristic aspect of design processes (Carreño, 2019) is decision making in scenarios subject to uncertainty in which there is no control over the variables that affect the final decision. The very nature of the design process leads to a situation of uncertainty due to the lack of knowledge of the result that the decision taken will produce. Uncertainty thus becomes a property of the design process itself; but not only that, it is also a perception that the designer has and a characteristic of the world in which and for which the design acts (Cash and Kreye, 2018).

We focus here on attitudes towards uncertainty from design and how the evolution of these attitudes in recent years, driven by scenarios of new and multiple complexities, are (re)drawing the development of the design discipline, opening new ways of approaching the future.

This article reports on the development of an exploratory research project that connects the attitude in which design approaches uncertainty with new ways of coping with complexity. The aim is to explore the attitudes of design and designers towards uncertainty by comparing the old and the new in order to learn that in the current moment of complexity new ways of thinking and acting are necessary.

In the first part the theories on design processes and their relationship to complex problem solving are analysed in the literature. The second part maps the different design attitudes towards uncertainty, concluding in two predominant approaches. The third part interprets possible connections between the different attitudes towards uncertainty and the evolution of the design discipline and suggests some conclusions for future research.

> "To accept complexity is to accept uncertainty, the inability to achieve certainty, to conceive of an absolute order; and to recover something related to logic and the inability to avoid contradictions". (Morin, 2011, *p.99)*

2. Design processes and complexity

The origins of many modern theories of the design process (Stevens, 2009) can largely be traced to Schön (1983), who was in direct opposition to theorists such as Buckminster Fuller (1969) and Simon (1969), who sought to apply "scientific" standards of objectivity to the design process. Schön preferred to take into account "artistic and intuitive processes.... (applied) to situations of uncertainty, instability, uniqueness and value conflict" where objective approaches had been inadequate or insufficient. Buchanan (1992) drew on this to (re)introduce Rittel's concept of wicked problems in systems and planning theory (Rittel, 1972; Rittel and Webber, 1973). Stevens remarks in his doctoral dissertation "Design as a strategic resource, 2009" that the application of creative methods to wicked problems is distinctive to design thinking and has significant potential in

addressing complex challenges as recognized and researched by those who strive to understand the design process and how designers "think" through it (Friedman, 2007).

The very complexity of design processes is duly recognized through the discussion of ill-structured or wicked problems (Simon, 1973; Rittel and Webber (1973); Buchanan, 1992; Coyne, 2005; Dorst, 2006; Farrell and Hooker, 2013) and also from the iterative (re)framing of problems through design action (Dorst and Cross, 2001; Paton and Dorst, 2011; Ball and Christensen, 2019).

Rittel, Webber, and Buchanan argue that most design problems are wicked. Wicked problems (Rittel, 1972) are not only complex, but unlike "tame" problems, they do not have a single "right" solution, but only "good" (or perhaps more commonly, "better than..."). They have no rules for defining when a solution has been reached and there is no definitive test of a solution, it can only be evaluated relative to its own formulation and to other possible solutions.

Stevens states (2009, p.16) that if design methods and tools are suitable for addressing complex design problems, then these methods and tools can be useful for complex problems outside the traditional design domain. This would fit well with a broader view of design, which encompasses many activities and professions. "Everyone who designs devises courses of action aimed at changing existing situations to preferred ones" (Simon, 1969: p.111) This element of design practice, when separated from the making of artifacts and applied to tangible and intangible problems, is often referred to as design thinking.

Authors such as Johansson-Sköldberg, Woodilla, and Çetinkaya (2013) note an increase in the popularity of design thinking (measured through formal and informal publications on the topic) from 2008, around the time this term was adopted in management discourse (Martin, 2009). Generally, design thinking is based on a similar series of stages in the design process, often adopting a cognitive or problem-solving approach, which Dorst (2006b) sees as developing from Simon's 1969 proposal in The Sciences of the Artificial. The application of this approach is well illustrated in disciplines other than design in Brown's (2008) article on Design Thinking published in the Harvard Business Review. Brown (2008: p. 86) states that business leaders "should incorporate design thinking into all phases of the process."

> "Disorder and order co-operate in some way to organize the universe".
> (Morin, 2011, *p. 92)*

3. Different design attitudes toward uncertainty

We define uncertainty, in general terms, as the absence of certainty, i.e., a state of limited knowledge in which it is impossible to describe exactly the existing state, a future outcome or more than one possible outcome. The existence of uncertainty means that the outcome of an action cannot be known in advance or that something different than expected may happen.

We find in the literature two main attitudes (in design processes) to uncertainty, **a) reducing it** *versus* **b) taking advantage of it.**

3.a) *reducing it*

Uncertainty as an existing condition that must be resolved to achieve an outcome; as an emotional reaction of the designer to the lack of knowledge; as cognitive processes that counteract the feeling of uncertainty based on problem-solution dualism; as an activator of design activity.

Philip Cash and Melanie Kreye (2017) pose in their UDA Uncertainty Driven Action Model the design activity as a process whose actions are linked through the perception of uncertainty. Defining uncertainty as the designers' lack of understanding regarding the design task and its context (Ball et al., 1997; Kreye, Goh, & Newnes, 2011), and has been shown to connect some aspects of behaviour and cognition in the design domain (Wiltschnig, Christensen, & Ball 2013; Christensen & Ball 2016a,b). Cash and Kreye (2018) concur that framing uncertainty as a lack of knowledge implies the need to correct this lack and acquire knowledge and thus mitigate uncertainty. Ball and Christensen (2019) conclude that "designers" ability to work their way through uncertainty… enables them to move effectively from an ill-defined design problem to… a design solution" (2019: p 36) Cash and Kreye also see uncertainty as a key component of the design process, demonstrating that the perception of uncertainty, defined as "how unsure or unconfident a designer feels based on their perceived lack of knowledge" (2018: p 52), becomes a driving force behind design action. As they state, this premise assumes that "design is a process in which uncertainty is gradually resolved" (2018: p 51).

Simon, 1996, situated uncertainty in the design process as a state that requires resolution, he places it firmly as an existing condition: there is an existing situation of uncertainty (something not yet known, posing a design problem), it is mitigated (as a design action) to provide a lower level of uncertainty (as something that is now known, a design solution).

There is great diversity in the design thinking literature regarding the "types" of uncertainty (O'Connor & Rice, 2013; Tracey & Hutchinson, 2015), methods for reducing uncertainty (Ball & Christensen, 2009; Ball et al., 2010; Cross, 2011), and its role as a driver of design action (Cash & Kreye, 2017, 2018; Ball &Christensen, 2019; Lasso, Kreye, Daalhuizen, & Cash, 2020). At a fundamental level, this derives from an understanding of design as a process in which uncertainty is gradually resolved (Ball & Christensen, 2009). However, before an individual can act on uncertainty, he or she must perceive and interpret it with respect to his or her own understanding of the situation (Tversky & Kahneman, 1974). Other studies have highlighted the perception of uncertainty as a driver of design activity progression with respect to a number of specific actions, including sketching (Scrivener, Ball, & Tseng, 2000) and prototyping (Gerber & Carroll, 2012), and cognitive processes such as mental simulation, co-evolutionary developments in understanding the problem/solution space (Ball & Christensen, 2009; Wiltschnig, Christensen, & Ball, 2013), and creative cognition (Christensen & Ball, 2017).

According to other authors such as Kim and Lee (2016) designers seek, collect and interpret information in order to resolve their perception of uncertainty. The action of knowledge sharing has also been identified as a means to reduce the perception of uncertainty (Deken, Kleinsmann, Aurisicchio, Lauche, & Bracewell, 2012), and recent work by Christensen and Ball (2017) highlights the impact of uncertainty perception and creative cognitive processes in group discussions.

3.b) taking advantage of it

Uncertainty understood as a condition external to the design process itself, inherent to the context by and for which the design acts; as a dialectic of possibility-opportunity; as an activator of new scenarios, experimentation and learning.

Uncertainty exists in the design process both as feelings and thoughts of the designer and as a quality external to the designer: not only as an emotional or cognitive quality, but also as a structural one. That is, uncertainty is both a property of the designer and of the world in which and for which one designs. The view of design as a resolution of uncertainty is only one possible attitude towards uncertainty, the diversity of design includes forms that are not included in the ideas of the problem-solution dialectic and may look more like a dialectic of possibility (or opportunity), inspiration (or experimentation), and the possibility (or opportunity) of the world in which and for which one designs.

Authors such as Karl T. Ulrich and Steven D. Eppinger (2012), speak of identifying opportunities and articulating them through the design process and propose the detection of opportunities as a goal in itself that should be analysed holistically.

Cross's discussion of collaborative design in teams in Design Thinking (2011) demonstrates a mode of design that clearly values a structured problem-solving approach as a conscious strategy, but also harnesses and relies on the introduction and prolongation of uncertainty at key points in the process.

Tironi recognizes that, in complex process the designer is "guided more by uncertainty than by certainties about their knowledge" (Tironi, 2018, p. 130) "and that they achieve success through a change of attitude towards uncertainty and a move away from the need to solve a problem" by "expressing and embracing uncertainty in the very formulation of the problem." Uncertainty is thus shown as a design action (described using terms such as "problem creation", "speculation", "exploration", "elicitation"); moving from a problem-solving process to a new form of "problem creation" (Tironi, 2018, p. 118). Projects such as Wilde and Underwood's (2018) "Poetic Kinaesthetic Interface" and Wetter-Edman, Vink and Blomkvist's (2018) "Chronically Involved" expand and multiply the positioning of uncertainty within the design process.

Community and participatory co-design projects (Dyer, 2021) are especially notable in their repositioning of uncertainty in the design process, due in part to the unknowns they present. The design outcome in these projects does not represent a solution to a problem, but the creation of something outside the problem-solution dialectic. In these cases, they situate uncertainty as a design goal (described in terms such as "material agency", "generative", "volatile"), a design action (described in terms such as "exploration", "emergent", "negotiating") or as something inherent to the preferred condition created (described in terms of "hybrid spaces", "material expression", "unconstrained").

In the field of social innovation, authors such as Espiau (2022) call for the incorporation of a complex system perspective (Morin, 2001) that allows an integrated understanding of the challenges we face. Like all living systems, social systems can be considered as complex adaptive systems (Clayton, Radcliffe, 1996) and are inevitably characterized by uncertainty, change and surprise are dynamic networks of relationships, not just aggregations of static individual entities.

> "Everything concerning the emergence of the new is non-trivial and cannot be predicted in advance" "much of what is important arises from the unexpected" "don't forget that reality is changeable, don't forget that the new can and will emerge anyway" "in normal situations automatic driving is possible but strategy is necessary when the unexpected or uncertain occurs". (Morin, 2011, *p.118).*

4. New directions from design discipline

If we understand the object of the design process only as the need to solve a problem, we will only advance if we reduce the degree of uncertainty; but if that uncertainty is conditioned by an increasingly complex, diffuse and unexpected context and per se cannot be solved, what would be the role of design? In complex contexts it is necessary to be guided by uncertainty rather than by the certainties of knowledge and learn to take advantage of it. Where does all this lead us?

Listening to some relevant voices makes us think that new approaches are taking shape that point to the need to reposition uncertainty in the processes.

The Institute of Design at Stanford University, for example, defines the role of the designer as follows "To be a designer is to be a steward of possibility. We search for outcomes that do not yet exist and in doing so we dive deep into the unexpected and unknown" and in the presentation of its design programs, it talks about 8 skills of designers and the first one it highlights is Navigating Uncertainty "This is de ability to recognize and persist in the discomfort of not knowing, and develop tactics to overcome ambiguity when needed. Design is loaded with uncertainty. As a result, it involves being present in the moment, reframing problems, and finding patterns in information. Ambiguity can arise in many places —within a project, a process, or within oneself. It's important to put students in ambiguous and give them tactics to emerge from them."

Kaospilot School in Denmark is already teaching its design students how to deal with uncertainty.

Authors such as Nathan Furr and Susannah Harmon Furr, write in their book "The Upside of Uncertainty" that "Uncertainty is here to stay. Learning to face the unknown well is critical to our ability to survive and thrive. Numerous studies across academic fields suggest that people comfortable with uncertainty are more creative and are more successful as entrepreneurs and more effective as leaders".

Well-known entrepreneurs such as Jamie Rosen claim "I used to see life as trying to get straight to my objective. And the periphery — those where the uncertainties, those where the distractions" "But, the most wonderful and important things in my life have always come from the side, from the periphery. I still go toward and objective, but now I'm looking for the periphery, I'm looking for those surprises. That's the good stuff. It all comes from the uncertainty. That's the point of the journey".

Jostein Solheim, former CEO at Ben and Jerry´s says "there is ambiguity and paradox everywhere" "for people who like the linear route forward, life is getting harder and harder, in any field!". "The single biggest predictor of executive success is how you deal with ambiguity" states CEO San Yagan, and Hamilton Mann, head of transformation at Thales says "to innovate, we have to seek risk, we have to seek uncertainty. If we try to avoid it like in other parts of the business, we won't innovate"

Jorge Bucay, writer and therapist in BBVA, we learn together explain "uncertainty is part of our life, and then how do we do without certainties? By learning to plan, not to plan. There is a very important difference between these two concepts. To plan is to make a plan from A to B, from C to D, from E to F, from G to H and reach the goal. But in these plans there are so many alternatives. When we get from A to B we may find out that C no longer exists. To plan is to advance as one

advances in a glider. The glider takes off in one direction but then it can fly depending on the winds it encounters, that is, like sailing, floating, happening, transiting between the breeze, the winds and the weather that one encounters. Life can be planned but should not be planned."

Gorka Espiau (2022) director of Agirre Lehendakaria Center in his doctoral thesis on social transformation points out that organizations that are able to stimulate and improve the knowledge of their members are in a better position to innovate. The ability to learn and adapt continuously (as opposed to exclusive technical knowledge that is not shared) is what determines the success of a company, organization or territory (Lundvall, 2007). The ability to learn becomes a collective process of cooperation between different people and organizations.

Nacho Lavernia, national design award winner (2012) stated in his conference "Three reasons to be there, (2020)" that "we are living in an era of unpredictable social, technological, economic and ecological changes, our society needs experts in uncertainty, experts in the management of ill-defined problems". "It needs designers and not only graphic or product designers, but also service designers, specialists in social design... Disciplines that should be incorporated as soon as possible to the training plans of our schools or design centers".

These new approaches point to a repositioning of uncertainty in design processes, new perspectives in understanding the role of designers in the current context of complexity.

a) Design as activity/process/discipline that reduce the uncertainty — solving problem — achieve objectives. Design as resolution of uncertainty

b) Design as activity/process/discipline that take advantage of uncertainty — exploring the periphery —identify opportunities. Design as create something outside of the problem. Design as taking advantage of uncertainty. Design as capturing new opportunities

c) Design as glue, as bridge — as a new reconstructed form of design leadership can include acting as the "glue" — the bridge, facilitator, protector, explainer, valuer, modeler, orchestrator, and advocate of all thinking types (Kelley, D., VanPatter, Gk. 2005)

> "Every brilliant insight, choice, act, and innovation comes only after a phase of uncertainty. And the uncertainty brought about by every mistake, setback, discouragement, and even disaster carries possibility within it". (Furr, & Furr, 2022)

5. Looking ahead to the future

We are in a moment that requires forgetting a past where thoughts and processes were oriented to eliminate imprecision, ambiguity and contradiction in order to move towards a future in which we accept chance and embrace uncertainty. A new scenario to recognize inexplicable phenomena such as creativity, a place where collaboration between perception and thought, between reason and imagination take on a new meaning, where we can build together a culture that allows experimentation, collaboration, that admits error... Wouldn't all this help us to make better decisions, to know what to do, how to do, when and why? What role does design play in this new context? What are its main tools at the service of this purpose? Should it be closer to creativity, art and culture... or closer to efficiency, profitability and results? Can design provide the knowledge and methods necessary to respond to the complex and universal challenges facing us? Are designers great at managing uncertainty?

Repositioning uncertainty in design methodology is absolutely necessary to improve transformation processes and contribute to decision making in complex contexts. Understanding the role of uncertainty in the different design disciplines is key to facing the new challenges that lie ahead.

Designers must be able to move from looking at uncertainty as something to be mitigated to communicate how uncertainty is part of the creative and transformative potential of the process. Designers must be able to talk not only about the problem and the steps they can take to arrive at a solution, but also where uncertainty is in the design process, what opportunities they see as valuable and how they can find them, and what assumptions and connections designers are used to making and are allowed to make.

Designers are used to work with the imprecise and the insufficient, their ability to imagine and sense is an advantage when it comes to moving forward in situations where we do not have everything under control. Design thinking, therefore, must be part of the transformation processes in which we find ourselves, contributing its way of thinking and acting, from that privileged place it occupies between art and science, between the rational and the intuitive, between the tangible and the intangible. In this situation, it is necessary to expand its frontiers, to assume new responsibilities in order to propose solutions that have a positive influence on the well-being of people and the planet.

Because when rational thinking alone is not sufficient, when established methods and programs are not enough, What tools do we have left?

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