# Understanding design as a messy socio-technical Actor-Network

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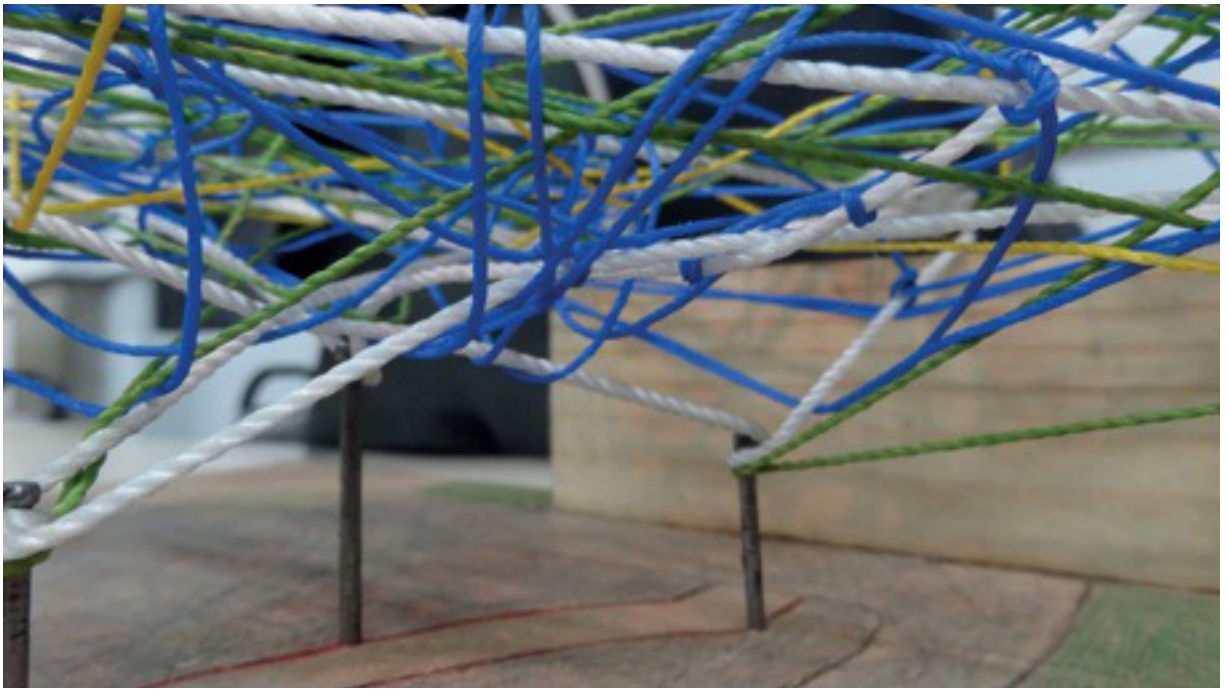

Received: 10.05.2021
Reviewed: 08.06.2021
Published: 30.06.2021
How to cite this article
Hasbun,Y., 2021. Understanding design as a messy socio-technical Actor-Network
*Inmaterial. Diseño, Arte y Sociedad*, 6 (11), pp. 47-68

**Abstract**

Drawing on key analytical principles of Actor-Network Theory and Science and Technology Studies, the present paper introduces a material semiotic study on the *agency* of non-human entities in the performative construction of new emerging realities, materialized in the creative conception, representation and circulation of objects understood simply as' design'. Hence, its focus will be in reflecting on the ability of material objects –models, sketches, renderings, etc.– to *actively* determine the emergence of new creative realities (designs) that takes place daily in our classrooms, workshops and studios. Its intention is to contribute to the growing academic work that seeks out to equip design teachers and researchers for the construction of an alternative design theory capable of understanding design as a *more than human* endeavor.

Three arguments are drawn: First, that the creative process of design is characteristically *messy*, *contingent* and non-linear, rather than the orderly, controllable and linear account that key design textbooks have largely suggested. Second, that design should be understood as a process that necessarily relies on a balance between the *presence* of certain material entities and the simultaneous *absence* of others; and lastly, that much of the *mess* that characterizes the creative process of design is result of the intricate difficulties that arise in the process of constant negotiations between 'human' and 'non-human' actors.

All three arguments suggest the need to reinterpret a series of *black boxes* that both designers and design teachers have largely tended to ignore despite the heterogeneous and *messy* nature of our discipline.

**Keywords**: design, creativity, materiality, non-human, Actor-Network Theory

## Resumen

**Entendiendo el diseño como una red socio técnica desordenada.** Basándose en principios analíticos clave de la Teoría del Actor-Red y de los Estudios Sociales sobre Ciencia y Tecnología, el presente artículo presenta un estudio *semiótico material* sobre la *agencia* de entidades no humanas en la construcción performativa de nuevas realidades emergentes materializadas en la concepción creativa, la representación y la circulación de objetos comúnmente entendidos simplemente como 'diseño'. Por tanto, su enfoque estará en reflexionar sobre la capacidad de los objetos materiales –modelos, bocetos, etc.– para *activamente* determinar el surgimiento de nuevas realidades creativas (diseños) que se dan a diario en nuestras aulas y talleres. Su intención es contribuir al creciente cuerpo de trabajo académico que busca equipar analíticamente a profesores e investigadores del diseño para la construcción de una teoría del diseño alternativa que sea capaz de entender el diseño como un asunto *más que humano*.

Se cimientan tres argumentos: Primero, que el proceso creativo de diseño es característicamente *desordenado*, contingente y no lineal, en lugar de la explicación ordenada, controlable y lineal que algunos libros de texto clave sobre la teoría y metodología del diseño han tendido a sugerido. Segundo, que el diseño debe entenderse como un proceso que irremediablemente se basa en un equilibrio entre la *presencia* de ciertas entidades materiales y la *ausencia* simultánea de otras; y, por último, que gran parte del *desorden* que caracteriza el proceso creativo de diseño es el resultado de las intrincadas dificultades que surgen en el proceso de negociaciones constantes entre actores 'humanos' y actores 'no humanos'.


**Palabras clave**: diseño, creatividad, materialidad, no-humano, Teoría Actor-Red.

This contribution intends to spark the interest of academics who are involved in practicing, teaching, or researching any type of design by reflecting on the active role of material entities—models, sketches, renderings, etc.—in shaping the emergence of design objects, and in influencing the very nature of the performative design practices in which we (design practitioners, teachers and students) are engaged in day-to-day.

More precisely, the paper discusses how human/non-human interfaces allow 'good' design ideas to be *simplified* (Callon and Latour 1981; Law 1992) and *recorded* (Kalthoff, 2005) in models, drawings and renderings while others get 'erased' in digital or physical trash bins. Drawing on Actor-Network Theory (ANT), and Science and Technology Studies (STS), this paper addresses *how* designers and design students are commonly struck by unexpected ideas and possibilities *as they* sketch or build models. The empirical evidence to support these discussions derives from my personal experience as a lecturer, and later as an associate professor, at the Escuela de Arte y Comunicación Visual (School of Arts and Visual Communication) at the Universidad Nacional of Costa Rica.

By introducing a material semiotic study on the *agency* of non-human entities in the performative construction of emergent design realities, this paper responds to the call made by Wilkie (2016) to "move away from the normative politics of design [ … ] where what counts as human and what counts as the technological is pre-given, to an unfixed, heterogeneous and emergent political ontology" (p. 876). This ontology would portray design ¬as both a practice, and a distinctive domain of expertise capable of novel ontological possibilities fit to participate in the collective construction of our world. Therefore, its immediate intention is to contribute to the growing academic work that combines the conceptual and analytical resources offered by ANT and STS with the *inventive methods* (Lury and Wakeford, 2012) involved in practice-led design research (Wilkie, 2016); while its far-reaching goal is to help equip design teachers and researchers for the construction of an alternative design theory capable of understanding our particular knowledge field and our daily situated practices as a more-than-human endeavor.

Rather than discussing the state of the research in the subject, this paper will first illustrate the specific context in which the relevant actors are *followed as they act*, and thus the local sites where observations take place. This will allow me to establish some of the general variables that describe the way in which the research problem is performatively constructed (rather than simply defined). More precisely, this paper elaborates a recognizable characterization of the way creative design

processes are commonly *enacted* (i.e. accepted or understood) as neat, linear, ordered, and controllable things.

After introducing this general illustration, the paper will begin a discussion about the different issues and notions that shape this particular narrative. I will argue that the urge to characterize design—as a verb—as a neat, linear, and 'exact' process (and thus a method) originates in a generalized obsession to legitimize design—as a subject—as a 'serious', 'robust' and 'rational' discipline. I will argue that this legitimization is rooted in the imitation of the modernist illusion of an objective 'scientific method' capable of rigorously approaching a positively given world.

Once the above discussion has been engaged, I will follow up with a critical reflection on some relevant aspects of my own teaching experience in the training of future professionals in visual arts, and graphic and environmental design. To do so, I will resort to the use of selected documentary material as recorded testimonies of the particular creative processes followed by my students through the years.

The discussion of these empirical findings will allow me to establish three conceptual hypotheses: first, that rather than linear, neat, ordered and controllable, the implicit creative process of designing is, in practice, *messy*, *mutable*, *local* and *fluid* (Law and Singleton, 2005). Furthermore, I will discuss how the work of the designer is one characteristically mediated by contingency, subjectivity and guesswork.

Second, I argue that far from rendering the design process as a linear journey that departs from the definition of a problem, eventually arriving at a particular solution that is then materialized in a designed object, product or space, the design practice should instead be understood as a *fluid* and *precarious* process that necessarily relies on a patterned exchange of *presence* and *absence*. In other words, doing design is a contingent process characterized by the *stabilization* of certain *enactments* of reality, at the expense of alternative others. All of which once again reinforces a positivist understanding of design that largely continues to prevail in many teaching settings of this discipline worldwide.

My third and final hypothesis is that a large part of this embedded *mess* (Law and Singleton, 2005), which characterizes creative design pro-

cesses, is the result of the very difficulties that constantly arise in the incessant negotiations between designers and a vast array of material entities who jointly co-construct the objects, products or spaces we simply *punctualize* (Law, 1992) as 'the design'. Therefore, this third hypothesis explores the way in which the 'non-human' material entities (Whatmore, 2006) that participate in a design process (commonly organized in actor-networks known as models, sketches, planimetry, etc.) do so *actively* and partially independent from the designer; and what is more, often 'stubbornly' or 'unexpectedly'.

## The imaginary linearity in the design process

To this date as an associate professor, and ever since my own years as a design student at the *Escuela de Arte y Comunicación Visual*, a widespread understanding of the design process as a linear and reductive route persists in many of our courses and workshops. This understanding can easily be traced back to the very selection of the basic textbooks still in use in the vast majority of courses that make up our current curriculum. Particularly, the majority, if not all, the classes where students learn basic design methodology are now based on the use of Bruno Munari's textbooks, predominantly his 1981 *Da Cosa Nasce Cosa* (or *¿Cómo nacen los objetos?*, as we know it in the Spanish-speaking world).

Before I attempt to offer my own impressions on the aforementioned work, I would like to clarify that the purpose of these few propositions should not be misread as an absurd attempt to belittle Munari's invaluable work, or even to hint that this work is 'outdated' or somehow 'flawed'. On the contrary, my own experience as a university teacher has proven to me that Munari's methodological proposal builds a robust and very valuable didactic tool for introducing design and art students (mainly those in the first stages of the study program) to the solution of specific design problems. In my experience, the approach offered by this Italian designer is particularly useful at the earlier stages of a program when students have not accumulated a basic experience in the design field that would allow them to differentiate between design implementation of *a priori* preconceived ideas, and the implementation of emerging design concepts *a posteriori* the empirical and analytical work to fully grasp the multiple variables that come into play in a design process. These are variables that Munari orders in 'stages' which he calls

'problem definition', (dissecting) 'the elements of the problem' and the 'analysis of data'. However, in this paper I propose contrasting Munari's work with an inherently different epistemological vantage point from the one followed by the original author himself, and from which his work is commonly appreciated.

Firstly, and starting from the general and moving to the specific, the ultimate purpose of Munari's approach is to provide us with a practical method based on the notion that "If we first learn to face smaller problems, it would later be possible to solve larger ones" (Munari, 2004, p. 10, author's translation). Therefore, the method involves solving complex problems from an eminently reductionist philosophical perspective. What is more, I believe that analytical sensibilities rooted in *material semiotics* (Law, 2007) can only reaffirm the epistemological starting point established by Munari, since they both concur that every network, assembly or problem is the result of the constant and active interaction between smaller and smaller elements or *actors*; and henceforth that (design) problems are, in turn, nothing more than the result of a complex assembly of these intertwined 'smaller' *actors*.

However, Munari's approach presupposes the fundamental proposition that every problem, from the most complex to the simplest, has a 'solution' that can be reached by following a method; one that is inherently based on a Cartesian paradigm which itself operates on the premise that an objectively given physical world is the sum of static, indifferent and undeviating closed systems. In other words, it remains largely believed that this method is capable of 'deconstructing' a problem into its 'invariable' constituent elements which can in turn be analyzed separately bit by bit, and reorganized time and again (Munari, 2004, p. 46). More precisely, Munari argues that the possibility of deconstructing a problem into its elements allows for a better projection or solution because "Once the small problems are solved one at a time, they can be coherently recomposed from all the functional characteristics of each of the parts. Functional characteristics that themselves derive from inherent material, psychological, ergonomic, structural, economic and, finally, formal properties" (Munari, 2004, p. 44, author's translation).

With this, Munari unequivocally aligns his methodological model within an eminently positivist paradigmatic approach that assumes that

the world's 'objectively given' problems can be approached, ordered and solved through the 'scientific method', and hence from the 'objective' or 'indifferent' attitude of a designer (subject) towards the space or product being designed (object).

This starting point, apart from presupposing the existence of a structural order of reality, seeks to 'legitimize' design as a quasi-scientific activity. According to Schön (1983), this obsession of transferring a 'rigor or relevance' to some areas of practice conveys that "there is a *high, hard ground* where practitioners can make effective use of research-based theory and technique, and there is (in contrast) a swampy *lowland* where situations are confusing 'messes' incapable of technical solution" (p. 42. Emphasis added). In other words, Munari's approach seeks to transfer the 'rigor' that Schön speaks about to design (as a field of knowledge and as a pragmatic discipline), a rigor that modernism has traditionally attributed to the 'high grounded' field of 'natural sciences'[1].

Munari argues that his methodology—which, as I suggest here, explicitly seeks to imitate the Cartesian scientific method—is, ultimately, a method that forwards a certain enactment of knowledge that contains a 'liberatory value'. A value that allows the designer to understand 'what has to be done or known' to solve a problem (Munari, 2004, p. 12). Now, Munari emphatically insists that his method "simply consists of a series of necessary operations, *arranged in a logical order* dictated by experience" (Munari, 2004, p. 18. Emphasis added. Author's translation). Therefore, the final design or 'solution', as he puts it, can be possible only if the different steps that the author enumerates throughout his methodological proposal are followed; and only if these steps are followed in the sequential linear order that his method conveys.

However, I ask: how linear is the design process in practical reality? In my experience, it is sufficient to observe, with some level of detail, the dynamics followed by design students enrolled in workshops that implement any supposedly linear design methodologies (such as Munari's) to witness how they often begin to build a conceptual solution to a certain design problem, only to realize that something they had proposed at an early stage of the project does not quite work

[1] This does not quite apply to the 'social sciences'.

as they first imagined. Commonly this is due to either the appearance of an unexpected technical, material or expressive challenge; or the haste to obtain a 'result' within a certain timeframe, and under certain economic resources; or simply because of a change of heart, interest or expectation of the designer.

In all these cases—and many other similar ones—not only are students reluctant to 'go back' and rethink their own generative ideas out of a fear that such a dynamic may threaten their chances of 'finishing' the workshop with a 'presentable' design; but we teachers find ourselves often encouraging students to ''go back'' as many times as necessary to 'rethink', 'redraw' and 'refine' their own designs, thereby building a 'project log' full of diagrams, sketches and models we simply call 'process', which will eventually be put under quantitative and qualitative evaluation.

I will now argue that in practice, the description I provide in this section of the non-linear nature of the design process does not sit well with Munari's—theoretical—proposal which famously drew the analogical example of comparing the design process with the elaboration of 'green rice' in which the author argues that "you cannot add rice to the casserole without first adding the water; or sauté the ham and onion after having cooked the rice [ … ]. Otherwise, the green rice project will be a failure and will have to be thrown away" (Munari, 2004, p. 18. Author's translation).

Additionally, I would like to remind the reader that this proposition is not entirely new. On the contrary, my argument departs from the notions of *divergent thinking* and *problem setting* which produced the first explicit distancing from the linear 'problem solving' tradition embedded in positivist technical rationality. More precisely, contrary to the later tradition, *divergent design* encourages the designer to generate as many creative ideas as possible through the iterative and spontaneous exploration of multiple solutions to an uncertain situation (Runco, 2020), while *problem setting* is a process which interactively defines the decision to be made, the ends to be achieved, and the means that can be chosen (Schön, 1983, p. 40).

Far from limiting myself to arguing that the divorce between the two former postulates simply responds to an alleged 'unavoidable disso-

ciation' that we have arguably learned to expect between 'practice' and 'theory'; or to elaborate on the notion that, as Munari puts it, the lack of 'order' leads to 'chaos'; I am interested in questioning the very idea that design is something that is at all *orderable*. To do this, I again refer to the familiar 'project log' prepared by design students, which I believe is in some way equivalent to the metaphorical garbage dump where Munari will ultimately dispose of his burnt rice.

The following images, taken from selected 'final' project reports from License Degree students enrolled in a particular graduation seminar under my supervision, show a series of design explorations where design students combined the use of textile as both an ephemeral expressive medium, and a lightweight roofing solution. Eventually, the design team scrapped the idea, switching to the use of tense industrial structures and other more conventional systems.

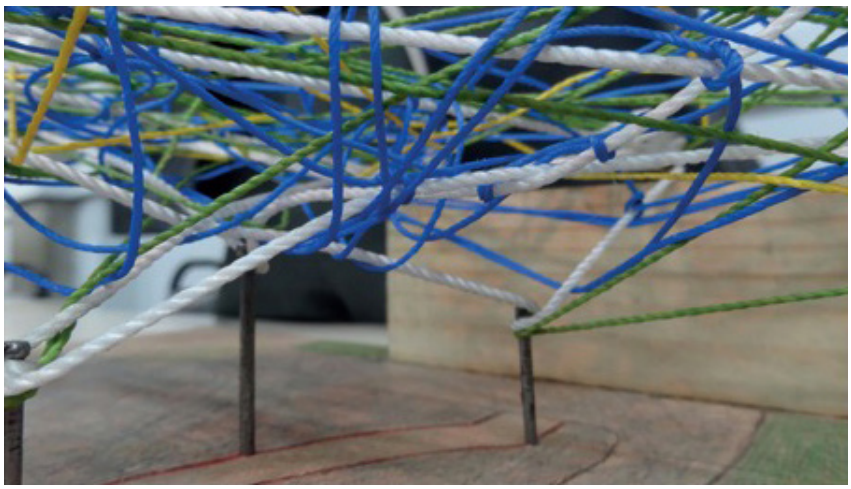

Image 1. Students' explorative working models for the 'IP' project in the 2012 Graduation Seminar in Arts and Visual Communications. The models show how the students first proposed the use of textiles as an ephemeral expressive medium and as a light roofing solution. Eventually, the design team discarded the idea and switched to the use of industrial tensile structures and other more conventional constructive systems.

Typically, a design project in a university teaching and learning context is constructed around a 'roadmap' that teachers elaborate to set 'the rules' of the game. Thus, the student's task is to propose a 'solution' to the challenge materialized in the design of an object or space; or as Munari describes it, a 'solution' to the 'problem'. Commonly, teachers set a number of hypothetical variables through which students must navigate in search of their emerging proposals. These typically include a hypothetical customer, or target audience or user; a series of objectives to be achieved by or through the design; and usually some element of specificity that restricts the overall temporal, spatial or material framework of the project (for example, the selection of possible geographical sites or contexts; a set of constraints in the allowable formats of the submittable proposals; a certain restriction in the materials or techniques to be used; a deadline, etc.). Following Schön (1983), we can establish here a rupture between these traditional 'problem setting' classroom dynamics and those of 'real-world practices'[2] —prescribed in the *problem setting* paradigm where "problems do not present themselves to the practitioner as givens. [Instead] they must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain" (p.40). Again, departing from the preset constraints described above, students generally develop a series of sketches, models, diagrams and notes where their ideas are 'gradually' *translated* (Callon, 1986) from an 'abstract' and non-material plane of ideas to a 'concrete' and material one ruled by material objects, or more precisely, *things* (Latour, 2008).

I contend that suggesting that a 'final design' is the result of a gradual ensemble of things, or a kind of creative 'evolution'[3] of ideas materialized in models and sketches would only be partially true at best. While it is true that certain ideas generated in a sketch may transcend in one way or

[2] Whether they take place in those same classrooms or in a practitioner's design studio.

[3] 'Evolution' understood here in its Darwinian definition as found in biology.

another to the following sketch and so on until reaching that 'final design', what eventually happens to these 'non-final' sketches? Put differently, as students carefully—almost ritually—display their 'finished' proposals on the walls and tables of the design workshop at the end of each semester, what has become of all the quick and dirty sketches that allowed those neatly polished—and apparently static—'new' realities to emerge? Furthermore, it is worth mentioning that 'finished' designs are commonly understood as singular and almost monolithic *entities* that one arrives to by means of gradually 'polishing' or 'cleaning up' an otherwise 'unfinished' proposal. All things considered, I contend that students do not produce morphologically *fluid* and *mutable* (Law, 2007) models and sketches capable of continuously transforming themselves as many times as required to finally arrive at the 'finished' design that the designer envisioned in the first place. Instead, I argue that designers produce a series of unique, static, unrepeatable and necessarily unfinished *enactments*—materialized in two- or three-dimensional inscriptions—that will eventually end up in the workshop's trash bins as the designs are 'polished' and 're-written' into their final 'clean' versions. Therefore, I ask: what is design if not a *contingent* and epistemologically *messy* activity? And consequently, what are design objects if not ontologically *fluid*, *multiple*, *mutable* and *precarious* entities?

However, Munari (2004), who without the slightest hesitation holds that "everything is easy when you know what to do in order to reach a solution to a problem" (p. 10) attributes any latent difficulty of pursuing design solution through his strategy to either technical failures (thus strictly rooted in a methodological insufficiency), or to managerial failures understood as problems derived from the inability to 'orderly' manipulate or manage the design object (Law and Singleton, 2005). Therefore, following the latter authors, I propose an understanding of design as a *messy* object that, due to its own ontological condition, resists being *technically* and *managerially* ordered. More specifically, I agree with Latour's (2008) and Yaneva's (2009) call to understand design as an *ontologically multiple* object of study insofar as it characteristically emerges not only from *multiple interpretations* (that is, from a diversity of simultaneous epistemological perspectives),

but from multiple performative representations[4]. To reinforce this last argument, I again refer to the role played by 'two-' and 'three-dimensional' material inscriptions[5] (Latour, 1987) in the design process.

As I suggested earlier, each *inscription* (models, sketches, and notes) produced by design students with the intention of 'arriving' at the final design of a particular problem represents a construction of a particular reality in itself. By literally and figuratively discarding each of these material objects in the workshop's trash bins, or by 'bundling' them up with each other in the submitted project logs that are evaluated at the end of each semester, the possibility for alternative realities to emerge from those *other* than from the 'final design' is also being discarded. This statement echoes Timmermans and Epstein's (2010) proposal regarding the typical standardization processes[6] of the industrial and post-industrial economy by stating that "Just as the choice of one standard (or in our case, a design) over another signals a preference for a specific logic and set of priorities, so the choice of standards of any sort implies one way of regulating and coordinating social life at the expense of alternative modes" (Timmermans and Epstein, 2010, p. 85). In other words, behind each 'final design' there is an inevitable process of synthesis, evaluation and discrimination that allows certain realities (material, social, aesthetic, etc.) to emerge at the expense of others. Therefore, whenever we are confronted with a 'final design' we must bear in mind that these constructions are nothing less than the partial and materialized result of certain versions of a reality that depend on the balance and the interaction between entities made *present* and *absent*. In other words, each 'final design' implies the loss of certain alternative versions of reality, and therefore simultaneously of other paths to understand, act, and make decisions in the world.

[4] *Representations* to be understood here not as the Peircean *substitution* of an object for a semiotic sign; but rather from its definition derived from ANT, which more appropriately resembles the process by which an actor or actress in the performing arts represents a character or a particular situation.

[5] As coined by scholars enrolled in ANT as well as in Governmentality studies: i.e. Miller, P. and Rose, N (1990).

[6] Evident, for example, in the proliferation of 'codes' and 'standards' whose purpose is to *normalize* the production of objects and designs in fields as varied as ergonomics, biogenetics and even the musical instrument industry.

Image 2. Conceptual sketches for the 'Anforas' project in the 2012 Graduation Seminar in Arts and Visual Communications 2012. Each of the proposals *affords*[7] a universe of formal, discursive and pragmatical possibilities that are unique and unrepeatable even for the same design team. The team's selection of one of these expressive universes necessarily implies the disappearance of all other alternative realities offered in the discarded proposals.

Law and Singleton (2005) affirm that "we cannot understand objects unless we also think of them as sets of *present* dynamics generated in, and generative of, realities that are necessarily *absent*" (p. 343. Emphasis added). This means that, on one hand, making certain designs emerge into *presence* makes it necessary, in turn, to make others simultaneously descend into *absence*; and on the other, that whatever emerges as a new 'reality', breaks into the present through its very absence.

Hence, the sketches and models that end up being compiled in 'project logs' at the end of each semester are judged as (evidence of) the design 'process'. Their ultimate goal is therefore to act as reliable representative *spokesmen* (Callon, 1986) capable of witnessing for the comprehensive nature of the process that leads to the 'final design'.

## Non-human agency in the design process

Up until this point , I have introduced three situations in which 'non-human' entities (such as models and sketches) play a leading role in the assembly of three specific *actor-networks*. These are:

1) In the creative process by which designers set out to 'solve' a design problem through trial and error.

[7] According to Harré (2002, p. 27) "The same material thing may have a great many different possible ways in which it can be used. Each is an affordance. Affordances are spatio-temporally located relative to well-identified material things and states of affairs."

2) In the process by which a 'final design' emerges as a 'new reality', while any alternative enactment of reality is consequently relegated to a mere hypothetical exploration.

3) Finally, in determining the 'grade' to be obtained by design students at the end of each workshop.

From this point forward, I would like to focus the discussion on understanding the role these 'non-human' entities play in determining the internal dynamics and the 'final' result of any given design process. To do so, I consider it necessary to introduce the concept of *agency*, as originally coined in the neo-materialist tradition of post-human feminism, and as widely developed further by ANT and STS scholars.

Even though the traditional concept of *agency* essentially refers to the capacity of any entity to act, think and experience emotions (Callon, 2004), Callon and Muniesa (2005), following the analytical traditions mentioned above, propose the concept of *distributed agency* to refer to the capacity of 'human' and 'non-human' entities to *act* on equal terms. Furthermore, these authors propose that all action is only possible through the work of hybrid collectives, and not of 'human' entities alone (p. 1236). In this work I argue that the design field may offer one of the spaces where this notion can be more clearly evidenced.

For instance, let's take the less spectacular, everyday scenario that first comes to mind. A designer sits in her comfortable office chair, sketching (with a marker on sketching paper) ideas for a certain design project. We may ask ourselves who is acting in this situation. Of course, the most obvious and predictable answer would be the designer. But is she acting alone? If this were so, then the design resulting from the designer's sketches would be nothing less than exactly what she first envisioned in her mind, and thus what she ultimately materialized 'as is' on paper. But in this case, why did she produce as many as 80 different sketches of the same thing during the process? And furthermore, how can we explain that typically, designers don't just 'get it' on the first try?

Is it because the designer usually runs into the difficulty of translating the ideas in her head into images on paper, or rather is it that sketching and doodling on paper allow the designer's ideas to emerge?

If the latter is true, then the designer's ability to materialize abstract ideas in graphite on paper is mediated not only by their sketching skills, but because of the possibilities, qualities and finishes that a paper, pencil and the even the surface of the drafting table (among many, many other things) allow. Again, referring to the most mundane scenario possible in the life of a designer; a pencil and a piece of sketching paper will never *allow* the exact same design to emerge as could materialize from the interaction between square-tip markers, fountain pens and tracing paper, even if we speak of the same designer who is sketching on the same drafting table on the same day. As stated by Callon (2004), 'non-human' entities (such as pens and tracing paper) "[…] "take part in the process of production of knowledge and know-how. Intellectual achievements, ideas, projects, plans, production of information, are through and through material processes" (p. 7).

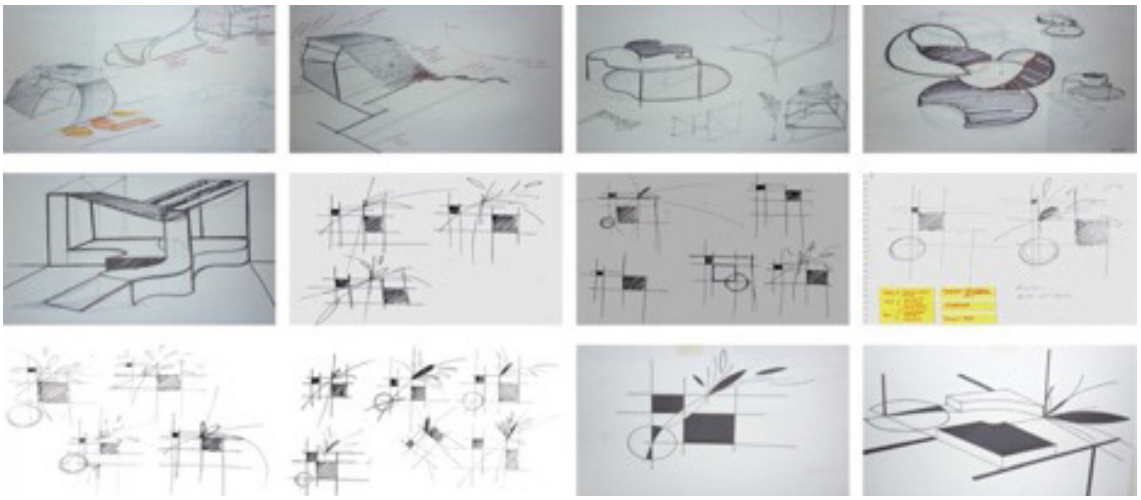

Image 3. Explorative sketches for the 'Anforas' project in the 2012 Graduation Seminar in Arts and Visual Communications 2012. Note how the first ten sketches by hand and pencil differ in gesture and expression from the digital sketches in the lower right corner.

To develop this idea further, we can add the following thesis coined by Latour and Yaneva (2008): "Drawing and modeling do not constitute an immediate means of translation of the internal energies and fantasies of the architect's [or more generally, designer's] mind's eye, or a process of transferring ideas from a designer's mind into a physical form [ … ] Rather, the hundreds of models and drawings produced in design form an artistically created primal matter that stimulates the haptic imagination, astonishes its creators instead of subserviently obeying them" (p. 84).

The conceptual, critical and paradigmatic approaches explored in this paper may spark an interest in observing, researching and reflecting on the multiple ways in which we designers are actively and inseparably linked to a constellation of 'non-human' entities every day. Moreover, the various yet intertwined discussions in the work also suggest understanding our daily professional duties as the result of constant heterogeneous negotiations between objects, skills, bodies, knowledge, and guesswork. Following Wilkie and Michael (2015), I argue that highlighting the complex, *heterogeneous* and *synthetic* character of design as an *inventive method* (Lury and Wakeford, 2012) or *device* would allow us to understand it as a distinctive domain of practical expertise "situated at an extreme because the elements that enter into its synthetic processes are particularly heterogeneous. [Hence,] design studio[s, workshops, and classrooms are] particularly 'expansive' version[s] of centres of synthesis" (Wilkie and Michael, 2015, p. 39).

In short, I have explored how the analytical principles of ANT and STS allow us to further understand the conditions through which designers may be particularly sensitive to the complex and intimate negotiations they perform using myriad materials and technologies with remarkable *agency*; a capacity for action without which the emergence of design objects, products or spaces would be inconceivable. Or as Yaneva (2009) so proficiently states it "such accounts of design reveal to what extent designers are attached to nonhumans; [and how designers] can hardly conceive a new object or environment without being assisted and amplified by many drawings, tools, models and other devices" (p. 283). The greatest challenge involved in joining a paradigm shift that implies a *generalized symmetry* (Callon, 1986) of *agencies* between 'human' and 'non-human' entities is, according to Sarah Whatmore

(2006), "the onus [this places] on experimentation and, by implication, on taking (and being allowed to take) risks" (p.606).

## Conclusions

This paper has sought to contribute to the growing body of research in the design field that, rather than looking at design objects and design practices from the 'outside' (as would be, for instance, an ethnographical or a historical study of how design ideas or influences are transferred from designer to designer), looks at designing—as a verb—from the 'inside'; that is, in the performative negotiations between designers, technologies and materials that occur daily in brainstorming sessions, model building workbenches and university classrooms and workshops.

Therefore, these pages ultimately intend to spark an interest in researching design—both as a *field* and as an *action*—from an analytical perspective capable of actually observing actors (both human and non-human) as they *act*, and as they performatively assemble socio-technical hybrids (Bowker and Star, 1996) or *actor-networks*.

To support this interest and the arguments made in this paper, I have referred to my own experience in university teaching in the design field, and to my own interest in critically inquiring about what Callon and Latour (1981) refer to as the *black boxes*[8] that we as teachers produce and reproduce time and again without questioning their paradigmatic, ideological, or contextual roots.

However, understanding design as a messy **socio-technical Actor–Network** should not be mistaken as an analytical solution to a multitude of situated problems. Doing so would possibly lead to the forced reduction, normalization and 'bracketing out' of the complexity, instability, and uniqueness of each individual situation. Instead, understanding the heterogeneous and *messy* nature of our discipline may allow us to 'open up' a conversation on the limits of our prevalent research methods and our analytical concepts and notions. The new discussions generated in this context could, in the long run, constitute an intellec-

[8] "A black box contains that which no longer needs to be considered, those things whose contents have become a matter of indifference" (Callon and Latour, 1981, p. 285).

tual emancipatory force that would allow us to build knowledge from the most mundane and less spectacular practices of our daily activities that we take for granted and are often even belittled, and not just from certain abstract positions 'borrowed' from other disciplines such as semiotics, psychology, or as Munari has it, exact sciences.

After all, the promise of engaging in an ontologically flat design research from the studio, the classroom or the workshop would involve a "speculative obligation to those entities (users, collectives, communities, [and *things*]) who *emerge* by way of research practices" (Wilkie, 2016. p. 876. Emphasis added). Furthermore, doing so would also allow us to restore the often-overlooked *thingness* of design practices, objects and skills which are necessarily "encoded in everyday and specialized technologies and assemblages in which agency is no longer the sole privilege of human actors" (Lury and Wakeford, 2012, p. 9). That said, I also believe that a *messy* understanding of the design field may present us scholars with the challenge (and the sensibilities) to build a new design theory distanced from the generalized anthropocentric conception that still prevails in our universities, firmly embedded not just the way we produce academic knowledge, but also the way we perceive and act in the world.

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