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The e-journal for the dissemination of doctoral research in architecture.

14

February2020

www.archidoct.net

ISSN 2309-0103

META

Listed in:

Scopus®

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

archi|DOCT

The e-journal for the dissemination of doctoral research in architecture.

Editors of the current issue: Polyxeni Mantzou and Maria Voyatzaki

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Editorial Board //

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Scientific Committee // 4

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Scientific Committee // 5

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Editorial // 6

Meta

Maria Vogiatzaki

The call of this issue, authored by Professor Polyxeni Mantzou, from the Department of Architectural Engineering, Democritus University of Thrace, Greece addressed "the notion of 'meta', a term typically used to denote something of a higher or second-order; or a change of position or condition; or a position behind, after or beyond. 'Meta' in Greek is an extremely wide-ranging word, used to denote, among others, the way in which, in accordance to, after, in-between, with. We use the term "meta" to define our current condition, of a higher or second-order, one that comes after and goes beyond but also with the one that came before and more importantly, describe the intermediate, betwixt, in-between nature of our times.

Our Meta- age is difficult to define as many separate conditions of the past coexist and are blended and merged together in a new, hybrid and fused reality. The pre-modern, pre-industrial, pre-alphabetic world, reigned by handicraft, orality, immersion, randomness, aggregation, nowness and emotion and the modern, industrial, alphabetic world, ruled by machine-made, text, theory, regulation, analysis, perspective and rationality; are now merged in this meta- condition, where new hybrids are conceived and engendered and a new and programmed wilderness emerges.

Relation and mediation characterise this meta- age and architecture as a formerly principal mediator is challenged. The Meta- issue aims to examine this challenge in different aspects of architecture. Design as a detached and separate process from construction is reconsidered; typologies and customization are re-examined; representations no more aim to describe buildings or objects but rather to relate the experiences of subjects in or with them; unbuilt simulations become autonomous and even more seductive than the experience of physical space; materials are no longer classified as natural, artificial or industrial as they are all calculable or even programmed; description of forms surrenders to the survey of in-formation through abstract modeling conceptions; subject and object opposition becomes irrelevant as interconnected subjects and re-contextualized things that form part of an almost animated standing reserve, define new possibilities for novel interrelations and configure dynamic atmospheres."

The good practice example, authored by Professor Constantin-Viktor Spyridonidis from the School of Architecture, Canadian University of Dubai, and by Professor Maria Vogiatzaki from the School of Architecture of Anglia Ruskin University, is entitled "Architectural Interregnums". The authors argue that architectural design has always been the laboratory where experimentation with ideas about the newness, and elaboration of forms and spatial arrangements take place towards architectural creations. Prefixes such as post-, de-, re-, neo-, appear as typical signifiers of the spirit of novelty representing the different shifts that shape the history of architecture and could be broadly summarized by the term 'meta'. Even if 'meta' is a kind of ontological reference to newness, implying its definition with what preceded, it always remains polysemic and, for this reason, ambivalent. Design

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

is acting between the existing and the coming, the established and the expected, the familiar and the xenon, the antipathy and the empathy. It is driven by the quest for a 'meta', known (or not) that since its appearance, it will lose its newness and will become commonplace. What type of novelty does it put forward through its creations in the contemporary interregnum? What are the primary formal or material traits that can attribute that identity to the new that can clearly distinguish it from the old? The paradox we are confronted with nowadays is that despite the unprecedentedly fast pace of changes happening in the sphere of the intellect, the sciences, technology, and the geopolitics of the globalized world, there are no apparent signs of novelty in contemporary architectural production.

The 14th issue of ArchiDOCT attracted five different voices from five different institutions around the world, all doctoral students and researchers who submitted essays that examine the notion of "Meta-" and the way this radical but subtle paradigm shift creates novel possibilities but also demanding challenges for architecture.

"Immediate Systems: Exploring the Potential of Human-In-The-Loop Cyber-Physical Systems that Embed Design and Implementation in Situations of Use" is the essay submitted by Christian Friedrich, doctoral student at the Faculty of Architecture at Delft University of Technology, in the Netherlands. Aim of this essay is to introduce the notion of Immediate Systems which embed design and implementation in situations of use and thus overcome the limitations of remoteness. This is based on the hypothesis that Design activity, especially in architectural praxis, takes place in spatial and temporal remoteness from the use of its outputs. This remoteness impedes the ability to respond to actual needs that arise in situations of use. Immediate Systems, as defined by the author, are cyber-physical systems comprised of interacting digital, analogue, physical, and human components. As meta-systems they include people and environments in a tight loop between human intention and immediate adaptation. Immediacy in this context indicates a state of continuously available adaptability at the speed of human intention. Such meta design systems take design methodology to an extreme that paradoxically resembles the situation before design emerged as separate praxis. Three theoretical contributions propose and frame the notion of Immediate Systems, present and discuss a series of examples indicating opportunities and challenges of such systems, and identify characteristics of and conditions for Immediate Systems derived from the first two contributions.

Adolfo Jordán, doctoral student at the School of Architecture, Engineering and Design, Universidad Europea de Madrid authored "Systemic Considerations: Regarding the Importance of the Pre- in the Post- on the Path Towards the Meta-system". The first part of the essay is a historiographic trajectory of the system as a notion, in various critical shifts of paradigm. The traces of these shifts have brought about what we currently appreciate as a system, especially in a world mediated by machines. The merging of these various traces, despite the linear thinking yielded, are putting forward the notion of meta-system. More specifically, as meta-system, the author defines as deriving from ongoing processes anchored in the distant past, finally leading to a new paradigm. The essay traces the evolutionary nature of systems as these emerge from the broader worldview and the view of architecture, towards gaining a better insight into the present and future: in order to achieve the role of intelligent machines, we must see that, rather than being the origin

of the new paradigm, they are neither the origin nor the product. Therefore, the author's concept of "meta-" constitutes a hybrid condition that implies an appreciation of the "prior" and the "subsequent", not only in the sense of "post", but also in the sense of "with" and "alongside", based on the intermediate contemporary perspective. Finally the essay suggest that in order not to conflate meta-progress with just digital advance, we ought to look into the future of comprehensive research based on the origins of parametricism in architecture, based on the hypothetical existence of an equally rich parametric pre-digital theory and history that has been barely explored.

The essay entitled "Architecture in a Petri dish: co-programming Meta-Life in design through biointegration and synthetic biology" by Selenia Marinelli, doctoral student at DiAP (Dipartimento di Architettura e Progetto), Faculty of Architecture "Sapienza", University of Rome, Italy, touches upon 'meta' through the investigation of the concept of meta-life as a grey area between the animate and the inanimate, the natural and the engineered, the born and the built, in order to demonstrate how these entangled notions could be applied also as new design strategies. The essay suggests that the advent of synbio and bio-information as tools for architecture could in fact drastically change the way we conceive buildings as meta-living beings in ontological continuity with the biosphere. Fine illustrations of how biotechnology and synthetic biology are offered, and suggest the entanglement of contemporary architectural contemplation and practice to climate change and environmental decay.

Meta(re)presentations essay authored by Antonis Moras, PhD candidate at Aristotle University of Thessaloniki, reviews the key literature on the notion of metarepresentations in fields beyond architecture. The essay is an attempt of rereading the conception of representations in the architectural domain. Two main categories of metarepresentations in architecture are proposed and depend on their effect on thinking representations; Content and context aware metarepresentations
Content aware metarepresentations are based on a value system and can be divided in two categories. The first one is characterized by standardization and selfreferentiality while the other one is structured as criticism by enabling referencing and quoting within content. Characteristic examples are modern and postmodern architecture. As the author argues "Context aware metarepresentations resemble the condition of monitoring a system by focusing on the relations between the different parts that temporarily constitute it as such. Characteristic examples are post-cybernetic and post-digital architectures".

Verena Ziegler, doctoral student at Linz University of Arts and Design in Austria, in her essay "InBetween – a post-digital turn – Crafting 4.0" discusses the "continuous beta" version of becoming as a way to describe the between space for the merging and coexistence of what used to be the ends of polarities and the dialectics of anthropocentrism. As Ziegler explains, post-digitality involves the physical dimensions of spatio-temporal engagements. This new ontological paradigm reconceptualizes digital technology through the experience of the human body and its senses, thus emphasizing form-taking, situational engagement and practice rather than symbolic, disembodied rationality. The emerging questions focus on ways in curiosity, playfulness, serendipity, emergence, discourse and collectivity, are encouraged. Furthermore, ways in constructing working methods without foregrounding and dividing the subject into an individual that already takes position are

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

discussed. The essay briefly outlines the rhizomatic framework developed by the author, aiming at overcoming two prevailing tendencies: first, the one-sided view of scientific approaches to knowledge acquisition and the purely application-oriented handling of materials, technologies and machines; second, the distanced perception of the world. On the contrary, the work presented, involves project-driven alchemic curiosity and doing research through artistic design practice. This means thinking through materials, technologies and machinic interactions. 10 interdisciplinary projects that have emerged from this ontological queer-paradigm that is post-digital–crafting 4.0. are illustrating the underpinning theoretical viewpoint.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Table of Contents //

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

II

A Good Practice Example

Essays

Contributors

A Good Practice Example // 12

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Architectural Interregnums

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The authors are put alphabetically and have contributed equally to this publication.

Abstract
Architectural design has always been the laboratory where experimentation with ideas about the newness, and elaboration of forms and spatial arrangements take place towards architectural creations. Prefixes such as post-, de-, re-, neo-, appear as typical signifiers of the spirit of novelty representing the different shifts that shape the history of architecture and could be broadly summarized by the term 'meta'. Even if 'meta' is a kind of ontological reference to newness, implying its definition with what preceded, it always remains polysemic and, for this reason, ambivalent. Design is acting between the existing and the (be)coming, the established and the expected, the familiar and the xenon, the antipathy and the empathy. It is driven by the quest for a 'meta', known (or not) that since its appearance, it will lose its newness and will become commonplace. What type of novelty does it put forward through its creations in the contemporary interregnum? What are the primary formal or material traits that can attribute that identity to the new that can clearly distinguish it from the old? The paradox we are confronted with nowadays is that despite the unprecedentedly fast pace of changes happening in the sphere of the intellect, the sciences, technology, and the geopolitics of the globalized world, there are no apparent signs of novelty in contemporary architectural production.

Nothing is new, neither is anything old.
Robert Smithson [1]

Keywords
Becoming; novelty; interregnum; architectural design; posthuman

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

I Architecture and the new

The ongoing repair of the old ship of Theseus, the wooden monumental object Athenians preserved to remember Theseus's great achievement to exterminate the Minotaur, raised a long-lasting philosophical debate about identity and persistence in changes through time [2] The question if the replacement of the parts of an object retains its identity and uniqueness was tackled by many philosophers such as Heraclitus, Plato, Aristotle, Plutarch all the way to contemporary philosophical contemplation. How can the question be answered if, instead of changing the parts to preserve identity, one changes the parts to transform the object into something 'other,' creating the new, the different, something that would follow, a 'meta'? Furthermore, if to transform in order to change creates the new, then how could this new jettison its oldness?

To be the same or to be different are profoundly rooted values in the human intellect.

To be different from what has preceded has always been the cornerstone of the edifice of architecture as a discipline since the Renaissance. Even though the value to be different from the obsolete conventional was always utterly important for Architecture, the definition of this value in architectural discourses is somewhat obscure. Prefixes like post-, de-, re-, neo-, appeared as typical signifiers of the spirit of novelty representing the different shifts that shape the history of architecture and could be broadly summarized by the term 'meta.' Even if 'meta' is an ontological reference to newness implying its definition about what preceded, it has always been polysemic and, for this reason, ambivalent, diffused into the ideas encompassed by the broader term 'avant-garde', labeling practices for longer or shorter transitional periods. Architectural design has always been the laboratory where experimentation with ideas about the newness of this 'meta,' and elaboration of forms and spatial arrangements take place towards architectural creations. Design is always acting between the existing and the upcoming, the established and the expected, the familiar and the xenon, antipathy and empathy. It is driven by the quest for a 'meta,' known (or not) that since its appearance, it will lose its newness and will become commonplace. The meta stands for a new condition to be, formulated, structured, and completed. The pursuit of the new empowers architectural design to perform between the old and the meta, in an in-between state, a metaxu state, a fertile ground for change and continuous variation, an interregnum [3] A place to investigate the becoming.

What is new in architecture? Why is architecture preoccupied with longing for the new. [4] Michael North (2013), in his studies of the history of the new, distinguishes two long traditions ruling our as-

1. Robert Smithson, 'Ultramoderne', Arts, XLII/1 (1967), p. 31.

2. The ship wherein Theseus and the youth of Athens returned had thirty oars, and was preserved by the Athenians down even to the time of Demetrius Phalereus, for they took away the old planks as they decayed, putting in new and stronger timber in their place, insomuch that this ship became a standing example among the philosophers, for the logical question of things that grow; one side holding that the ship remained the same, and the other contending that it was not the same.

3 Interregnum was the term used in ancient Rome to refer to the moment of legal and political in-betweenness that followed the death of the sovereign and preceded the enthronement of his successor.

4. Theodor Adorno (2002:32) shifts the definition of the new to the desire for the new from its outcome. "The new is the longing for the new, not the new itself: That is what everything new suffers from."

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

pirations towards the new that have their origin in the beginnings of Western philosophy. The one starts from Parmenides and is further refined by Aristotle, who appreciates the new as the outcome of cycles of recurrence in which incremental changes happen to adjust, adapt or improve the development of these cycles. The underlying assumption on which this understanding is based is that "nothing is coming from nothing," which transgresses all the history of Western philosophy and finds its more contemporary version in Wittgenstein's statement "the effect is implicit in its cause [5] " The second tradition starts from the atomist philosophers like Democritus, Epicurus Heraclitus, and Lucretius, who understood the change as the outcome of recombination of the eternal minute and invisible elements that in their perpetual movement recombine themselves in various configurations. As everything flows (τα πάντα ρει), these elements are exposed to various random recombinations that stimulate changes in the existent. Lucretius used language as a reference when he argued that a small number of elements could provide a wide variety of recombinations [6]

5. Cited by Michael North (2013: 21)

6. "Therefore, the supposition that, as there are many letters common to many words, so there are many elements common to many things, is preferable to the view that anything can come into being without ultimate particles." Cited by Michael North (2013: 32)

Through the years, these two traditions formed different variations of how the new becomes a subject of contemplation in the sciences and the arts. Signs of these two traditions could be traced as coexisting or even combined, in the history of human-centered contemplations about the new and the transitional, from Darwin to Kuhn and from Wiener to the more recent debates on aesthetics and the arts. As opposed to the combinatory approach, the tendency to incremental repetition shifts the focus on being rather than on becoming, on unity than on multiplicity, on the similar rather than the different, the constant rather than the mutable, the purposeful rather than the random.

Similar signs of these traditions can be found in Architectural discourses and practices. Françoise Choay (1980) suggests two types of discourses as the foundation of architecture as a discipline after the humanism of the Renaissance. The one embracing the rule is introduced by Alberti. The other focuses on the model, introduced by Thomas More. The first advocates architectural novelty as a creative articulation of predefined rules, the implementation of which would establish the order of the new, while the other advocates novelty as the almost revolutionary implementation of ideal models defined as utopias. We can easily distinguish the attachment of the former to the incremental cycle tradition, as opposed to the alignment of the latter to the recombination one. Choay detects the coexistence of both of these two types of foundation discourses in the texts about architecture and the city produced by modernity after the 18th century. Extensions of the logic of the rule can be traced back to the participatory practices, the syntactic rules of the 1970s, the architectural deconstructivist approaches of the 1980s, or the parametric experimen-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

tations of the last twenty-five years. Similarly, model-based thinking is associated with all the utopias accompanying modernity, but also with its request for models, standards, ergonomics, as well as with interest in the typology advocated by the early post-modernity.

If the new, incremental or recombinatory is always based upon the old, then is the 'meta' a really new condition? Is what humans appreciate as new or else revolutionary or radical, finally an inventive revival or reconsideration and reformulation of the old? Is it possible for the new to exist when the future is circumscribed in the consciousness of the present? Is finally the human intellect what draws us towards predefined possibilities, and is the 'meta' nothing more than an alibi humans abuse to declare even more boldly their dominance on planet Earth?

7. Cf. Colomina, B. Wigley, M. (2017:9)

2 Spatio-temporalities of the new

If what we have created as humans constitutes the so-called Anthropocene, a new geological époque characterised by the human's impact on earth's geology, and ecosystems, then design plays a vital role in this rapport. Design, the way we use it today, that is to say, a professional practice that elaborates the form and the materiality before their construction is a pure creation of a human-centered appreciation of the world. Design is the most essential human outcome of post-Renaissance anthropocentrism. It is a stratagem through which human superiority was manifested on Earth. Design is the 'laboratory' where the new is created, tested, and offered to become old. Novelty was, has been, and always be the ultimate aim of design.

Architecture, as the ultimate inventor of design, is the protagonist in the accomplishment of this aim. Its social project was not only through design to glorify and manifest the superiority of the human intellect spatially but also to change the humans by making them believe in this superiority. To achieve this objective Architecture had to define itself as a design discipline and to produce its own toolkit in a way that both its disciplinary foundations and practices would be compatible and complementary with the under-construction new social, intellectual order. As disciplinary foundations, we mean the ways in which Architecture defines itself as a discipline according to a particular worldview and to a conception of the human into this world. Changes in the contents of the disciplinary fundamentals affect the design and how it is spatially manifested.

Always claiming to respond to the needs of the human, the ultimate aim of Architecture was to design the human [7] In the Renaissance, Architecture promoted the human figure that observed the world to appreciate its truths. The human was the curious observer, creative, eager, and thirsty for new knowledge and experiences. Hence, the

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

eye becomes the most vital human organ to serve the search for truth (Savignat,1981) as knowledge is no longer theocentrically defined but becomes the outcome of the human intellect observing and revealing the requested truth.

The Renaissance human is conceived not only as intelligent but also as sublime. Its proportions reflect the natural beauty and harmony which design has to reflect in architectural forms. To substantiate this social project design needs a professional legitimization originated by the human intellect. This explains the division between contemplating an idea and its making, that attributed superiority to the intellectual tectonics of human-centered Architecture. Design became the hallmark of a professional practice that distinguished intellectual from manual work, attributing to design a political and an ethical dimension. Since then, Architecture's social project has been to manifest the sovereignty of the human spirit and culture onto the natural world and to create forms and spaces that reflect this conception and directly and profoundly affect the habits, the aesthetics and the intellect of those experiencing them.

The new understanding of the human is not only diffused in the design outcomes. The design tools and the design processes also have strong symbolism. The perspective, as a representation technique, is not only a consistent and accurate representation of what the observing eye can see, but it also incorporates in its construction the visible presence of the vanishing point as the meeting point of the parallel lines, the infinite, what for Christianity was defined as the divine [8] Renaissance Architecture takes the infinite from the sky, that is to say from the end of the Gothic spire and iconoclastically locates it into the perspective drawing as a vanishing point [9] The accurate depiction of form and enclosure prior to construction is an achievement of human-centered architecture that marks its development till present times. If what has to be built must be drawn in advance, then what can be built is what can be drawn [10] That means that the drawing with its techniques, tools, and means defines the context in which the architects are constrained to think and conceive form.

As for the design process, the architect-designer elaborates form and space, refined to the last detail, and employs the materials that can best fulfill the project, deterministically and linearly, following a top-down process. On the contrary, the builder works with the material idiosyncrasies of the building [11] negotiates with it, acts on it, teases it, fights with it, reconciles and attunes with it to extract the expected form always moving in between forces, tensions, perfection, imperfections, and transitions in a bottom-up process [12] In the former case, the authorship is assigned to the one who generates the idea and the formal qualities and meanings of the outcome [13] , while in the latter to the one who masters the techniques and harnesses the materiality of the building.

8. Erwin Panofsky (1991), revealed the importance of this profoundly symbolic gesture to place the infinite in the center of the drawing board as a glorious manifestation of the liberation from the theocentric world view.

9. According to Whitehead (1911, 119), "the spire of a Gothic cathedral and the importance of the unbounded straight line in modern Geometry are both emblematic of the transformation of the modern world."

10. Cf. Savignat 1981: 25, Carpo, 2011: 31, 75.

11. Cf. Voyatzaki, 2018, p. 9.

12. Lars Spuybroek (2011) in the 'The Sympathy of Things' presents the building process of Gothic as a permanent condition of in-between, metaxy, using the term slider to express the continuous shift of priorities between construction, meaning, and continuity.

13. Mario Carpo, in his book 'The Alphabet and the Algorithm,' distinguishes the pre-Albertian times of architecture as autographic in lack of drawings to delegate to the builder the idea of the architect. Alberti sustained the distinction between the thinker and the maker, attributing to architecture its allographic nature.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

The natural limitations of the observing eye opened up the way to the invention of the microscope and the telescope, principal instruments to invent other 'Kosmoi' of other scales and other resolutions: the micro-cosmos and the macro-cosmos. The eye stayed tuned with these two entities giving sense to the continuity of scales, the transitions, the coexistence, and the resolutions, till the moment it became unreliable, not because of its limited capacities, or because the appearance does not always tell the truth, but primarily because it cannot be detached from the subjectivity, the values, the prejudices and the linguistic limitations that govern the human. This is the most critical point of the Enlightenment that changed the condition of anthropocentrism and introduced what Whitehead (1964) in his 'Concept of Nature' defined as 'bifurcation': The distinction between material nature and non-material minds, objectivity, and subjectivity, reality and appearance. Bachelard (2002) much later similarly defined it as epistemological obstacles and later on Althusser (1969) as an 'epistemological break'. Since then, nature became what the Cartesian radical dualist ontology defined as res-extensa, a real and inanimate entity devoid of any meaning or possibility of agency, producing its effects only through the power of its causes, opposite to the res-cogitans, a subjective and value-based substance but void of any reality [14] . Science becomes the solid ground to reveal the hidden truth by attributing effects to causes, which in turn become new causes for new effects.

Changes in worldviews directly impact architectural design. The project of Architecture becomes now to design (for) the rational human. Not the polymath human of the Renaissance but the Kantian human of the Enlightenment; To design its material environment capable of hosting the objectively defined-by-science human needs. Designing (for) the rational human is no longer to prioritize aesthetics, memories, or cultural, social, and intellectual references but the needs of that species called human. The human is progressively pushed to the realm of res-extensa, to lose its face, its gender, its identity, and to become the human that is legitimized by its dimensions, proportions, anatomy, and ergonomics.

The shift of the conception of the human affects the design process but also the design tools. The building is conceived not to be seen but to function, to arrange spaces ensuring the functional rationalities of the activities to be hosted, far from any traditional habits, or unreasonable subjectivities. It has to work, just like Isabelle Stengers's (1997) 'medieval' clock [15] All its parts are arranged in a way that the whole will fulfill its ultimate finality, to host (a certain understanding of) the life of the human. This teleological thinking encompasses all parts in a top-down finality, which the genius of the architect has to organize, putting them together in place, com-posing, towards

14. Cf. Bruno Latour (2010: 481)

15. Isabelle Stengers (1997:11-13, 77-82) uses the case of the medieval clock as the efficient weapon against the Aristotelian thought used to metaphorically describe the construction of the Universe as well as later on the formation of the alive. This way, it introduces its machine-based understanding in the Enlightenment and its study through physics.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

affirming what is true in the life of a human, namely the biological needs of the species. Designers no longer perceive but arrange and organise.

This new priority renders the arrangement and organization of the inner part of the building the starting point and the generator and the reflector of this organization in the built form's appearance, its elevations. This is entirely different from the eye-centered approach. This shift renders perspective a pointless and obsolete drawing tool [16] and alludes towards drawing techniques freed from the eye and its numerous practical and ideological deviations based on projective and descriptive geometry [17]. The Euclidian visual cone is replaced by the geometric beam of parallel lines that depersonalize representation but also moves the human eye from the experienced world to the infinite, with all its insightful connotations and symbolisms [18].

The appreciation of the act of 'becoming' is based upon the appreciation of the state of 'being.' If there is a genuine intention to debunk the latter, then the design practice, even if it pretends to be looking forward, cannot avoid looking back to take the maximum possible distance from the past. This is the ground on which Bruno Latour (1993) argues that we have never been modern: In their effort to distance themselves from their past, the humans, almost religiously, believed that they had to abandon any connection and association to subjectivity, history, interpretations, towards establishing reliable objectivity, that is to say, to separate the Cartesian 'res extensa' from the 'res cogitans'. Under the labels of reason and causality, progress and, more recently, innovation, appearing as the motivators of what North (2013:16-19) presents as 'the pathos for the new,' the human 'produced' and created artifacts and conditions, the dominant value of which was that they would not be what they used to be [19].

Divisions imposed in the spirit of the Enlightenment opened up avenues for the development of a human, radically different from what it was before, as it was progressively detached from nature to create an englobing artificiality to live in. The lifecycle of this pursuit, however, was underestimated and ignored. It is becoming increasingly apparent that this artificiality was founded on a false appreciation of nature conceived as a passive and stable res extensa, without any agency attributed to its constituting parts. From the moment that the laws that govern nature became known by physics, humans believed that they could totally control it. As Bruno Latour (2010) states, humans designed their future but not their prospect on Earth, a frivolous choice that threatens their very existence as species.

3 The emergent newness

Since the mid-sixties, the philosophical, epistemological, scientific,

16. The Perspective could offer a reliable view of the building before its existence, but it was not equally efficient to assure measurability in the construction process. For this, architects had to do their drawings in projection so that measurements could be taken from them (Ackerman, 2001, p.29). The coexistence of these two ways to represent space indicates the need or the wish to combine, in the new profile of the architect, the artistic with the technical and to expose the creative work to aesthetic and rational judgments.

17. Architect Jean-Nicolas-Louis Durand, Professor at École Polytechnique in Paris, a prestigious institution founded by Gaspar Monge, founder of the descriptive geometry, just after the French Revolution, embedded principles of Descriptive Geometry into his architectural teaching. For a detailed description of the shift from perspective to descriptive geometry cf. Savignat 1981.

18. Cf. Spiridonidis 2018:23

19. Niklas Luhmann (2000: 199) characterizes novelty as 'ontological nonsense. Something is, although and because it is not what was before'.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

and technological debates around the world questioned the ideas and the practices of anthropocentrism. Philosophical circles criticized the worldview and the respective conception of the post-enlightenment human trying to reveal its impact on our social, emotional, and political life [20] They questioned the operational value of 'progress' as a concept that underlined the thinking and practicing of Modernity. They expressed concern about the impact of the exclusion of subjectivity from contemplation. Philosophy also questioned the construction of a worldview founded upon binary oppositions and polarities which biased human contemplation, language, habits, and understandings by imposing fragmented views and supposedly clear-cut distinctions which obscured the real and essential connections and affects between parts, particles, living substances, and materialities, through which an interconnected world could exist. Terms like assemblage, emergence, difference, agency, affect, immanence, sympathy, ecology, symbiosis to state some of them progressively immigrated to many other subject areas and spheres of contemplation, associating them through new ecologies, connections, and continuities.

20. Cf. for example, Braidotti (2013), Delanda (1997, 2016).

At the same time, epistemology acknowledged the weaknesses of the key premises of the sciences of anthropocentrism and the effective repercussions that its fragmented knowledge had on the appreciation of the world. Supported by the philosophical debate, epistemology attempted to clarify the reasons for what was then called 'the war of sciences' 21 , to reconsider the utility of what was up to that point considered to be useless, or at least secondary and to acknowledge the value of new terms able to open new perspectives to our appreciations of the world. How 'to arrange' and 'to mix' constituted different ways of appreciating the materiality of the world and the important information was gaining in the different constellations of human knowledge connecting them all across, while replacing the notion of the system as an inherent notion in modernity's objectivity.

21. Cf. Stengers(1997).

In the scientific realm, the de-codification of the DNA did not only put information on the pedestal of life but also provided a valid model for understanding life as entirely dependent upon its environments, material, or organic, which are vital parts of its development and existence. At the same time, cybernetics and information theories claimed that the most basic level of this universe is composed of units that have a simple on-off function. Each unit has properties that are defined by the interactions it has with its environment(s), part of which are its adjacent units. The understanding of this interdependence assisted in appreciating the human impact on the environment and, more specifically, on climate, totally neglected in modernity. The catastrophic effects of our recent times not only are far from the promises of prosperity that modernity's progress would

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

bring about, but are, in fact, putting us under threat, in peril of our species, nearing extinction.

The second-order cybernetics elaborated those capacities of a system of information transmission, which give it the capacity to process information empowering machines to develop artificial intelligence, artificial life, self-organizing systems, learning, and other forms of cognition 22. The acceleration of information technology and computation highly supported modernity's project to artificialize the living environment and life itself, as a sign of human superiority and sovereignty. Intelligent machines, digital devices, and applications formed a new artificial environment in which it becomes difficult to define the line of demarcation between the natural and the artificial, the organic and the inorganic, or the human and the non-human. Absorbed by a broad spectrum of human mental and practical activities and senses to make them faster and more effective but in the same time detached them from the body, affecting its capacities directly as it has now to remember, to calculate, to write, to see, and finally, to think exclusively alongside media 23.

The breadth of questioning anthropocentric thought concerns not only other than the human species but also or perhaps above all, the sustainability of our planet entangled with its political and economic dimensions. It seems that we are already in post-anthropocentric times, in the so-called post-human era. In this transition, the emerging thinking dispenses the human from the center of intellectual preoccupations and replaces it with Gaia (planet Earth) conceived as a living organism. The concept of Gaia advocates the reconciliation of old polarities founded in anthropocentrism, as we have mentioned before, such as life versus matter, given versus constructed, mind versus body, human versus nature, immaterial versus material, humanities versus sciences. Gaia is appreciated as the declaration of the existence of permanent and necessary symbiotic relationships between these polarities which due to these symbioses, blur their lines and falsify their established identities. The human is no longer conceived as the dominant agent and controller of natural elements and artefacts. The human is now located within the natural and artificial environments it created, no longer acknowledged as the unique entity that can safely form and transform them (Voyatzaki, 2018, p.12).

Architecture is undergoing a long period of crisis and discerns as our world is progressively relocated from what takes time to die into what is not ready to be born as yet. What architecture is created in this particular interregnum, to use the famous phrase of Gramsci 24? What type of novelty will it advocate through its creations, and what will be the main formal or material traits able to offer an identity to the new and to clearly distinguish it from the old? The paradox we

22. Cf. Hayles (1999), How we became posthuman, p. 243.

23. Cf. Hayles (2012), How we think. Digital Media and Contemporary Technogenesis. pp. 18, 60-62.

24. In his 'Prison Notebooks' Gramsci wrote in 1933 that "The crisis consists precisely in the fact that the old is dying and the new cannot be born; in this interregnum, a great variety of morbid symptoms appear."

are encountering nowadays is that even if tremendous changes happen in the sphere of the intellect, the sciences, the technological advances, and the geopolitical developments, we cannot 'see' either with our human eyes or with our mediated eyes, evident signs of an architectural production reflecting a radical and distinguishable novelty, or else the contemporary architectural 'meta.'

Architecture cannot yet produce its post-human face, while it is busy constructing its own intellectual tectonics. As we tried to make it clear in the first part of this essay, design as a creative discipline is a definite 'product' of anthropocentrism. We attempted to circumscribe design's intellectual framework briefly by relating its processes and tools with the worldviews at different historical periods, accompanied by the conceptions for the human and the appreciation of the nature of architectural creations and the social project that architecture undertook to accomplish. We curated these design directives in two different periods of architectural history: One characterized by the change of the dominance in human thinking (from God to the Human) and the other by the establishment of a different understanding of the dominant human. In both cases, the history of architecture suggests that architecture is always agile enough to offer in each period its Palladio's Villas or its Crystal Palaces as signs of a revolutionary recombinatory novelty. In a world identified not only by the importance of changes but mainly by their speed, the silence of architecture is at least bizarre.

Architectural design is made to serve the human and to redesign it. If there is a post-human era, the human in it is no longer, its dominant character, the prima donna. Gaia replaces it, and it is only a part of it alongside other material and organic substances, but certainly no longer the dominant transformer and reformer of Earth. This becomes a profound contradiction in the foundations of the established by anthropocentrism, architectural intellect.

Architectural design was registered as the glorification of the human intellect. It was the domain where human ingenuity manifested itself by creating either the ultimate beauty as the outcome of the thoughtful observer or the perfect spatial arrangement as the achievement of the rational scientist. It was tailored to create the beautiful body or the perfect machine. However, today a significant part of this architectural intellect is co-creating with machines or nonhuman entities, not as in the eighties and the nineties architect's assistant specialized in space representations, but as a competent collaborator participating in the decision making and often demonstrating unprecedented creativity. The skeptics could argue that the more the machine absorbs parts of architectural thinking, the more the architect thinks less, and the more the intellectual part of architectural creation loses its social and economic value. As artificial intelligence is very close to creating designing machines, a severe threat of the established profession is sensed. Signs of this fears are sites, which offer online low-cost architectural services from around the globe if the clients would request an open competition on their project.

In order for architectural design to celebrate the human intellect, humans organized its processes in a top-down logic. The 'Idea,' this almost metaphysical term, the definition of which troubles architects and educators, is an absolute outcome of the human mind dominating the creative process, organising the formal arrangements, and their discursive legitimization. Designing for the Gaia cannot follow any 'Idea' as geocentric thinking demands a re-composition of its parts piece by piece. [25] The ideological background of the design Idea is the prerogative that the designer, as a human, can predict to plan the future.

Architectural design is a tool to elaborate the predictable. The anthropocentric architect believed that the human mind had the capacity to extrapolate the randomness, the unpredictable, even if this attitude could lead to the imprisonment of the 'other' by the 'familiar'. For post-human thinking, the future is not a question with a predefined answer but an environment of possibilities and potentialities to emerge through a speculative process 26. This shifts the emphasis from established design practices following predefined methodologies towards making decisions, to unstructured, open-ended, speculative approaches to design. The more we appreciate the loss of our assumed capacity to predict, the more we abandon our understanding of the present as a stratum to realize possibilities. We are now constructing a new consideration of the present as an environment to initiate possibilities and, to a large extent, uncertain virtualities.

Architectural design was aimed to impose an idea on matter appreciating the latter as a passive and obedient entity, prepared to follow commands. This understanding of materiality kept it in the periphery of the design process and, to a large extent, of design thinking overall. Post-human thinking reinstates materiality as one of its critical points of departure. The no longer debatable vitality of matter renders it as one of the catalytic agents in the formation of Gaia 27 and requests different processes and manipulations towards constructing spatialities. Matter possesses morphogenetic capacities in all the spheres of reality: the geological, biological, cultural, social, and ethical. The world has to be recomposed as an assemblage of heterogeneities, through processes that give the possibility to heterogeneous elementary units to be composed.

Architectural design always targeted to create buildings that would exist forever. Even though logically, the life span of a building has been limited, it would conceived as everlasting. This idea is totally inverted in post-human times. A building is not a machine but has life. It has a limited lifespan, and after that, it has to renegotiate the resources used for its materialization. The warnings emitted by all possible sources (scientific, political, and social) about climate change, the sustainable development of the planet, and the reasonable use of existing resources, calls for other design strategies. Buildings have to possess passports and to be part of a perpetual loop of upcycling: their strongest trait must be their ability to compose, decompose and recompose themselves in eternal loops. Design becomes the design of these loops.

The incompatibility of the established architectural design with the intellectual framework of the geocentric understanding of the world flags the emergency to re-design architectural design. Architecture's perpetual task is to redesign its own substance and ontology in each

25. Cf. for example, the Compositionist Manifesto of Bruno Latour (2010).

26. Cf. Manuel Delanda (2016:133).

27. Cf. Maria Vogiatzaki (2016) The Vitality of Matter.

major turn of nonlinear history 28. In our ongoing architectural interregnum, this becomes an imperative task.

28. Cf. Delanda's (1997) A thousand years of nonlinear history.

The paradox in the ship of Theseus's narrative lies in the emerging question 'would an object composed by more than one elements be the same, if gradually some or all of them were replaced?'. This question is nowadays pertinent more than ever before. As its answer is based upon the tolerance of the change or upon the belief of the continuity of the sameness, we can argue that both answers are as valid. Those who understand the new as an improved extension of the familiar will certainly answer positively. They would revisit existent theories of modernity to elaborate their updated version. Those who understand the new as a recombination of existing elements would answer negatively. They would reject an essential part of the established thinking and replace it with new arguments, hypotheses, and speculations. The 'meta' has more than one faces. Parmenides and Epicurus are still amongst us, or rather they never deviated from the orbit of our interregnums.

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Immediate Systems
Human-In-The-Loop Cyber-Physical Systems that Embed Design and Implementation in Situations of Use

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Abstract
Design activity, especially in architectural praxis, takes place in spatialand temporal remoteness from the use of its outputs. Thisremoteness impedes the ability to respond to actual needs that arise in situations of use. Ultimately itmakes design dependent on hypothesis.Aim of this essayis to introducethe notion of Immediate Systemswhichembed design and implementation in situations of use and thus overcome the limitations of remoteness.
Immediate Systems,as defined by author, are cyber-physical systemscomprised of interacting digital, analogue, physical, and human components. As meta-systems they include people and environments in a tight loop between human intention and immediate adaptation. Immediacyin this contextindicates a state of continuously available adaptability at the speed of human intention. Such meta design systems take design methodology to an extreme whichparadoxically resembles the situation before design emerged as separate praxis.
The essaycontains three theoretical contributions. The first one proposes and frames the very notion of Immediate Systems. The second one, presents and discusses a series of examples of such systems.The third contribution, identifies conditions forand characteristics ofImmediate Systems derived from the first two contributions.

Keywords
Immediacy; immediate Systems; design by use; design environments; design methods.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

1 Introduction

The aim of this essay is to introduce the notion of Immediate Systems (IS) whichovercome the limitations of remote design by embedding design and implementation in situations of use.The essay binds into a larger research effort in Immediate Architecture which is focused on research-by-design of IS..[1]

The term immediacy here indicates a state of continuously available adaptability at the speed of human intention. Immediate differs from instantaneous in that instantaneous indicates just a temporal direct response, whereas immediate can denote a direct relationship or state which is maintained over time and can include any combination of multiple modalities, for example temporal, spatial, tactile, embedded or intentional.

IS are meta-systems; they connect and surpass, in psychological terms between the self and the other, in terms of human-computer interfaces (HCI) between user and computational systems, in ecological terms between animal and habitat,and in architectural terms that between inhabitant and built environment. The notion of IS applies to all these worldviews.For the remainder of this essay the terms user and environment will be used for generalized descriptions of IS.

In the following section of this essay, the notion of IS will be further defined, in their relevance to architecture, through the psychological phenomena of the immediacy effect and the state of flow experience, through the concept of direct manipulation developed in the field of human-computer interfaces, and by relating them to the Theory of Affordances (Gibson, 1986). The third section of the essay discusses characteristics of IS which are highlighted in description of examples. Based on the findings of these sections the essay concludes with a summary of the initial framing, of the conditions and characteristic of IS, and perspectives for future work.

2 Framing Immediate Systems

2.1 Relevance to architecture

Design activity, especially in architectural praxis, takes place in spatial and temporal remoteness from the use of its products. This remoteness makes design dependent on hypothesis and impedes the ability to respond to actual needs that may arise in situations of use.

To illustrate different aspects of immediacy, the architectural example of the igloo is considered. Developed as cultural technique in a natural habitat, the igloo is constructed entirely from snow, a material which is readily available in its builders' environment, following techniques with minimal use of tools and constructed literally as a bubble around the body of the human. It offers protection against weather and predators, has excellent insulating properties and will strengthen over time as surfaces of the enclosure repeatedly melt and freeze, reinforcing weak spots and closing gaps with newly built ice. When it no longer is in use it will literally melt with the environment, leaving no waste products. Even though an igloo is traditionally constructed with the temporal immediacy required for adaptability at the speed of human intention, it is immediate in the aspects of resource

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

gathering, to the human body, in applicability, in constructive rationale, in its structural and functional self-reinforcement and in its ecological disposal.

Contemporary technological developments increase the feasibility of IS which offer the types of immediacy mentioned in the example offer even temporally immediate adaptation.Robotic building, the Internet of Things, interactive environments, to artificial intelligence, smart materials and a digitally driven circular economy, all can contribute to involve even activities of fabrication and construction within feedback loops at the speed of human intention. To design an IS is not the same as designing a specific part of the built environment, it is its meta-design in the sense that it takes traditional remote design methodology to an extreme where it paradoxically resembles a situation before design, implementation and use were separated. IS take a special case in the discussion on Cyber-Physical Systems in architecture in that they do not exclude the human user, as designers, builders and inhabitants, but conceptualize them as essential and integral to the system.

2.2 Human-in-the-Loop Cyber-Physical Systems

IS can be conceived as Cyber-Physical Systems(CPS)(Lee, 2015)comprised of interacting digital, analogue, physical, and human components. A typical CPS contains feedback loops between embedded computers and physical processes, where computers track and direct physical processes but not without being affected by them in turn. As a special type of Human-in-the-Loop Cyber-Physical Systems (HiLCPS)(Schirner et al., 2013), they include people and environments in a tight loop between human intention and immediate adaptation.

The term cybernetic, derived from the Greek word for steersman(Wiener, 2009), predates digital computers and stood for the field of control and communication theory, whether in the machine or the animal. A human constructing an igloo could be considered a Human-Physical System in which the human takes a central role as helmsman who interacts with components of the environments, navigating the entirety of the system towards habitable configuration. With contemporary technologies that make a wide range of transformations between the realms of the digital and the physical readily available, e.g. Computer Numerically Controlled (CNC) and robotic fabrication and construction, sensor-actuator networks, the Internet of Things, gesture detection and brain activity analysis, IS can be conceived as true cyber-physical systems even in the narrowest definition of the term.

2.3 Immediacy Effect

In behavioral psychology and economics, the term immediacy effect refers to the tendency of decision makers to amplify the significance of immediately experienced outcome relative to delayed outcomes. When confronted with intertemporal choices, with choices between two or more alternative outcomes expected to be realised at different points in time, experiments have shown that time discounting is not determined by comparing present values discounted by a fixed discount rate. People tend to overweigh more immediate outcomes. In this sense, regarding human behavior, there are close interrelationships and a high level of similarity between risky decisions

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

and intertemporal decisions (Keren, 1995), best illustrated in the immediacyeffect and certaintyeffect. The certainty effect refers to the observation that people overweigh outcomes that are considered certain relative to outcomes which are merely probable. When offered the choice, people will assign a far higher value to an immediate outcome than to a delayed one.

Since the purpose of ISis to provide immediate feedback, an embedded user can be assumed to be affected by the immediacy effect. The directness of outcome, as the immediacy effect suggests, is preferred and may provide a sense of certainty and control. As suggested by Roberts (2014), the immediacy effect may impact the user's decision-making processes and lead them to best practices by affording quick execution.

2.4 Flow experience

Immediate feedback is one of the prerequisite conditions for the flow experience, a psychological concept developed by Csikszentmihalyi in the late 1960s. Flow is a subjective state people report when they are fully invested in the task at hand and function at their fullest capacity.

Csikszentmihalyi identified three conditions for the flow experience to emerge. A clear set of goals directs attention and adds purpose, immediate feedback promotes a sense of control and a balance between perceived challenges and skills that offers. When these conditions are met, one enters a subjective state of flow for which a series of characteristics have been found. These characteristics include intense and focused concentration, merging of action and awareness, loss of reflective self-consciousness, a sense of control over one's actions and their impact, distortion of temporal experience and an autotelic experience of the activity in that it is intrinsically rewarding and self-sufficient to the extent that it is valued higher than the original set of goals (Nakamura and Csikszentmihalyi, 2009).

IS as defined in this essaycan provide some of the conditions for flow experience to arise, but for the condition of a clear set of goals, formed by direction and purpose, they depend on the user to develop their intentions. For flow to emerge, the need for a balance between skills and challenges is brought to attention. The autotelic, intrinsically rewarding nature of the flow experience suggests that users can be expected to actively sustain the flow experience once it is established.

While the literature on flow experience presents flow as a generally desirable state which allows people to unfold their operational potential to the fullest, it also mentions as pitfalls the narrow focus and loss of reflective capacity that are associated withit.

2.5 Direct Manipulation

Computer scientist Shneiderman coined the term 'direct manipulation' (Shneiderman, 1983) for a human-computer interaction style which involves continuous representation, reversible operations through physical actions, immediate visibility of results and a scaffolded approach to learning that affords experimentation with minimal prior knowledge. As examples for such systems in the early 1980s, Shneiderman listed display edi-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

tors, spatial data management interfaces, video games, interactive CAD/CAM systems and driving an automobile. Users experience direct manipulation interfaces as lively and enjoyable. They are easy to learn, faster to operate and more satisfying to use. Immediate feedback affords users to adjust input as soon as the effect is undesired, often removing the need for instruction and error messages. According to Shneiderman, direct manipulation is both beneficial for learning situations and affords fluid and extensible operation to expert users. Even though Shneiderman did not refer to Csikszentmihalyi's flow concept, his description of the conditions and user experience of direct manipulation bears strong similarities to the psychological concept of flow experience.

A seminal essay on the topic, Direct Manipulation Interfaces(Hutchins et al., 1985), was written with the goal of giving cognitive account of direct manipulation. Itwas rooted in the assumption that the feeling of directness which emerges in direct manipulation originates in the commitment of fewer cognitive resources. Two underlying phenomena of the feeling ofdirectnesswere identified, called distance and engagement. Distance isthe information processing distancebetween intentions of the user and executions of actions by the machine. Direct engagement occurs as appropriate application of the model-world metaphor. Following this metaphor the world is explicitly representedand the user has the sensation of acting immediately upon the objects of the task domain. The other of the two major metaphors for the nature of human-computer interaction, the conversation metaphor, would have the interface act as medium in which user and system have a conversation about a not explicitly represented world.

2.6 Theory of Affordances

The IS includes the embedded user similar to the way in which an animal is embedded within its natural environment, in an environmental niche. The abstraction of habitat applies itself to formulate a holistic approach to design modeling because it indicatesa type of socio-technical systems, comprised of the interactions between people, devices, codesand processes that join them (May and Kristensen, 2004).

The Theory of Affordances(Gibson, 1986) is based on the idea of a world of ecological reality, a conception of the world through its meaningful relations to the animal. The relationship between animal and environment is reciprocal, they can only exist as each other's complement. Affordances are what the environments offers, or affords, to animals and humans.Raw materials afford manufacture, surfaces afford pose, mobility, contact and handling, shapes of certain form and size can afford protection from the elements. To a skilled animal or human, objects can afford to be used as tool or as weapon.

At the core of Gibson's theory of affordances stands the argument that affordances are invariants which are not affected by their perception or misperception.Their meanings are not to be imposed upon them; they are to be discovered. Because of this they have been described as actionable relationships(Norman, 1999)between animal and environment.

IS can be further framed through the affordances that can occur in them.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

1. Immediate Systems afford their use in a state of immediacy
Affordancesare actionable relationships between animal and environment which exist entirely independently of being perceived or misperceived. In this sense, immediate systems offer the user immediacy independently of their perception, but they depend on successful perception and activation for the user to engage with them. Being human-centered, the IS requires with the human to be in the loop. Human and IS have a reciprocal relationship. The IS can be conceived as ecological niche.

2. Immediate systems shift the boundaries between self and environment.
Gibson describes how tools in use are no longer part of the environment but become an extension of the body of the user. They have capacity to attach to the body, suggesting that there is no strict separation between animal and environment but a shifting boundary.Like Gibson's affordances, the notion of ISis based on a world of ecological reality. In an architectural setting this means that IS shift the relation between human inhabitant and builtenvironment.

3. Immediate systems can afford furnishing the environment with new affordances.
IS are essentially meta-affordant because they afford to furnish the environment with new affordances, and they afford to do so in a state of creative immediacy Architectural immediacies are special affordances for modification of the environment. They let the inhabitant to project intended affordances onto their surroundings and to explore and navigate alternative constitutions of the environment for their affordances.

4. Immediate Systems in general provide a characteristic set of affordances.
In the following section, a series of examples shall be discussed with the aim of deriving further affordances specific to IS. In the following, these affordances will be called characteristics of IS.

3 Characteristics of Immediate Systems

3.1 Introduction

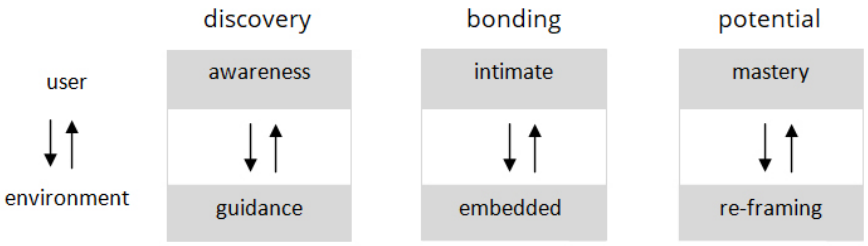
In order to further define the notion of IS, a series of examples will be described and discussed. They were found in the fields of human-computer interaction, behavioral psychology, performative art, algorithmic art, architecture and industrial design methodology.

While all the following examples share the following characteristics, they are individually described by one of the main characteristics they each exemplify for immediate systems in general:

awareness, guidance, intimacy, embeddedness, mastery and **re-framing.**

A model of these characteristics can show them as complementary pairs mirrored in the tight feedback loop between the user and the environment:

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020



Discovery
The user's **awareness** of the environment grows through the use of its actionable properties. The environment provides **guidance** through vectors of beneficial action revealed by the interaction.

Bonding
The user encounters the environment **intimately**, as they are **embedded** in it. IS have minimal resource footprint in terms of e.g. cognitive and material resources.

Potential
The immediate system affords **masterful** action, including continuous **re-framing** of the user's objective.

3.2 Examples

Awareness – IS stimulate merging of awareness and activity

In his text Video in Relation to Architecture, Graham describes the notion of immediacy in modernist art as follows: "A premise of 1960s modernist art was to present the present as immediacy—as pure phenomenological consciousness without the contamination of historical or other a priori meaning"(Graham, 1993).Immediacywas thought to bring self-sufficiency and novelty: "The world could be experienced as pure presence, and without memory. Each privileged present-time situation was to be totally unique or new."

Graham builtart installations thatconfronted spectators with mirror images and video feedback loops. He intended to critique the modernist notion of immediacyby demonstrating that it is impossible to locate a pure present tense. He noticed that the installation challenged the spectator's awareness. Temporal immediacyallowed the spectators to see themselves as both subject and object at the same time, a sensation that is usually visually unavailable. In this way the viewer was made aware of the difference between intended and actual behavior, immediately influencing future intentions and behavior. Due to the feedback viewers could enter a process of continuous learning. Since the intentions are interior to the observer and the self-observed behavior is exterior to them, the observer's notion of interior and exterior self is challenged. The immediate mediation of images as provided by video/television takes on an architectural function, it permeates public and private boundaries between rooms and social classes.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

The installations of Dan Graham focus on performance, not production. They have no memory and the users' activity does not leave a trace. What persists is the mechanism of re-presentations in mirrors and video-cache. Still, the installations can affect experience and behavior of users through otherwise unavailable sensations, challenging their **awareness**.

Intimacy – An IS is experienced as extension of self

For British painter David Hockney (Weschler, 2009)(Figure 1) the IS isa smartphone used as canvas for painting – a convergent device which combines screen, touch interface, computer, memory and communication to deliver a coherent, fast-responding experience. The IS affords Hockney, a master-painter, to enter an uninterrupted flow of work due to the multiple ways in which it immediately embeds into his creative process. The smartphone as pocketable instrument it canalways be at hand, work can commence without the need to prepare and collect drafting equipment, and afterwards there is no waste and the output can be shared with peers. Hockney even states that it pervades the activity with a quality of freshness.The ISis experienced as an extension of the acting selfand lets the artist proceed at a natural pace that allows for the emergence of a feeling **intimacy**.

Mastery – An IS offers a sense of control

In his PhD thesis on Immediacy in Creative Coding Environments, Roberts(Roberts, 2014) combined theconcept of direct manipulation interfaces(Shneiderman, 1983)with the notion of the immediacy effect from behavioral economics(Keren, 1995), to define immediacy as "the effect of latency on the perception of control in interactive, real-time systems and the impact of time discounting on the decision-making processes of interactive system end-users. Systems that are immediate provide a sense of fluid productivity and lead people toward best practices by affording their quick execution. […] We can infer from this that we should lead users towards best practices for creative authoring by making such practices as rapid and as unobtrusive as possible."
Roberts developed a live coding environment called Gibber.cc (Figure 2) which allows simultaneous coding and code execution for creation of audio-visual content and live performances. It is set up to guide users towards an enjoyable and productive experience.

The developed live coding environment Gibber.cc allows for a certain amount of simultaneity but not for convergence of manipulation by coded instructions and representation of visual and auditory results. The interface overlays a coding pad on the visualization area, and written instructions can be added to the live execution in their entirety or as selections of parts of the code. Thus the transfer from intention to changed behavior mostly depends on code formulation in themind of the user and input via keyboard, the information processing distance (Hutchins et al., 1985)is direct only when parts of written code are selected and executed. Still the environment allows for a feeling of direct engagement to emerge. One of Roberts' aims was to lead the user towards best practices by employing immediately available actions as a form of **guidance**.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Embeddedness – An IS is bound to and specific to its environment

Keinonen(Keinonen, 2009)suggested the term immediate design for"a mode of design characterized by responsiveness to users' current needs, intensive layperson participation, continuous incremental improvements, and the implementation of do-it-yourself developmental platforms. It takes place where the activity and challenge are on the site, and aims at solving the problem directly without withdrawing to product development fortresses."

Keinonen opposes immediate design to remote design, which is meant to produce general solutions and foundations for others to develop products or local practices. The development project for a general-purpose product ends when the product is launched, but immediate design aims atimproving specific human-technology systems and is open ended.Immediate design fosters temporal and spatial immediacy, and direct interaction between designers and users. It also changes causes for design action, as it is driven by the explicit and implicit needs of users, instead of being driven by trends, economic rationale or technology. Immediate design optimizes the human-technology match in a fluid process of continuous improvements.

In immediate design, design collaboration is not something that takes place only between designers and engineers, it takes place between designers and users. Design and use take place simultaneously, the designer acting side by side with users, separated by neither hierarchy no value. This **embeddedness** of design activities, directly in the practices of use,occurs as normal work and improvement of the environment coincide, generating specific and context dependent solutions.

Re-framing – An IS affords to continuously re-formulate the user's objective

Artist Martino developedfor her doctoral thesis research a digital drawing instrument which provides creative immediacy by maintainingthe artists' mark(Martino, 2006). Her thesis focuses on digital instruments based on the shape grammar approach(G. Stiny, 1972)(Stiny, 1980) because the immediacy of the artist's mark in visual creation has historically been lost in computation. Neither did digital design tools do not answer the fluid demands of the artistic process, nor did prior research address the immediacy of drawing and painting as a device in computational art.

According to Martino, the practice of visual creation is a shifting process, in which the artist has the role of a creator who dynamically re-creates problem space. The canvas into which a sketch is drawn changes with every stroke of the pen. This leads to new visual realizations and re-formulates the artistic task at hand at that specific moment in the process of creation, which"occurs in the tight loop between the hand and the eye where every mark influences every other mark in a re-framing of the picture plane."(Martino, 2006)The immediate, dynamic input allows the designer to operate outside of the constraints of a static model or boundary system.

A system which allows for such practice should accommodate process at both the conceptual and implementation level. Such a system should combine flexibility with repeatability and furthermore be adaptive, with an elastic schema that allows a visual

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

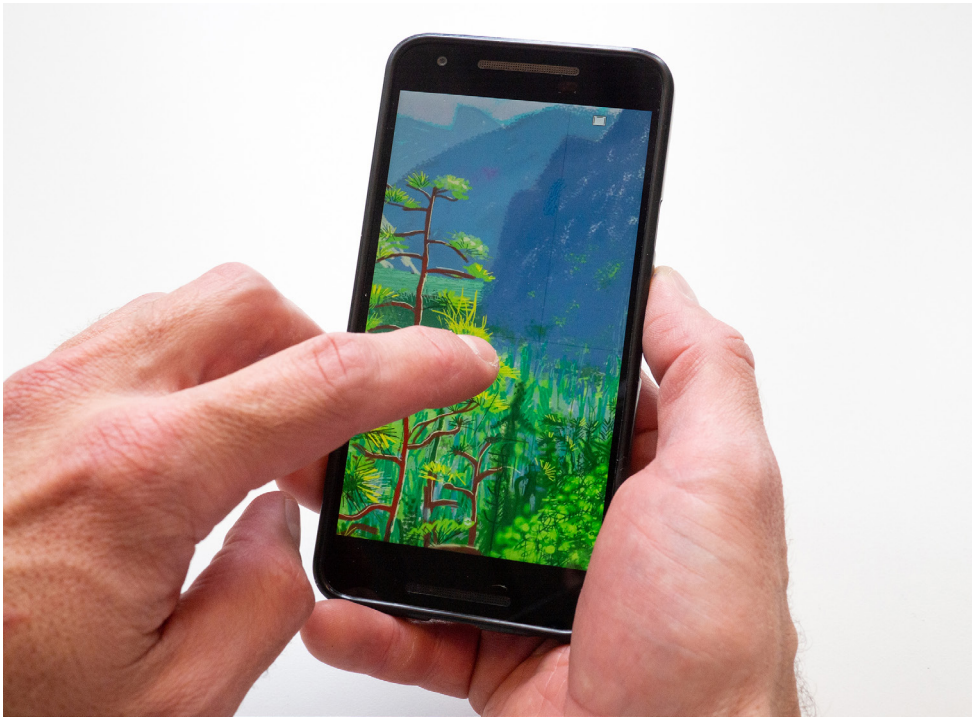


Figure 1.
A Hockney iPhone painting, opened in a drawing app on the author's phone.

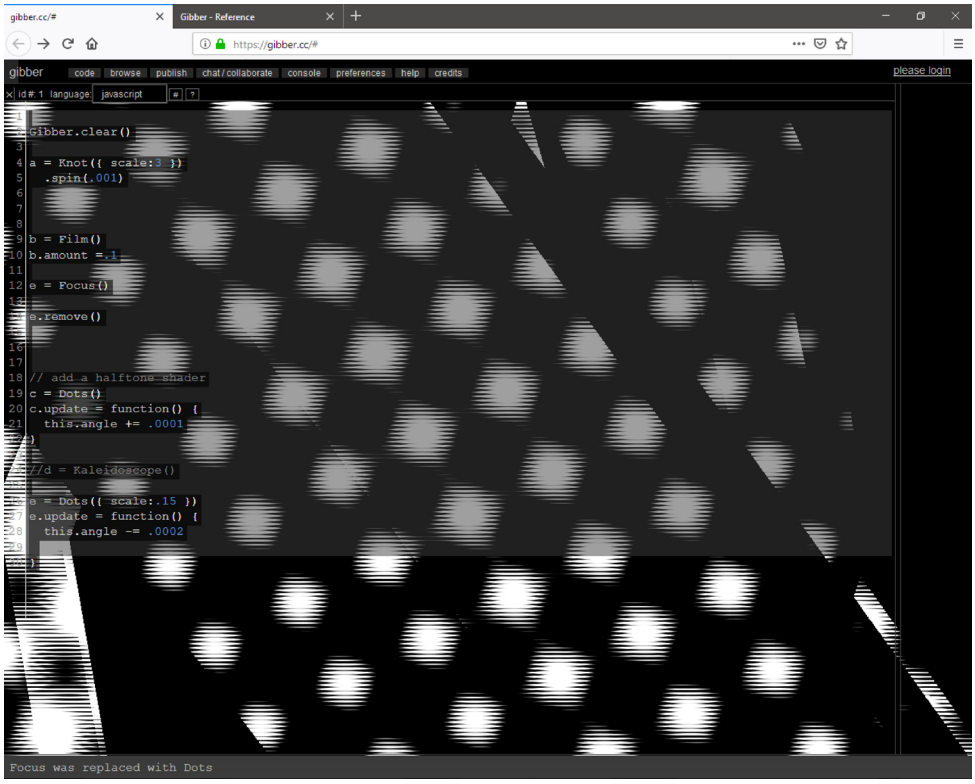


Figure 5.
Screenshot of a Gibber live-coding session

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

designer to identify and use emergent features. The design environment affords the designer to continuously and simultaneously frame and solve the problem. Design and implementation coincide in this process of **re-framing**.

3.3 Overview

The examples are discussed from two perspectives: One perspective is the internal, connected view of the human users which are embedded in them, as the system shapes their experience and affects their consciousness, their behavior and potential. The other is the external and detached view which allows for analysis of system components and of characteristics of specific instances of IS on a technical level.As previously described the characteristics found in the examples can be described in complementary pairs:

Awareness&Guidance

Regarding **awareness,** all examples contain tight feedback loops which offer confrontations between intended and actual behavior. In this feedback loop adequate action is continuously validated, and it allows the users to adjust their actions accordingly, matching intentions with results. The userbecomes aware of their relationships to the environment through its actionable properties. All IS implicitly afford **guidance** through vectors of beneficial action revealed by the interaction.Some examples were attributed to lead to continuous learning, others were explicitly designed to offer guidance through the availability of immediate action opportunities.

Intimacy & Embeddedness

The examples show that IS occur with the user's body in the loop and become extensions of the body. Hence,they let the user proceed at such a natural pace that it allows for a feeling **intimacy** to emerge. From an outside perspective the user is embedded, and in this **embeddedness** as temporal, spatial, social and architectural intermediaries dissolve and roles of designer and user overlap.

Mastery & Re-framing

IS are geared for emergence of the psychological flow experience, they thus can help individuals to function at their fullest capacity and to enhance their competence. IS let users act in a mode of direct manipulation, where they are initiators of action and feel in control, gaining confidence and **mastery.** The problem space is a dynamic re-creation of problem space by framing and solving the problem simultaneously, in a fluid process of continuous **re-framing**.

4 Conclusions

Overview

In this essay IShave been introduced and framed as Cyber-Physical Systems and through the lens of Gibson's Theory of Affordances, alongside the notions of flow ex-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

perience and the immediacy effect from psychology, and related to the direct manipulation interaction style from the field of human-computer interfaces. A series of examples have been described and discussed. Based on this effort characteristics and conditions of Immediate Systems have been presented. In conclusion of the essay, the findings will be listed in short and a glimpse at future work will be given.

Initial **framing** of IS indicated that they embed design and implementation in situations of use, overcome limitations of remote design, offer a form of direct manipulation interaction style, leverage the psychology of the Immediacy Effect and Flow Experience. Their implementation as HiLCPS radically improves applicability of the concept.

As **conditions** were named that ISare meta-systems binding user and environment, provide a tight feedback loop between intention and adaptation,establish and maintain a state of continuously available adaptivity andcan include any combination of multiple modalities, e.g. temporal, spatial, tactile, embedded, intentional or procedural.
IS, framed within Gibson's original Theory of Affordances, offer the affordances toshiftboundaries between self and environment,afford creative immediacy andafford furnishing the environment with new affordances.Additional affordancesderived from examples are awareness, guidance,intimacy, embeddedness,mastery and re-framing. Outside of the section on affordance theory, these affordances were referred to as characteristics of IS.

Future Work

The presented description of IS makes it possible to position them in history and contemporary discourse. Itidentifies predecessors and technical as well as socio-cultural contributions and eventual pitfalls. It also makes it easier to relate the notion of IS to architectural research and praxis.

Additionally, the presented work serves as guidefor research on innovative architectural systems, which the author is invested in. The development of architectural systems asIS,involves the discovery of new applications and the unraveling of potential synergies of emergent technologies. Inherently itinvolvesresearch into the relationship between humans and the built environment. Hence developingISin architecture is an agenda that reaches beyond mere design and performance optimization, it requires a transdisciplinary approach relying ona constructive assessment of the quantitative and qualitative impact of technological change on architecture and its users.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Systemic Considerations

Regarding the Importance of the Pre- in the Post- on the Path Towards the Meta-system

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Abstract

Historically, systemic considerations adapt their meanings in each era, incorporating progressively new conceptual, methodological and operational advances. Thus, the idea of a system during the Middle Ages, the Renaissance, the Baroque Period and the Contemporary Era has risen and evolved, and linear thinking has first been made possible and then altered and subverted by alternative techniques, leading us towards the meta-system.

This progress towards the meta-systemic derives from ongoing processes anchored in the distant past, finally leading us to a new paradigm.

We aim to trace the evolutionary nature of the systemic character, to clarify its changing notions and its influence on the view of the world and the view of architecture, to gain a better perspective about the present and future: in order to achieve understanding of tools such as computers, we must see that, rather than being the origin of the new paradigm, they are neither the origin nor the product, when the cause-effect dipole is no longer operative.

Therefore, our concept of "meta-" constitutes a hybrid condition that implies an appreciation of the "prior" + the "subsequent", not only in the sense of "post", but also in the sense of "with" and "alongside", based on the intermediate perspective of our time.

And all of this constitutes the starting-point of a future comprehensive research on the origins of the parametric architectural project, based on the hypothetical existence of an equally rich parametric pre-digital theory and history that has been barely explored. In this respect, we should not confuse meta-progress with just digital advance.

Keywords
System; Meta-system; Pre-digital; Parametric Architecture; Zeitgeist.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Regarding the Importance of the Pre- in the Post-

In recent decades, interest in parametric projects has undoubtedly grown. Their strategies are customary, and based on this, creative and research horizons have increased, and outstanding works have been designed.

We, convinced of the importance of the parametric in architecture, are interested in a different matter from the opportunities provided by the digital tools: the hypothetical consideration of a rich pre-digital parametric theory and historythat has been barely explored.So,we call for a review of everything that is "aside what is well known, and yet constitutes tradition, and also the substance for progress" (Unamuno, 1895/1916).

Parametric thinking in architecture precedes software. This is explained by Mellaartin relation to housing in the first city in history, Çatalhöyük (Mellaart, 1967), or by Gage in relation to Ancient Greek architecture (Gage, 2012). We might also consider Cache on the theme of machines in Vitruvian treatises (Cache, 2003), or Soler when he defines Gaudí as one of the first parametric architects, showing that the traditions underpinning parametric design are veryold (Soler, 2013),and Kontovourkis who confirms that "computational form-finding techniques follow the pioneering work on physical models conducted by Gaudi" (Kontovourkis, 2019).

And for thestarting-point of our exploration, it is important to observe the evolutionary nature of the systemic character. This shall be the focus of this paper:reviewing the process for the preparation of system thinking,which will lead to the contemporary parametric and systemic architecture, to clarify its changing notions and influence on our view of the world and our view of architecture.

We shall start from the moment in which the reductionist models of science defined by Galileo, Descartes orNewton were no longer sufficient, and other forms of complementary thinking were required.

Methodologically, we propose a review of a selection of texts on the evolution of philosophical trends regarding the system. We shall consider the Foucauldian approach, based on two techniques: archaeology and genealogy. The archaeologist is the archivist who builds the memory of previous testimonies with symptoms of present, whilst the genealogist raises questions, seeking to show the conditions (more than just the origin) that madepossible the new discourses(Foucault, 1988).

Our purpose will be to build a new interpretation, aside computers, because without the critical reflections it provides, processes become just another exercise in technological skill.We trust that this awareness will help to place the parametric question within a broader context, to gain a better perspective of the future.

The Meta-systemic Approach

First of all, we must explain what we mean by a "meta-systemic approach".
Unlike the scientific method, which only perceives parts of the world in a decontextualizedmanner, systemic thinking is based on the perception of totalities, to express the

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 1.
Gaudi's catenary model at Casa Milà. EtanTal.

Source Fig.1: https://en.wikipedia.org/wiki/Catenary>[consulted: 31st May 2019

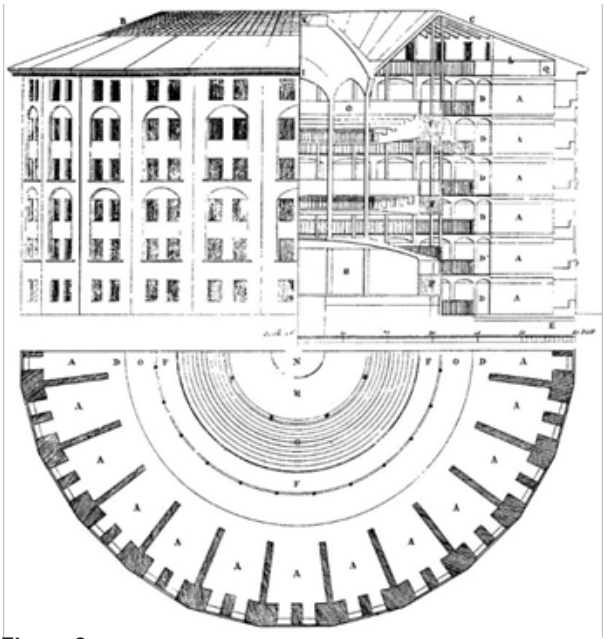

Figure 2.
Plan of panopticon prison, as drawn by Reveley in 1791. The works of Jeremy Bentham Vol. IV, 172-3
Source Fig.2: .<https://en.wikipedia.org/wiki/File:Panopticon.jpg> [25thNovember 2019]

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

interconnected aspects that constitute it, and to describe the design through an exploration of relationships.

Etymologically, "1610s, "the whole creation, the universe," from Late Latin systema "an arrangement, system," from Greek systema "organized whole, a whole compounded of parts," from stem of synistanai "to place together, organize, form in order," from syn- "together" (see syn-) + root of histanai "cause to stand," from PIE root *sta- "to stand, make or be firm"(Online Etymology Dictionary, 2019).

And when there is an extension of the limits of a system, we say that we are in the presence of a meta-system: it turns out that a former system is now a more complex one, with new elements and links. Butas we stated above, this implies an appreciation of the "prior" + the "subsequent", not only in the sense of "post", but also in the sense of "with" and "alongside". Bourriaud's (2009, pp.53) 'The Radicant' book talks about a "nomadic" or fluid style of thought that is structured in terms of circuits and experiments rather in terms of perpetuation.

So, to our mind, the meta-system is a hybrid condition between systems and pre-systems: first of allwe are interpreters or architects of a world as a system, and then we go one step further in a new reading that coexists with the previous one, so that we maintain the position of the one who builds and is also built by what surrounds us.

This meta-systemic approach enables rethinking how we analyse and design the world andrespond to previously irresolvable problems. This establishes a new way of dealing with issues, not as part of a new theory[1], as Rosnay explains, but rather based on a different methodology that categorizes information by investigating the interrelationships between the elements in an organization (Rosnay, 1975).

This is closely linked to the meaning of meta-, because revisited systems start withthe deconstruction (in the Derridean sense) of the usual paths. They originate from the incorporation of qualities of tangled reality, intermingling "heterarchical" levels and sublevels, overlapping meanings (McCulloch, [1945/1989), achieved from a modern perspective, even when it has existed since Ancient times.

1. In this respect, although the first systemic approach dates back to the origins of philosophy, and also way back in science, it wasn't until the second half of the twentieth century that it acquired the guise of formal knowledge.

Rationalism and Scientific Method

Descartes developed his scientific method (1637) based on the logical and experimental study of phenomena, and the irrefut-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

able discernment of new mathematics: no longer as a metaphor for the cosmos, but as a scientific instrument for rigorous interpretation, decisively undermining the principles of knowledge until the end of the following century.

Through systematic procedures, new contributions have transformed human knowledge and huge advanceshave been made, accompanied by decisive changes in our view of the world. This is because science is influenced by the social, historical and cultural environment that shapes its methods, theories and contents,in this works in a reciprocal manner(Purves, Sadova, Orians, Hillis and Heller, 2003).

With the advent of Newtonian mechanics, effective machine logic shaped our conception of the universe: now as a regulated and predictable artefact operating through an exact numerical system that can be understood and encoded (Newton, Leseur and Jacquier, 1833).

A renewed design process thus emerged, a modern one, which abandoned formal rules in order to focus on the characteristics of functional organization, materials or on the dimensions of construction elements, etc. In this manner, the reflection on functional organization would lead to the Panopticon-Project, or those related to Galileo's limit(Tzoniset al., 1984).

And, thus, determinism as a doctrine explains that any phenomenonis the consequence of a cause, and in view of that cause, the phenomenon develops without possible variation, denying any possibility of contingency.

Laplace's demon would declare that, if the exact position and momentum of each atom in the universe were known, its past and future values could be accurately calculated (Laplace, 1798). Thus, we move from the observation and study of Ancient man to the precise scientific domain of Modern man.

Crossroads Science

However, exacerbated interest in this type of scientific judgment led to a disintegration in fields of study, in contrast to a more holistic view, which would be called "crossroads science"(Gerardin, 1968): contrary to reductionismof a specialized science, those of a crossroads science grow increasingly wide, contemplating a range of diverse ideas at the same time.

Holism investigates systems by focusing on how the components act within the whole. This is based on the notion of the whole as being more than just the sum of its parts. In order to achieve progress based on synthesis, we mustrevisit and recapitulatematters that were not previously considered together, but that now turn out to represent the reality much better.

TwoLinesofThinkingTowardstheContemporaryAge:Enlightenmentsciencevs.Romantic science

In addition to the above, sceptics with the prevailing logic also emergedwithin the dis-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 3a.
Perrault's Colonnade, Eastern façade of the Louvre. Jean-Pierre Dalbéra,. Perrault collaborated on it with Le Vau and d'Orbayto solve the engineering problems associated with the construction.

Source Fig.3a :https://www.flickr.com/photos/dalbera/4793076608/

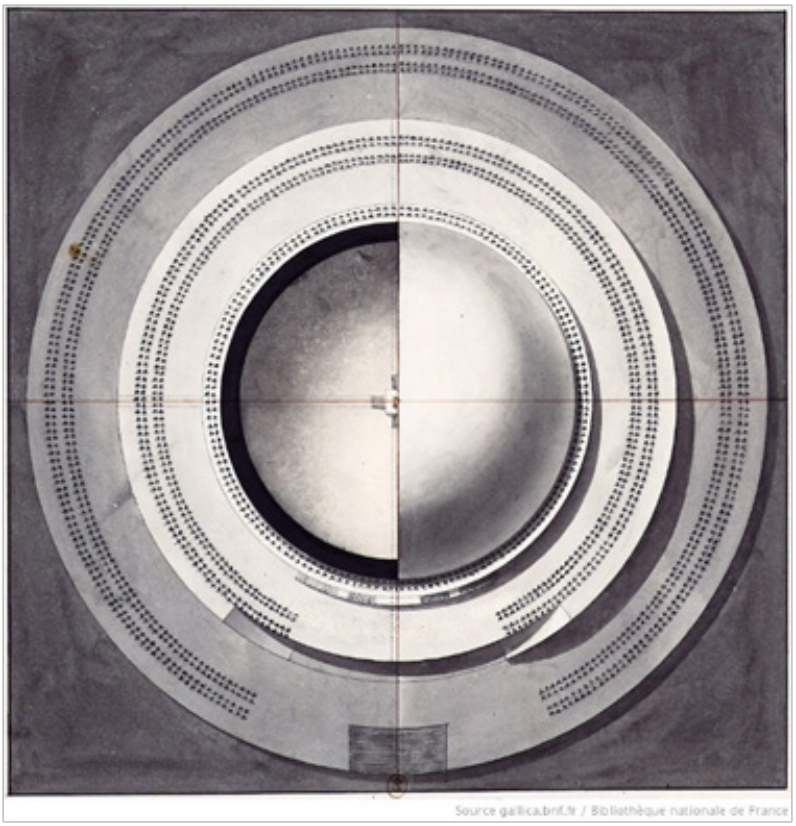

Figure 3b.
Boullée'sCénotaphe_de_Newton. Neoclassical features remain but also geometry and abstraction strongly marked.
Source Fig.3b: https://gallica.bnf.fr/ark:/12148/btv1b7701015b.r=boull%C3%A9e?rk=85837;2>[consulted: 25thNovember 2019

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

course in relation to the senses: emotion, opposed to intellection (butequally essential for an understanding of the world and Mankind),also claimed its relevance.

In this sense, discourses arose in Europe, such as Condillac'sTraité des systems (1798), or Berkeley or Hume's ideas, and, at the end of the century, there was shift in interest towards sensory dominance, which can be perceived in Locke's ideas.

So we can witness two parallel visions: an enlightened science, and another more romantic science of expressive capacity, which travelled on different paths but were also interlinked, because although they may have seemed antagonistic, they didshare, as Tarnas explains,goalswith regard to questions such as the appreciation of the potential of Man within his context, forms of individualism, criticism of habit or an exploration of hidden structures in nature (Tarnas, 1991).

And between these two poles, architecture also progressed, so that while it stayed in touch with aesthetic aspects, it gradually granted more attention to questions such as ways of building; thus, for example, the tectonic approach of Perrault and, later on, that of Laugier.

It come across an assumption of the laws of mechanics and, later, an interest for living forms, as well as inherited visions of nature that are more poetic, leading to somewhat entangled step-by-step developments. As an example of the miscellaneous of these two visions, we might mention Blondel: a superlative example of academic rationalism, but also a thinker who revealed echoes of the expressive traditions of Ancient cosmic harmony. And what aboutBoullé, with his appreciation of architecture that is endowed with a capacity to move us, as reflected in Essai sur l'Art.

The Contemporary Era: Natural Science and Major Advances in Engineering

The Contemporary Era revealed, through the auspices of engineering, some extraordinary advances regarding new calculation procedures applied to fields such as geometry, mechanicsor construction, based on numerous theoretical and practical writings that brought descriptions of new technical approaches. For example, the famous Encyclopédieby Diderot and d'Alembert (1780), orDurand'sPrécis des leconsd'architecture(1802), presentedthe earliest formulations of the standardization of architecture.

Similarly, this was also a period of progress regarding the natural sciences. Lamarck defined biology as the study of living beings, and he explained evolution as a tendency towards complexity and progressive refinement, based on the inheritance of acquired characteristics and environmental adaptation,as well as the concept of use and disuse (Lamarck and Martins, 1873).

This is described by Collins,in the same sense as Sullivan's functionalist expression in the twentieth century, as "form follows function" (Collins, 1998, pp. 188): in our matter referring to formal aspects (Labrouste, Viollet-le-Duc or Gaudí, etc.), and to structural aspects (Sullivan, Wright, etc.).Later on, Thompson would also contribute to the idea that this inheritance is not exclusively responsible for morphology, given that it also depends on the forces exercised and the optimization of energy (Thompson, 1968).

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

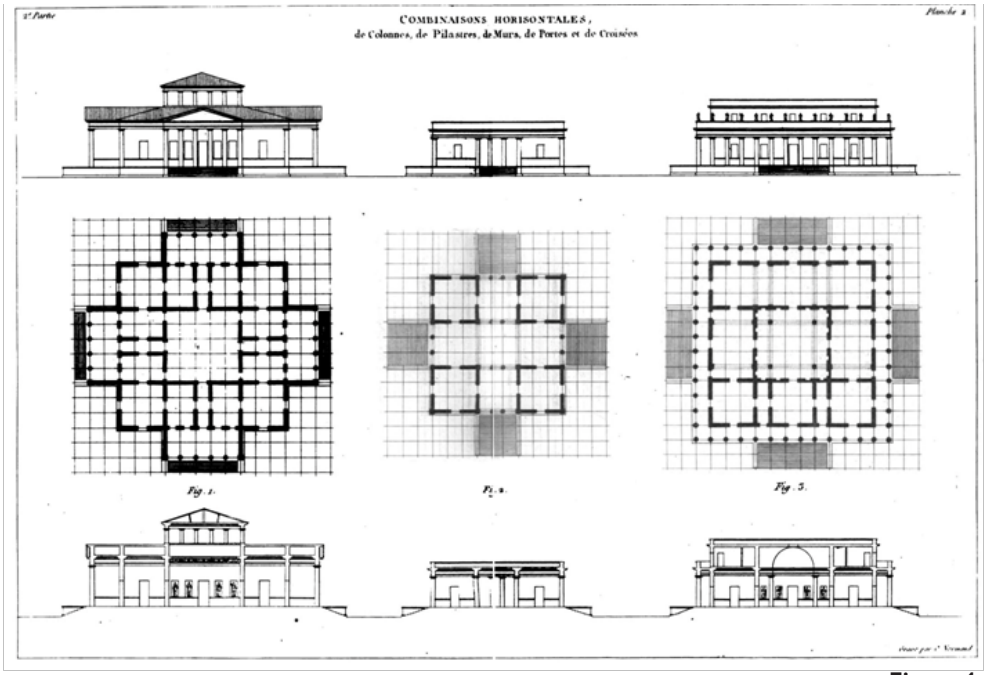

Figure 4.
Combinaisonshorisontales de colonnes, pilastres, mursportes et croisées
Source 4 in Durand's Précis des leconsd'architecture, 1802.

Figure 5.
Louis Sullivan's Wainwright Building, St. Louis, Missouri, emblematic for its famous maxim, "form follows function".
Source Fig.5: https://commons.wikimedia.org/wiki/File:Wainwright_building_st_louis_USA.jpg>[25thNovember 2019

Figure 6.
David's Charge to Solomon (1882), a stained-glass window by Burne-Jones and Morris, at Trinity Church, Boston.Morris explained that the 'diligent study of Nature' was significant, as nature was the example of God's design. He saw this as the spiritual remedy to the decay in social, moral and artistic standards during the Industrial Revolution.
Source Fig.6 https://en.wikipedia.org/wiki/File:David%27s_Charge_to_Solomon,_by_Burne-Jones_and_Morris,_Trinity_Church,_Boston,_Massachusetts.JPG

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

In a similar manner to the developments that took place in the 17th century regardingmechanics, biology now reinforced a systemic view based on theconcept of the organicas opposed to the machine, and the question was transposed intophilosophy, art and architecture.

As of 1750 until 1900 and beyond, biological concepts became capital tools for interpretation and creation (Collins, 1998), and multiple perspectives developed from their notions,based on the empowerment of tectonic aspects and, simultaneously, the persistent discourse of the organism. In this regard, the first major contributions emerged around 1800, with Goethe or Schlegel's nature and architecture approaches, although they never explicitly used the term 'organic' to designate any kind of architecture. They were followed by Hirt, Morris or Ruskin.

Renewal of Architectural Concepts

So, the main architectural concepts were revised, now with afocus on logical structure and unitary attributes. The question would arise recurrently, even though the theory was still missing, and the discussion still took place within the framework of existing styles, based on an organicism that was non-stylistic at first and then, later on, one that expressed an analogy of form that reflected a certain style.

Consequently, after a certain point, Euclid's geometryand Newton's mechanics were called into question, based on a wider-ranging reflection that brought together previously dispersed disciplines that were now articulated.

Uncertainties that were previously ignored began to be explored, whilst the dualist, reductionist and mechanistic foundations were challenged, leading us towards the approaches ofSaccherius, Cantoror, later on,Poincaré. Any former predictability turned out to be false, and thus, mathematics and physics first, followed by biology, the social sciences and psychology, etc., made a stand against the Laplacian demon who ignored the emerging. Based on rigorous but freer interconnections, featuring precision but also leaving space for eventuality, the history of science was identified with the history of thought itself, because even when mathematical results were presented as eternal, they were understood and conveyed in cultural contexts (O'Shea, 2007, pp. 74).

Nonlinear Dynamics and the Impact on Architecture

And, in this manner, at the end of the 18th century, interest in non-linear questions arose: within a deterministic world, when all the details regarding the state of an event are known, things are predictable,but when the number of elements makes the equation more complex, the calculations become unattainable, and then it is essential to make estimations based on statistical methods, taking into account both chance and admissibility.

Society must continue to be founded on reason, but now must "not only deal with what actually occurs, but with the possibility of things happening in thismanner or

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

otherwise"(Cruz Roche, 2012). And based on this possibility of a huge disparity in results, all obeying rigorous laws, anew conception of the relationship between calculus and geometry was proclaimed between the 18th and 19th centuries.

This was based on the idea of a mathematical function as an analytical expression consisting of certainties but also of possibilities, with the development of systems of equations and series theory, leading towards theThree-Body Problem, etc. Through this maze of chance, a series of possible regularities replace exact laws.

It was soon accepted that determinism only had a partial role to play in the modelling of reality, since different scenarios can emerge based on processes that are not entirely predictable.

The reductionism became too limiting to describe phenomena, and so work began on recognizing nonlinear patterns that focused on the exploration of interactions that led to the emergence of unwonted characteristics. Emergentists admit the existence of a single physical substance,but this is organized through processes at successive levels that emerge from one other, characterized by properties that cannot be reduced.
In the 19th century, geometry was considered the science of space, and arithmetic the science of pure time. Furthermore, the first non-Euclidean geometry was developed,building on the work initiated by Saccherius: this asserted the plurality of parallel lines that passed through a point outside a straight line, and then, subsequently, proclaimed the non-existence of these parallels (Saccherius, 1733). Thus, Euclidean geometry was reduced to the status of a special case within a more general repertoire, with a consequent weakening of the intuitionist view of mathematics.

The new geometries, which at first seemed outlandish to the real world, were those that best described the true architecture of the cosmos, and generated the idea that there is an irreducible uncertainty linked to probabilistics, quantum mechanics or Heisenberg's UncertaintyPrinciple (1927), etc. It was definitively concluded that determinism constitutedan incomplete picture, as would be demonstratedby Minkowskior Einstein.

And new science, which means that some complex phenomenon that was invisible to the science comes into its view now, and consequently, people's view of the world become to change,will lead to new architecture (Li, 2015).

The Path Followed by the Meta-systemic vision

Nevertheless, in 1917Thompson,in his work "On Growth and Form", addressingthe study of nature based on physical and mathematical tools for the first time, pointed once again towards the ideals of Euclidean geometry as being predominant in natural forms created by physical forces, because their laws favour simplicity as an optimal representation of those forces, he explained(Thompson, 1917).

Therefore: first, Euclidean geometry was considered by Kant as a form of pure a prioriintuition (Kant, 1781); and then by Russell as also a product of experience (Rus-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

sell, 1973); but then later, the concept was called into question by Gauss's multiplicity (Gauss, 2005);in which respect Poincarédeclared that there is no truer geometry, but only that which is more or less convenient for the world (Poincaré, 1905); and then Einstein dealt a definitive blow to Euclidean-Newtonian absolute space (Einstein and Lawson, 1920); and, yet, Thompson's biomathematics took up the ideals of Euclidean geometryagain (Thompson, 1968).And thus, as Spiridonidis explains, also the link between architecture and geometry transverses centuries and places and maps diverse forms of trust, dependenceor enquiring (Spiridonidis, 2019).

So, we come across avaried set of approaches that come and go, moving beyond the reductionist idea of orthodoxy. These areopen to an approach adapted to complexity, as part of an experimental search that analyses the conditions of possibility. They arenot certainties, but make up, rather, a huge debate, annulling those doctrines that seek any kind of discursive determinism or the imposition of certain propositions over others.

But in any case, there is always room for a renewed meta-systemic vision.

Conclusions and future work

Our review has enabled us to reach some significant conclusions, which reveal the significance of the knowledge of the pre- to gain a better perspective about the present and future, and also the early signs on the existence of a parametric pre-digital history which concerns us.

We can see that, although it is true thatsystemic concept has been incorporated into science in more recent times, they are not that recent in philosophical thinking, having been tackled since Ancient times.Starting with the earliest philosophers (aspects that Aristotle and Heraclitus had already sensed), andeven within the old reductionist debate on the foundations of modern science, we can find traces of new forms of reconsidered causality.

And so,the incipient definition, which is to sayan initial state or law that makes it possible to deduce future circumstances with certainty, has given way to a more liquid consideration, a meta-approach, departing from gradually obsolete positivist perspectives and moving towards holism and complexity theories, common in philosophy, science and architecture.

In architecture, the concept is also ongoing, understood from the beginning as a structure of interconnected formal relations: starting with the order of the Greek temple, to the patterns of each style within its corresponding time. However, within the field that interests us, we consider it to be more closely related to the concept of code. With ideas involving architectural space which more frequently distance themselves from long lasting materials and forms, or permanent definitions. In a scenario which progressivelyplaces architecture in a new pathos far from the old Vitruvian firmitas.

The evolutionary process does not play itself outin an invariably rectilinear manner,on the contrary, it passes through moments of agreement and negation, and then agree-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

ment again, moving backwards and forwards. Certain deviations are pursued in order to explore essential ideas, justifying the abandonment ofany discourse of origin-development-effect.

And thus, in an attempt to represent and explore this complex ambiguity, diverse approaches have emerged such as structuralism, logic and other branches that operate signs such as linguistics or semiotics, etc. We have moved from the machine to the biosphere, from causality to evolving contingency, from category to the pattern.

And even dating from long before the last unconditional confidence in linear approaches, even before computers, ourhistory is weaved with a confluence of pioneering attitudes, all of which added new knowledge and resulted in revelations leading to the pre-systemic era/ the systemic era/ and the meta-systemic path.

All this has had an influence on technology, with discourses being refined to introduce new symbolic languages that serve to create revolutionary artificial languages and algorithmic codes, granting absolute importance to the new digital architecture era.

However, as Lacasta explains, we should take into account the fact that although cutting-edge technological advances acquire importance when it comes to writing the history of the world, it seems legitimate to think that such advances are the product of a profound transformation in culture, and not the opposite.Thus, "if society makes so much effort to develop a tool as powerful as the computer, this would surely be the result of a prior need, because an awareness of change already exists. That is to say, wouldn'tthe personal computer be more a product of that new paradigm than the origin of it?" (Lacasta, 2010, pp. 7).So, he explained, in order to achieve understanding of tools of the present age such as computers, we must see that, rather than being the origin of this new paradigm, they are, in fact, one of its products.

Now, we add, they are neither the origin, nor the product at the end, when, as we explained, the cause-effect dipole is no longer operative at all.

And, although we have fully assumed the consequences of the revolution, we do not know in depth the conceptual path traversed of these transformations.In an uncommon scenario, ambiguous (a non-deterministic reading of the element, advanced (Albers, 1935)), today unthinkable, where the computer did not exist. Recognizing the object as a powerful cultural fact also aside the digital fascination.

This discourse featuring a parametric panorama weakened by an excessively digital affectation, arises as something of a problem when studying the matter at hand, andcould be the subject of a next paper.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

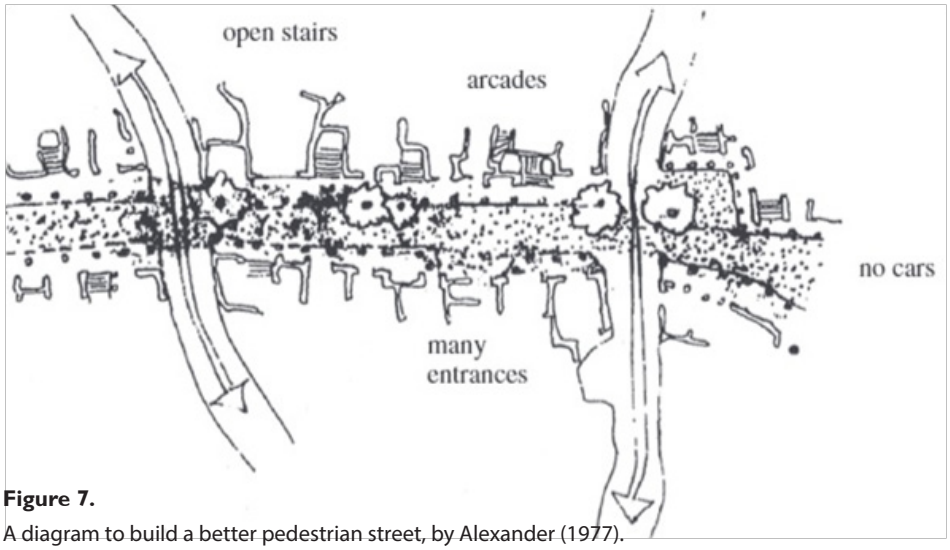

Figure 7.
A diagram to build a better pedestrian street, by Alexander (1977).

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Architecture in a Petri dish: co-programming Meta-Life in design through biointegration and synthetic biology

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Abstract

In the current era, marked by the increasing concern about antropogenic climate change and environmental problems, biotechnology and synthetic biology can offer solutions to several present and future problems concerning biodiversity. In this paper, the notion of "meta" will be discussed to investigate the concept of meta-life as grey area between the animate and the inanimate, the natural and the engineered, the born and the built, in order to demonstrate how these entangled notions could be applied also as new design strategies. The advent of synbio and bio-information as tools for architecture could in fact drastically change the way we conceive buildings as meta-living beings in ontological continuity with the biosphere.

Keywords
meta-life; synbio; biotech; bioart; ecosymbiotic architecture.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Introduction: new models of (e)co-existence
Human, non-human and meta-natural perspectives

Disruptive developments in biotechnology, synthetic biology and computing technology have led to new possibilities to engage and manipulate life in order to demystify the mythologized conception of nature, according to which we can refer to nature only if relating to its primitive "untouched" status.

The design and construction of new biological entities dramatically challenge the common understanding of the "natural". For this reason, we can identify biotechnology as a "third nature", in which life forms are crossed and sometimes genetically manipulated to create new, synthetic and augmented ones.

The "next nature", as Van Mensvoor labels it, may also be not entirely "green", because it underlies the intersection with anthropic agents and because it leads to the creation of new synthetic meta-life forms. For this reason, many researchers in media art, science, design, biopolitics and material feminism are currently trying to disentangle some very often misunderstood and mistakenly linked notions such as naturaleness, aliveness and greenness. For instance, the recent "Un/Green" conference and exhibition at the Latvian National Museum of Art, held last july 2019, aimed to provide a cross-disciplinary platform for discussions and artistic interventions exploring the paradoxical and fetishistic employment of the concept of "green" - symbolically associated with the "natural" – often used in order to metaphorically hyper-compensate its inherent ambiguity between alleged naturalness and artificiality[1] .

With all the pros and cons, the convergence of bio-technological dimensions is increasingly strong and some applications may constitute possible and feasible scenarios of experimentation for a new ecological co-existence between different species and between man and post-natural elements.

Bioart is one of the first artistic movements assuming this convergence as key point for its investigation. In this paper we will try to upack the core of some bioartistic experimentations in order to understood how art, through bio-information, biotechnologies and interactivity, can actually work as interface to trigger a dialogue between environment, technology, human and non-human beings.

At the same time, we will focus on multiple reflections about how a meta-natural perspective could led to serious implications also in the architectural realm. The contribution of disci-

1. See "Un/Green: Naturally Artificial Intelligences" homepage: http://ungreen.rixc.org/ and "RIXC Festival 2019, The 4th Open Fields Conference on Art-Science Research" homepage: http://festival2019.rixc.org/, last accessed 2019/09/11

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

plines such as biology, genetics, neuroscience, nano-bio-technologies and robotics in design and architecture is in fact relevant and it contributes to the emergence of numerous questions: how will the relationship between nature and biotechnology evolve? How will synthetic biology have repercussions also in architectural design and built environment? How can we use biotechnology in order to transform architecture itself into a biohybrid, into an example of meta-living being?

Living or semi-living? Natural or engineered? Overcoming the Cartesian dualism through bioart

Bioart represents undoubtedly one of the most significant approach to critically address concepts such as organic manipulation or meta-life.

The term was originally coined by Eduardo Kac, during his performance "Time Capsule" (figure 1) which took place in 1997: using a special needle, the Brazilian artist grafted onto his left ankle a subcutaneous microchip containing a programmed identification number, integrated with a coil and a capacitor, all hermetically sealed in a biocompatible glass capsule. With this work, the artist aimed to link art not only to figurative aspects, but mainly to the representation of the radical embodiment between a human and a technological apparatus. "Time Capsule" can be considered as halfway between an event-installation, a site-specific work (where the "site" is constituted by the intersection between the body of the artist and a remote database) and a simultaneous transmission of biological and digital informations.

Kac during his whole career tried to use the tools of biology, technology and devices to establish an inter-species dialogic communication. The intersubjective experience between biological organisms and electronic devices is in fact crucial in his early artistic research and the purpose is to use the concept of "telepresence" to build an interaction between bio-telecommunications, bio-robotics and human and non-human users (such as animals, plants and computers), in order to investigate cognitive, biological and social aspects.

His more mature works anyway started to embed also transgenic applications, proving to be able to absorb the biotechnological paradigm and to raise bioethical questions about the legitimacy of transgenic practices while used for aesthetic purposes.

Another crucial example in bioartistic experimentations is the work of Australian researchers Oron Catts and Ionat Zurr.

Back in 1996 they coined the term "semi-living" to describe compound entities generated with tissues extracted from complex organisms and kept alive by using technology. This technique of tissue culture is commonly used for biomedical purpose, but in this case is employed to create conceptual prototypes of semi-living organisms, cultivated in bioreactors. Their works undermine the very concepts of object and subject, as the cultivated biomass is actually alive thanks to a nutritional sustenance system, which prevent the non-living status.

In one of their most famous artworks, the "Semi-living Worry Dolls" (figure 2), Cutts

Architecture in a Petri dish: co-programming Meta -Life in design through biointegration and synthetic biology

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 1.
: Eduardo Kac, "Time Capsule": view of the needle and the microchip (on the left) and view of the injection of the subcutaneous microchip in the artist's left ankle (on the right).

Figure 2.
The Tissue Culture & Art Project, " Semi-living Worry Dolls", 2000

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

and Zurr used biodegradable polymers (such as PGA and P4HB) and surgical sutures, to which living endothelial, muscular and osteoblastic cells are subsequently incorporated. They are placed inside bioreactors, that become an artificial womb where these semi-living grotesque entities can grow.

The semi-living (or meta-living) condition raises a very interesting perspective: cells and tissues, despite being able to grow and to live also outside the organism from which they are extracted, they easily lose the status of living subjects, as this quality is apparently linked to the physical body in its complexity and not also to the individual entities that constitute it. Tissue cells are in fact used in the scientific field in a utilitarian way, without assigning to them an "agency" (Bandura, 2016) or a proto-agency that should be intrinsic to their status of semi-living beings. Instead, they are compared to inert objects.

In the case of Catts and Zurr artworks, technological mediation acts as amplifier of life, by reconfiguring the physical unity in the form of an extended body. For this reason, they affirm that we need to revise the current taxonomic system of Linnaeus, since it does not take into account the most recent biotechnological progresses which problematize the usual ways of understanding life, meta-life, species and the "natural" realm.

As is often the case, these examples show how artists react to cultural and scientific progress by critically elaborating it. Bioart aims to reflect on the continuum of life through the convergence between living, synthetic, biosynthetic and artificial realms. The dissolution of the binary distinction between what can be considered as "natural" and what is culturally understood as "non-natural" is decisive in this approach. One important difference compared to other practices is that in bioart art matter is no longer painted or sculpted or enclosed into a digital dimension: it is a living biological entity. This opens to many problems about whether to base the taxonomic criterion of bioartistic "products" referring to the content (i.e. on bio-media and bio-subjects) or to the methods and means used to create bio-artworks (i.e. bio-mediums). In fact, bioart represents an unprecedented situation in which "the medium is the message" – literally; the "bio" is both instrument and subject of the communication.

In order to overcome this issue, Jens Hauser introduced the concept of "biomediality" by referring to the intervention on living organisms or biological processes, whether they are technically manipulated or not, with inter-scale operations (Hauser, 2016). Biomediality is therefore understood as a practice whose main purpose is the direct intervention on the mechanisms of the living: by transgressing a formal or symbolic representation of life, it supports a phenomenological re-materialization through the interaction between the user/environment and the living or semi-living artifacts.

Hence, the bioartistic debate does not use technology just as a tool to simulate or to reproduce life using iconic images, but it uses devices in order to break into biological processes and to manipulate them. It also triggers a more complex notion of ecology by implying an entanglement also with new meta-life forms created through

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

the use of synthetic biology and biotechnology.

Bio-informed architecture: buildings as meta-living organisms

A Petri dish is a shallow transparent lidded dish that biologists use to culture cells: the potential role that biosynthesis can play in advancing architecture and urban design opens new future scenarios in which architecture itself could be produced in a Petri dish. The combination of digital design with biology and biotechnology, but also the increasing production of biomaterials from organic life forms (such as mycelium, microalgae, bacteria or protocells), can represent a gamechanger in "bio-informed" design practices. In fact, it opens to the possibility to recognize an agency also to architectural matter, thanks to the overlapping with the organic layer. Architecture can therefore act as a living system pointing to the development of a hybrid ecology.

The concept of architecture as evolving living system was pioneered by John Frazer in his publication "An Evolutionary Architecture" (1995), where he underlined the importance of using construction materials responsive to external conditions, in order to establish a mutualistic relationship between the building and the environment. As clearly stated by the cybernetician Gordon Pask in the preface of Frazer's book, this approach has nothing to do with the "often frenetic practice of copying the works of nature in architectural forms" [2] , rather it is about developing new models which are both tangible and rational, alive and in evolution. Frazer's goal is therefore clear: architecture fits into the natural construct as an artificial life form that triggers a symbiotic behavior with the environment and a metabolic balance that is proper to natural systems. Above all, the very interesting thing that emerges from the publication is the emphasis that an evolutionary architecture can be pursued not exclusively in terms of natural selection, but throught processes of self-organization and metabolism.

2. Frazer, J. (1995) An Evolutionary Architecture. Architectural Association, London, p. 7

At this point, following bioartisitc experimentations, we can assume that also as designers we need to develop a heuristic point of view to redefine the boundaries of the discipline in its interaction with the "natural", to favor complex relationships: ultimately, we need to embrace the emergence of a new collaboration between architecture and the fields of life sciences, biotechnology and synthetic biology. Moreover, by focusing on the creation of biohybrid artifacts, based on the coupling of organic matter or living engineered organisms with artificial

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

supports, we can overcome the excessive formalism of biomimicry. Although recognizing a considerable value to biomimetic experiments, they in fact take nature as an inspiration and mentor (Benyus, 1997) but by keeping it ontologically separated from the artificial domain they also reinforce a Cartesian dualism.

We should rather put the emphasis on co-construction principles: we need to replace the ideal of nature as a model to be simply emulated, in order to start using it as a co-worker in design strategies. Assuming nature as an active contributor within architectural processes, we stress the fact that design outputs are results of a co-evolution.

According to Neri Oxman, we should in fact look at the technology of nature in order to open design strategies to a neomaterialist style, based on the integration between organic ("natural" or engineered) and inorganic materials.

The integration of the bio-logic leads to significantly changes in how to design the architectural envelope or in what construction and production methods to use. Furthermore, principles of growth, self-organization, self-repair or other biological principles often associated to architecture metaphorically, in this way can be applied effectively, thanks to the presence of actual living matter. In one of the recent projects with the Mediated Matter research group she founded at the MIT in Boston, Oxman used melanin as substance to represent a "universal pigment" found indiscriminately in human and also other living beings. It acts as a crucial technological system in providing protection from ultraviolet radiation, along with other important functions linked to biological survival, like mechanical protection, energy harvesting, cell growth or thermal regulation.

The installation "Totems" (figure 3) aims to investigate the possibility to intersect culture and nature by questioning this dichotomy through designers' ability to engineer melanin's expressions within and across species. The pigment used for the biological totem is in fact synthetized hybridizing an enzyme from a mushroom, called tyrosinase, and protein building block L-tyrosine, which can be extracted from bird feathers and cuttlefish. The manipulated genes for melanin production is then introduced into Escherichia coli, abling this bacterial species to express the gene itself and to change coloration in response to changes in the environment, in order to provide protection from solar radiation. Next to the design installation, the research group propose also to apply this technology in order to build an environmentally responsive melanin-infused glass structure and to obtain a biologically augmented facade.

Also Rachel Armstrong, one of the leaders of the Living Architecture Systems Group at the University of Newcastle, stands against the biological/mimetic formalism, which is based on the metaphorization. In her Manifesto against biological formalism (Armstrong, 2011) she argues that, despite the continuous parallels with the biological world, our cities continue to be built with the use of inert materials and they don't acutally follow biological principles such as metabolism, omeostasis or self-organization.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 3.
Madiated Matter Group, "Totems", 2018

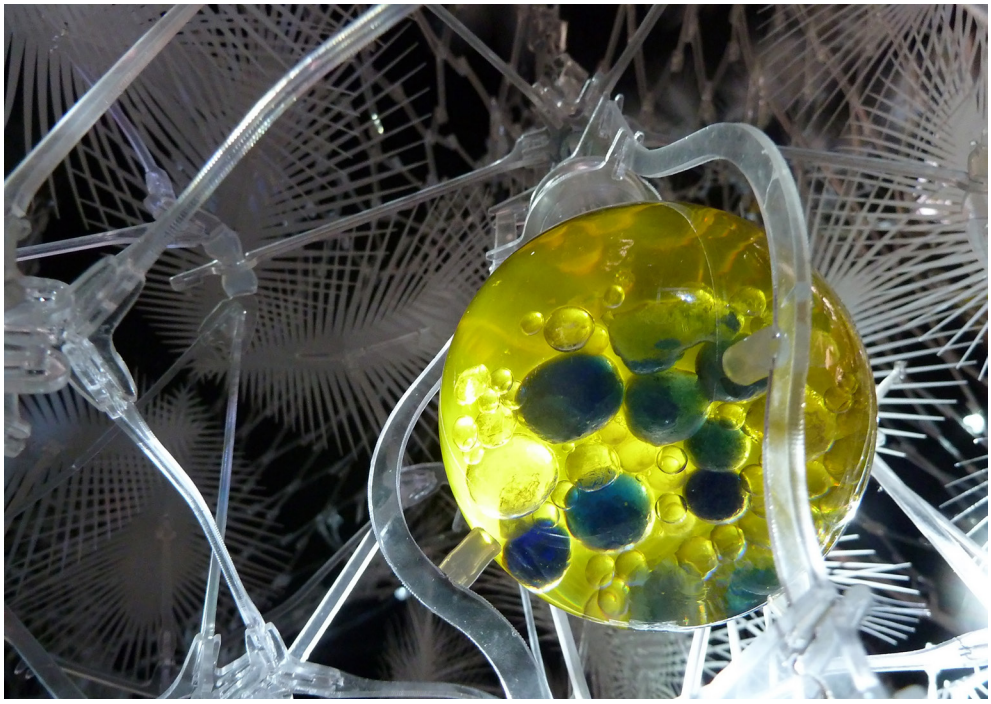

Figure 4.
Philip Beesley (with the collaboration of Rachel Armstrong), "Hylozoic Ground", 2010. Detail of the incubator flasks suspended in the installation matrix and positioned over light emitting diodes (LEDs) to capture heat and light. The flasks contain protocells (specifically modified Bütschli droplets) which are able to respond to environmental conditions.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

For this reason, in her research she investigates the possible use of protocells as building material, beyond a labotratory context. Protocells represent a turning point in the evolution of life-like technologies. They are prototypes of primitive cells, whose primordial nature is related to the bottom-up approach taken towards development of an artificially constructed cell. They are in fact capable of chemical self-organization, according to a spontaneous phenomenon called "emergency" and their behavior can also be engineered through the use of synthetic biology. In particular. Armstrong mainly focuses on the "meta" status these molecules demonstrate by embodying the convergence of natural and artificial systems. As she affirms, protocells "are characterized by their striking life-like qualities, which potentially have great value in design as they represent a platform that is simultaneously 'natural' in terms of its emergent spontaneity and also artificial, since they are also partly designed and deliberately constructed" 3. Their implementation in building envelops could then transform architecture into an autonomous meta-living organism, which is able to respond to external factors thanks to a bio-active facade.

3. Armstrong, R. (2014) "Designing with Protocells: Applications of a Novel Technical Platform" in Life, 4, p. 460 doi:10.3390/life4030457.

Recently, Armstrong developped also a new prototype of "living bricks" for the Tallinn Architecture Biennale "bioTallin" in 2017. She and her research group proposed metabolically active bioreactor building blocks composed by a microbial fuel cell, an algae bioreactor and a genetically modified processor (figure5).

As many of these experiments are based on biological matter, in addition to achieving a much more promising results in terms of sustainability, they also contribute to a paradigm shift from an aesthetic point of view. The envelope, in fact, is no longer inert, it does not simply emulate natural behaviors, but it literally incorporates life becoming a meta-layer in continuous development and evolution. We prefer to define this approach as "eco-symbiotic" in order to underlines that bio-integration of organic substances or biological organisms can bring architecture closer to establish a mutualistic symbiosis, rather than a parasitic relationship with the biosphere.

Conclusions

In the current era, marked by an increasing environmental concern, urban ecology becomes an important goal to achieve and it forces us to think about current design methods which are not ecologically aware of natural resources, nor adequately integrated into ecosystems.

The eco-symbiosis perspective applied to architecture can in fact help us to include in our future cities ecological dynamics of responsiveness and metabolism and to build positive relationships between

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 5.
Rachel Armstrong/Newcastle University, "Living Bricks", 2017. Photo: Tonu Tunnel

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

living organisms and the abiotic forces of our cities. Moreover, by emancipating architecture and design from a mere objectification, we can start conceiving built environment as assemblage of meta-living organisms thanks to biosynthesis.

This new field of research seems very promising, even if at this stage there still few implementations at the architectural scale and designers are more focused on the production of prototypes which are generally unrelated to the more purely architectural field, as they seem to be halfway between an artistic, scientific and design project.

However, we can detect also some disadvantages related to this practice, which are mainly economical since the costs for the synthesis and maintainance of biomaterials still relevantly high. The use of biological organisms coupled with artificial materials could also generate unforeseen circumstances related to the inpredictability of living systems and this is certainly something that will need further elaboration in order to reach a certain stability at the architectural and urban scale. Another possibile implication could be the reducing of these experimentations to the umpteenth way of technical manipulation and exploitation of living systems, ecologies, and the biosphere at large.

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Meta(re)presentations

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Abstract

This essay reviews the key literature on the notion of metarepresentations in fields beyond architecture and then attempts a rereading of the conception of representations in the architectural discipline.
Two main categories of metarepresentations in architecture are proposed and depend on their effect on thinking representations; Content and context aware metarepresentations
Content aware metarepresentations are based on a value system and can be divided in two categories. The first one is characterized by standardization and selfreferentiality while the other one is structured as criticism by enabling referencing and quoting within content. Characteristic examples are modern and postmodern architecture.
Context aware metarepresentations resemble the condition of monitoring a system by focusing on the relations between the different parts that temporarily constitute it as such. Characteristic examples are post-cybernetic and post-digital architectures.

Keywords

content awareness; context awareness; representation; metarepresentation; monitoring; control;

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

I Definitions of meta-representation

The etymology of the prefix "meta" finds its origin in the word μετά which is taken to mean after, beyond) means more comprehensive or transcending. We could argue that a material could be analogue and yet an immaterial representation , in the broader sense, constitute an intentional mental representation of the thing which is a lot different than a random representation of a thing which could be more closely connected to the notion of the trace, a fragment of a whole. According to Barbara Von Eckardt Peirce's mental representations have four important aspects (Eckardt, 1999); they are realized by a representation bearer, they have a content, its representation relations are "grounded" somehow, and as a result it is interpretable by some interpreter. Therefore, in the case of design a representation demands; A designer, content (literal or fictional, objective or subjective, literal or abstract etc), a discipline or a method, a competent reader / receiver to whom the information is communicated. In this path representation covers the ability to think about something and believe in something and communicate these thoughts to someone else (correctly or incorrectly it does not matter). According to Dennett (Stanovich, 2004) a metarepresentation is a higher – order representation of some kind, or what Sam Scott would define as a representation of a representation (Scott, 2001). It is also implied that the information that is communicated to someone through representation is method-relation sensitive, which means that metarepresentations are enabled by design thinking as a method. Design thinking constitutes a shift of focus from method to changing values (Spiridonidis,2009), feedback incorporation, experimentation, and engagement through making and fabrication (Voyatzaki, 2010) and thus it negates notions of classical top-down cognitive thinking.

We could decipher two stratas of metarepresentations depending on their performance; Those higher order representations that perform a task of selfreferentially returning the representations action in itself, and those metarepresentations that allow relational thinking on relations that refer to an individual's mental capacity to reason about the mental states of others and their social role and status, and the condition of the common ground that they share (Horton, 2016).

Returning to Eckardt's classification we could say that the former kind of metarepresentations emphasizes content, while the latter relations. By repeating intrinsically these actions the way of thinking is affected as the first strata is of a more automatic, fractal looking nature emphasizing encoding and belief in the method, that resembles a couple of early period Magritte paintings with the same title but similar content "the human condition" (figure 1), while the second one assumes a thinking that oversees the object level operations that resemble monitoring, that is evident in the use of Trompe-l'œil in Sala a Crociera, in Palladios Villa Barbaro (c1560). Magritte's description of one of the paintings is characteristic "In front of a window seen from inside a room, I placed a painting representing exactly that portion of the landscape covered by the painting. Thus, the tree in the picture hid the tree behind it, outside the room. For the spectator, it was both inside the room within the painting and outside in the real landscape (Magritte, 1977)." The ambiguity created through the repetition of the content is enabled by the realistic portrayal of an object that is represented twice in the same medium, the painting. This could be described as contentual self-awareness (Wildgen, 2009). The absence of a frame in the canvas literally (in the context of the painting) merges the landscape with the canvas and the center of the theme, the tree is repeated as an object between different states (painting – painting of a painting) inside a room that is signified by the presence of a window paired by curtains. In Palladio's Villa Barbaro the emphasis shifts from the repetition of the content to the experience of looking. The use of Trompe-l'œil in Sala a Crociera (figure 2) uses the frame of the windows, the balusters in order

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

to juxtapose a physical object and a painted one and merge the painted environment with the actual environment of Maser (Treviso). The realism of the frescos painted by Paolo Veronese in 1:1 scale create the illusion of the real window on the wall in a first level reading while in a second level this allows him to insert a mythological narrative in the paintings that creates a second level of thinking of the context, the villa, the owners and the history in which they wish to embed themselves. Contextual self-awareness is the name of the game here; Veronese and Palladio monitor the experience of the sala by opening it to the natural and the mental context by using architecture as a looking device.

Based on the above, in this essay we are suggesting that metarepresentations were not invented in a particular historical period. They are a way of thinking on representations and they are distinguished as either **content-aware metarepresentations**, based on a value system (a way of a higher level thinking on representations), or **context-aware metarepresentations** that resemble the monitoring of a system (thinking on the way we use to represent objects, thinking on how a representational system works). Making these assumptions is very crucial in the meta-understanding of the theories and practices within architecture through the function of representation.

2 Architectural practice and representations

Based on the above, in this essay we are suggesting that metarepresentations were not invented in a particular historical period. They are a way of thinking on representations and they are distinguished as either **content-aware metarepresentations**, based on a value system (a way of a higher level thinking on representations), or **context-aware metarepresentations** that resemble the monitoring of a system (thinking on the way we use to represent objects, thinking on how a representational system works). Making these assumptions is very crucial in the meta-understanding of the theories and practices within architecture through the function of representation.

The issue of representation and its relevance to architecture is crucially affecting architectural practice, especially in the digital and post-digital era when architectural representations as plans, sections, elevations, renderings, walkthroughs etc are not only produced by architects but by other practices too and commonly even by not specialized actors who have access to software that offer similar products. The use of CAD (Building Integrated Modeling especially) by different disciplines is blurring the line of demarcation of the roles of the various actors involved, and is calling for reinstating the social and professional role of the architect with regard to parameters such as originality, authorship and interiority. With a consciously reductionist approach to artistic nature of architecture, for the sake of the argument, architecture is here discussed as a science or rather as a field (Schumacher, 2016) that defines the role of the architect not only as the specialist that generates the preliminary or final drafts towards the built form, but also as the synthesizer and supervisor of inputs offered by various domains. This might be potentially problematic as it seems like an "over-easy mixing of discourses" (Leach, 1997) but it is very common for architects to function both as a filter and as a mirror of society in translating different sources of information into spatial qualities. This is also justified by the inclusiveness and openness, inherent in the timely (Spiridonidis, 2004) education of architects as a way to appreciate other disciplines' specificities involved in the creation of the built environment. The effective mediating skills acquired, also attribute to architects a social superiority that confirms their role as versatile, hence diachronic as it has been recently reaffirmed in the digital turn. A turn that has radically

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 1.
René Magritte, The human condition (1933).
Oil on canvas (100cm*81cm)
Source Fig.1: https://en.wikipedia.org/wiki/The_Human_Condition_(Magritte)#/media/File:Ren%C3%A9_Magritte_The_Human_Condition.jpg

Figure 2.
Andrea Palladio, Villa Barbaro. (1560). View of Sala a Crociera with the frescos by Paolo Veronese and sculptures by Alessandro Vittoria
Source Fig.2: https://en.wikipedia.org/wiki/Villa_Barbaro

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

changed the nature of most professions. Since the role of the architect is to appreciate different needs and inputs and transform them into space architectural representations are conceived as a language that codifies space, translates spatially different practices and conceptualizes environments in which these codifications are possible.

3.1 Content awareness_ Standardization_Self-referentiality

Referencing Carpo and Goodman, Buchli notes that the arts handmade by their authors are called autographic (for example painting) and cannot be replicated, the opposite, allographic, defines those artworks whose identities are irrelevant to notions of originality and duplication (for example music) (Buchli, 2016). Since Alberti's times architectural representations could be understood as a codification that affected both the design object and the designers' professional role in the social structures. The expertise in design mediation gradually set the foundations of the architectural profession, defined the domain and enabled architectural authority while at the same time imposed an architecture related aesthetic paradigm that was based in the method of architectural production implied in De re Aedificatoria (Alberti, 1991); design precedes construction, architecture is comprised by different parts that are related to each other according to firmitas – utilitas - venustas, that in their turn are defined by proportion, the rules of the orders, materiality, site and position and contouring. The standardization (Carpo, 2011) implied in technical representations and the notion of the identical constitutes a form of language that allows communication between different parties be it the relation between architect – object (construction and materiality) or the relation between object – appreciator of architecture (coincinitas) (Tavernor, 1985).

1. Writing, drafting, drawing, designing are terms that share a strong connection in our case.

Architects after Alberti's premises [1], by default, function on a meta-Albertian level which is a paradox as it assumes that in order to have a discipline someone functions on a meta- level although this level falls in the self-referential, content aware paradigm (architecture as a sub-group of Albertian practice). As architectural representations synthesize conclusions taken from various contributions that are then standardized by means of plans, elevations, sections and construction details that allow buildings or objects to be constructed in the absence of the architect, architectural representation is considered to be a non-representational art-form for a number of philosophers. Namely, Scruton, Langer and even Goodman suggest that architectural representation does not represent any content (Scruton, 1979) but represents the processes necessary for its materialization as is depicted through the repetition of symbols. This approach of course excludes the condition of architectural interiority, the way that architectural concepts and ideas are discussed and

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

formulated within the discipline and as a result they carry content that is architecturally and even aesthetically codified, communicated and similarly appreciated. In advance literature underlines that even technical representations are also guided by aesthetic values, even if they are conceived as purely procedural manifestations 2. This is easily understood in parallel to typography, graphic design or mapmaking and how these practices carry cultural content that goes beyond the information they communicate. This aesthetic parameter though is a first order representation that is based on the belief that there is some kind of an inherent truth in the code that architects use in order to communicate. The only way to test their meta – meaning would be to investigate whether codes are prolific in advancing cognition in architectural thinking, and not just symbols that follow a stylistic manner. This is related to architectural interiority and has historically been documented as a repetition happening in abstract-space through elements of what constitutes a disciplinarian architectural language.

2. "Within the spatial practice of modern society, the architect ensconces himself in his own space. He has a representation of this space, one which is bound to graphic elements […] this conceived space is thought by those who make it to be true. Henri Lefebvre,The Production of Space, trans. Donald Nicholson-Smith, (Oxford: Basil Blackwell Publishing, 1991), p. 361.

One example is the codification in Le Corbusier's "Five points" (Le Corbusier, 2007) (figure 3) of architecture; pilotis, the call for an absence of supporting walls in favour of a free-designing ground plan, the free design of the façade, horizontal windows and roof gardens adopt a typological vocabulary that references the advances in building construction, the autonomy of the façade from the structure, and essences of standardization that follow the first industrial revolution that at the same time conceal aesthetic aspects linked to machine age, modern painting, abstraction and the early 20th century avant – garde. Another example is the series of diagrams of interiority that Eisenman produced in the 1980s and the beginning of the 90s in which a cube is deconstructed following discreet steps and specific rules. Geometry as abstraction functions as a metarepresentation of the modern architectural production as it is used as a cognitive tool that measures relations between parts and justifies their necessity and role in a synthesis. Even in Eisenman's procedural experiments functionality is embedded in the somehow automatic, cause and effect logic that we believe that is hidden in the mathematic foundation of geometry. And although diagrams serve as criticism they do not depart from the meta-level of gaining coherence by referencing symbols. Belief is the basis of this contentual system and the seemingly infinite possibilities are embedded in the same eidetic path, the one of the rule, the canon that directs sameness and difference. By residing in abstract space in opposition to a qualitative environment, modernism inserts the necessary distance between the architect and the actual built environment . Architecture controls the material object as a representation of an object conceived in vitro, in the design praxis milieu almost symbolically. Architecture is mediated as an exteriority while any construction is nothing more but an image of the model. Alberti's notion of the "lineament", Le Corbusier's declaration that "architecture is the product of the mind" and Vitruvius's distinc-

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

tion between mind and matter (Hendrix, 2011) all point to the same direction. Representational distance allows the dominion of symbols that establish the authority of the architect while ensuring his control over what we call architectural space. Distance also effects on the temporalities of contentual metarepresentations as time seems to be obsolete since it is an intrinsic characteristic of the system that is reversible. Time is of a symbolic nature, to repeat time has absolutely no meaning as ideas are eternal or perpetuated.

3.2 Content awareness. Referencing – quoting. Criticism.

An action of metarepresentation that falls in the content awareness trope but what does not just fit in the previous paradigm is the action of referencing and quoting. This practice reached a peak with post-modernism and especially that branch that used historical references, figurative work in the architectural work. At that time Post-Modernist architects stood for differentiation, variation and choice (Carpo, 2013). Through the action of reappropriation or most famously deconstruction of forms that were taken from the span of architectural history they introduced a meta-thinking of the content and the techniques used in architecture but in a, more or less, strictly historical western metaphysical framework. According to Sanford Kwinter what we understand historically and geographically as Western metaphysics is rooted in the relation of subject-object in which the dipoles of representation-reality and criticism-representation are interjected, and through which any relationship between separate things can be understood (Kwinter, 2001). On the two dipoles of representation-reality and criticism-representation the relation of possible-real emerges internally. Thereby, representation constitutes a possibility of the real while criticism constitutes a possibility of representation that is not realized in the first place. Criticism of representation emerges as a form of metathinking on representation as by referencing juxtaposes what is realized with its possibility, what could have been thought and by this it criticizes ethics of originality and authorship.

A good example is the various references to architectural elements in James Stirling's Neue Staatsgalerie in Stuttgart (figure 4). James Stirling neither attempts to change the technology of architectural building nor he proposes a new dogmatic architectural vocabulary, but instead reconfigures the museum almost as a built index that opens up the building to interpretations. Michael Graves' Portland Building instead of elements indexes styles that then he merges. This combinatory practice again tests the limits of the possibilities inherent to criticism and content in architecture.

4 Context awareness. Monitoring

If contentual metarepresentations automate distance through repetition, contextual metarepresentations emphasize presence by monitoring the relations within the system. This constitutes a rethinking of architectural production within the tropes of exteriority that could mean an opening up of the inherent relations according to which architecture is produced.

A metarepresentation of context awareness demands a rethinking of the framework in which architecture is produced. This will demand a rethinking on key notions such as standardization, self-referentiality, abstraction, authorship, criticism, distance and the primacy of fixed content. In this sense a meta-architectural expression does not constitute a paradigm shift but a self-aware re-evaluation of the relations according to which architecture is in-formed by its representations.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

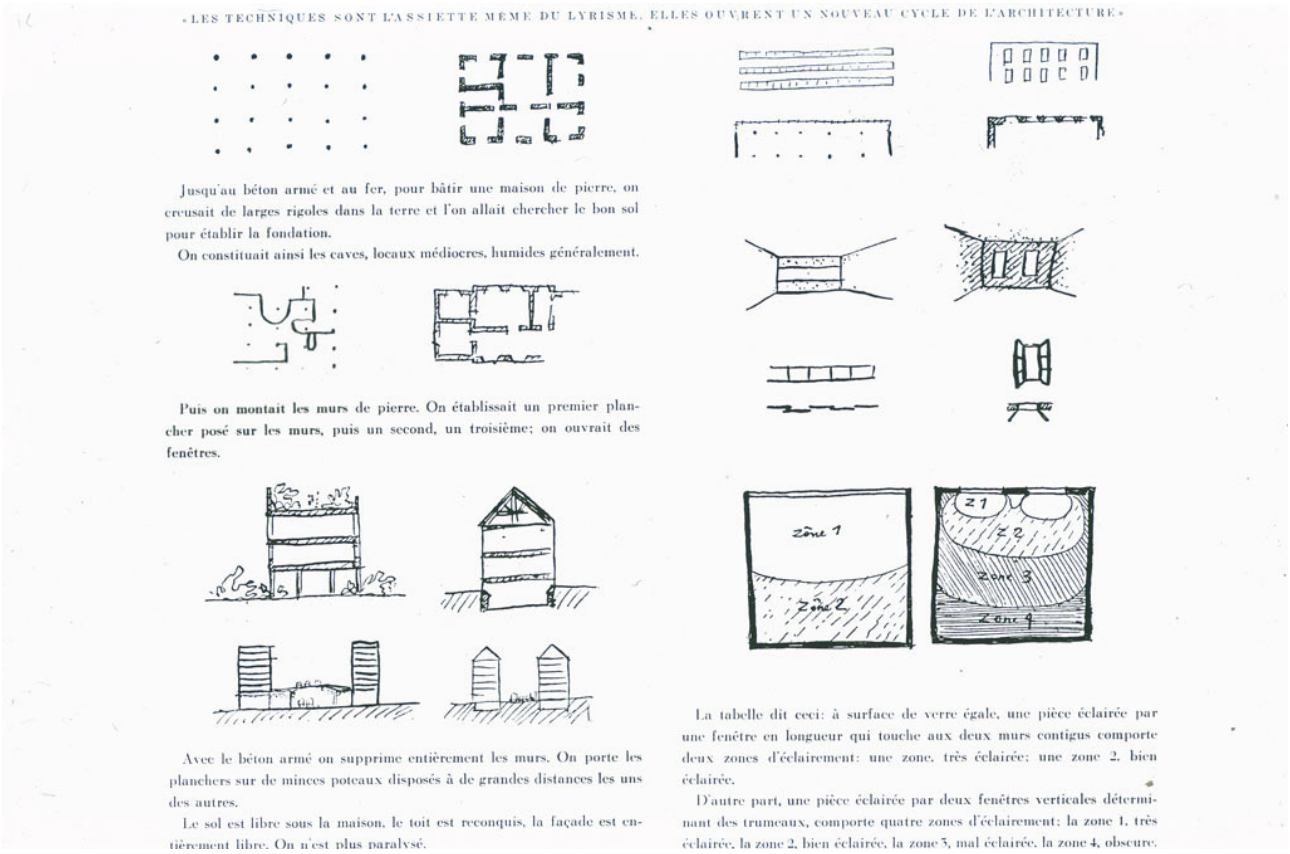

Figure 3.
An illustration of the "five points" of architecture by Le Corbusier
Source Fig.3 https://twitter.com/France_UNESCO/status/750638087022211072/photo/1

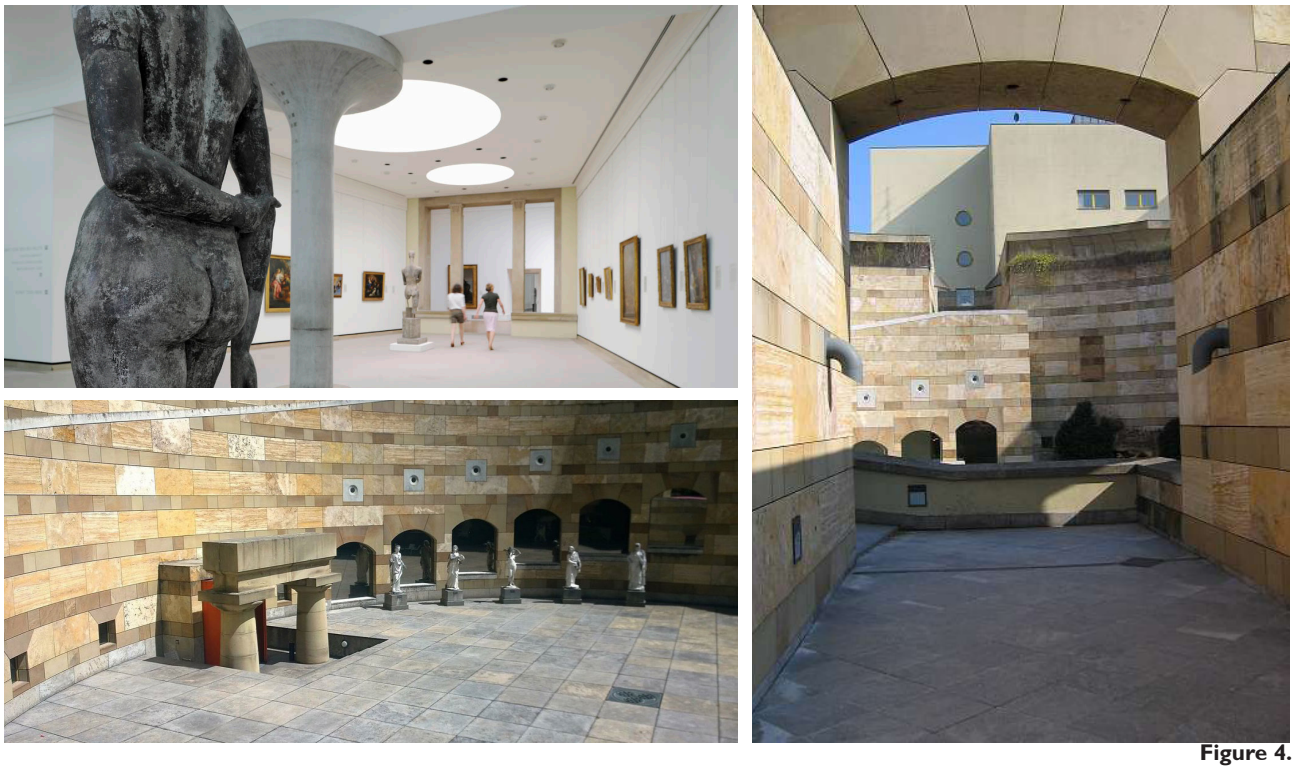

Figure 4.
James Stirling, Neue Staatsgalerie, Stuttgart.
Source Fig.4 https://en.wikipedia.org/wiki/Neue_Staatsgalerie

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

The beginning of this kind of thinking in architecture can be traced in the aftermath of WWII as the events that took place did not tolerate the modernist vision of formal abstraction as architecture along with the arts and the sciences had to take a stance against the historical events. It was part of this turn that architecture started to examine ideas of context and how to relate to specific situations. In other words, architectural thinking started to look for a common ground, a body of information to share with other discourses and practices. This immediately meant an opening of the architectural language in order to communicate in a way that it is understood outside it and a turn towards what we could call an exteriority. This exteriority was nether then nor now something specific, but it changed following the trends that gained importance from time to time; social and cultural studies, philosophy, anthropology, cybernetics, biology, systems and complexity theories… the list is vast. The important issue is the demand for hetero-referentiality that signified a rethinking (if not loss) of absolute authority in the finished object. Architectural representations were rethought in this prospect and, therefore, re-appreciated. The notion of collage was an early reflex as it graphically contested purism, the psychogeographic maps of the Situationists inserted randomness in the conception of cities along with subjective issues. Archigram and archizoom introduced a re-thinking of the medium of standardized representation by opening up to mediums as the pamphlet, the magazine or the video. These experiments remain symbolic in nature while the very first breakthrough towards a rethinking of the relations in which architecture contributes came with cybernetics and the realization that architecture should be able to be in-formed and not simulate a detached environment but "rather the organism itself and its psychological, historical, and sensorimotor experience within that environment" (Roche, 2014). By embedding real time changing information architecture is embedded into context ecologies .

This constitutes a meta-presence as a return or exaggeration of presence that was further enabled with the advent of the digital revolution [3]. that in architecture is realized through Building Information Modeling and File to Factory protocols to name a few. BIM enables real time monitoring of different aspects and infrastructures of a building while f2f protocols enable negotiation between design and product, engagement and a continuum (Voyatzaki, 2010) between the design process and construction. Architecture can become specific, customized and contextually aware if architecture manages to monitor information and channel it in directions that contest its sense of object. The metarepresentational scheme that architecture falls in is that of a mind monitoring an informational network where cognition is always situated in a specific environment that is both technical and subjective (Roche, 2014) where space is a trope of information. Contextual aware metarepresentations do not represent

3. As Mario Carpo writes "Systems theory, complexity science and the so-called theory of self-organising systems were part of the legacy that early cybernetics had bequeathed to contemporary digital design". Mario Carpo, Introduction in Mario Carpo (editor) The Digital Turn in Architecture. 1992-2012. ISBN 978-1-119-95174-2. Wiley 2013

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

information, the metadata 4 that follow meta-objects are characteristics of the objects and in-form them while at the same time can change and effect on the object. Here the subject object relationship is one of sympathy where they both cross-infect one another.

4 Metadata is content about content. Information about the author of the data, time and space when it was produced

This of course affects the focus in conceptualizing such kinds of architectures. Robotics and self-configuring electronic environments – enabled by compatible devices that take advantage of the internet of things start to become the norm while they also affect the agencies within an ecology and the contribution in the creative act that is now not only made by human but also nonhuman agents. Non-human agents become less predicatble, more adaptable, and interactive, less automatic, as Artificial Intelligence and Machine Learning introduce behavioural traits that incorporate feedback and correct or even better moderate (Hayles, 1999) their performance. As human and non-human agents are inscribed in the ecology of interactions cultural constructs are created that go beyond typical taxonomies of interiority and exteriority, content and context and thus architecture in a metarepresentational level is realized almost at the moment of its conception, in real time.

Lars Spuybroek's d-tower was one of the first examples of an architecture that had an interactive internet-based component (Spuybroek, 2004) that controlled the appearance of the object by changing its color according to a questionnaire that engaged the citizens of Doetinchem. Harvesting interactivity becomes a matter of conciseness and compatibility of networks with the design thinking / programing of architecture. The ideology behind smart cities is the same. Metarepresenting interactions comes with the promise of an umbrella software / environment that will be able harcest behaviors and feedback from all dimensions of ecos. The definition and interconnection of all parameters at once will allow monitoring of the ecologies. This pragmatic approach, that seems to push aside all ideological aspects of the city by harvesting all kinds of available metadata is evident in projects like Chicago: City of Big Data. The city is analyzed as multiple layers of infrastructure; the narrative of unhindered flow describes the relation of data to the city. High-tech infrastructure as wireless networks has to comply with the low-tech infrastructures of the sewers and the roads 5.

5. See also http://www.architecture.org/exhibits/exhibit/chicago-city-of-big-data/

5 Metapresence

Throughout architectural history and theories the control of the architectural object demanded a conceptual distance, a vantage point for the architect in order to overview the design object. This condition affects even the meta-thinking of architecture as it compels it to retreat in contentual awareness confines that are generally identified by criticism, historical or theoretical referencing and quoting and

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Figure 5.

NOX's D-tower emitting different colors depending on the different moods of the citizens.

Source Fig.5 http://tropolism.com/2006/02/nox-loves-you.html

Figure 6.

Chicago City of Big Data by Perficient / Digital labs

Source Fig.6 https://perficientdigitallabs.com/work/caf

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

selfreferentiality. This as a result sustains the distance between architectural discipline and the ever-changing social ecologies. Architecture becomes a style and thus the architect is self-identified as solely the custodian of a historical heritage, architecture conforms to the past as this is where it abstracts validation.

In the latter decades though the change in the sociocultural environment with the advent of the flow of capital and knowledge redefined our conception of boundaries, cities, countries beyond spatiality, language and even behavioral codes and ethics. The rapid expansion of the internet and the increase in the use of portable technologies is accompanied with the emergence of new media and the rapid increase in the production of knowledge. A new metarepresentation of architecture started to emerge that experiments with monitoring the relations within the system that it is connected. This metarepresentation is defined by contextual awareness and is practiced with an emphasis in the presence of design-thinking. This inscription in the field of ecologies that architecture is a part of constitutes an emerging meta-presence for both representations and practices of the discipline that put into doubt architecture's self-referentiality and historical and theoretical constitution as an object.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Inbetween – A Post-Digital Turn – Craft-making 4.0

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Abstract

Traditional Western philosophy, cognitive science and traditional HCI frameworks approach the term digital and its implications with an implicit dualism (nature/culture, theory /practice, body/mind, human/machine). What lies between is a feature of our postmodern times, in which different states, conditions or positions merge and co-exist in a new, hybrid reality, a "continuous beta" (Mühlenbeck & Skibicki, 2007) version of becoming .

Post-digitality involves the physical dimensions of spatio-temporal engagements. This new ontological paradigm reconceptualizes digital technology through the experience of the human body and its senses, thus emphasizing form-taking, situational engagement and practice rather than symbolic, disembodied rationality. This raises two questions in particular: how to encourage curiosity, playfulness, serendipity, emergence, discourse and collectivity? How to construct working methods without foregrounding and dividing the subject into an individual that already takes position?

This paper briefly outlines the rhizomatic framework that I developed within my PhD research. This attempts to overcome two prevailing tendencies: first, the one-sided view of scientific approaches to knowledge acquisition and the purely application-oriented handling of materials, technologies and machines; second, the distanced perception of the world. In contrast, my work involves project-driven alchemic curiosity and doing research through artistic design practice. This means thinking through materials, technologies and machinic interactions. Now, at the end of this PhD journey, 10 interdisciplinary projects have emerged from this ontological queer-paradigm that is post-digital–crafting 4.0. Below I illustrate this approach and its outcomes.

Keywords
new materialism; alchemy, aesthesis; embodiment; interdisciplinarity; responsibility

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

1 Introduction

Computer and web-based networks are integral to our digital, information-driven societies. Thus, technologies are interconnected to the conceptual models through which we understand the world (Busch & Palmås, 2006; De Landa, 1991; Deleuze, Guattari, & Massumi, 1987). History has witnessed epochal transformations of worldviews 1 as well as paradigm 2 shifts and industrial revolutions (so-called industry 3.0 and 4.0). Mechanization and later industrialization became decisive for how humans relate to each other, technology and nature (Marx, 1867). By nature, I mean how the material world was viewed epistemically and which active or passive character was attributed to non-living forms and forces. Post-industrial technology transformation and increasing dynamization have begun forming a hybrid reality and an intermediate, continuous state of transformation and becoming (Gilles Deleuze & Guattari, 2014). But our current, rather Biedermeier-like (Gordon & Mihailidis, 2016) approach to technology and digitality seems to shape our current alienation (Marx, 1932) from our existence (Dasein) (Heidegger, 1967), environment and fellow humans. In a social metabolic view, we again seem to be facing a turn of worldviews. We need to see the bigger picture of our own doing and acting and draw conclusions from our capitalistic consumerism. Some post-colonial, ontological and queering thoughts on digitality and handling of technologies attempt to illuminate this new emerging era, i.e., the post-digital turn (Crafting 4.0).

1.1 The anthropocene

Our present time, the so-called fourth industrial revolution (industry 4.0), is no longer phrasable, on either a cultural or an economic level, through a paradigmatic lens. Instead, the metaphor of social metabolism 3 is used to describe quantitative indicators of a metabolic turn of the Anthropocene (figure1). The Anthropocene captures a feature of human-made, artificial, technological interventions, actions and quantitative constructions over the last 100 years of high capitalism that impacts planet Earth on the level of the biosphere, lithosphere, hydrosphere, atmosphere and stratosphere.

In the age of craftsmanship, information, work and energy were coupled. In the digital age, machines take over work and design processes as well as control design and production information. Digital manufacturing seems to be increasingly eliminating both human, manual work in the production phase and the need for specialized manual skills. However, digital manufacturing techniques also offer opportunities, not least since they enable a new way of dealing with the topic of industrialization, mass production and individualization. Through so-called CAM (computer-aided manufacturing), technology and generative design enable us to produce copies from digital

1. Worldviews are constitutive manifestations of a particular view and determine how the world and its phenomena are interpreted. This applies not only to the interpretation of phenomena, but also to the selection of phenomena themselves. In this sense, the worldview defines what exists in the world and how we interpret and understand what exists (Wagner, 2011).

2. Paradigms are decisive for how we attribute active or passive character to materiality, how we perceive and recognize our material and technological world, based on which things in the world may only form meaningful and constitutive relationships between each other. Thus, our relationship with materiality and technology is always shaped by our understanding of the world. What I do not recognize neither exists for me nor can I understand it. Recognition — the recognizable — also concerns visibility, accessibility and experiencability. Experienceability implies experience and therefore perception.

3. The metaphor of metabolism is derived from the physical sciences. The notion of the social metabolism of the Anthropocene offers a framework for understanding how human technological and constructional actions cannot be conceived in isolation, but as interconnected transformations of the world (over the last hundred years, i.e. the high phase of technocratic capitalism) (Baccini & Brunner, 2012; González de Molina & Toledo, 2014)

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

data providing consistent quality from the same source. This makes digital production perfect for new and evolutionary craftmanship, as well as for making minor or gradual adjustments to and iterative improvements between digital and analog processes. The production line is becoming an individualized permanent "beta" state. Never completed, it is constantly updated. Thus, digital design and manufacturing processes can follow the principles of open source. This movement enables sharing a design code and incorporating improvements from the outside through collective engagement, hence adding value. Information, craftsmanship and energy become perceptible and once again coupled. Mass customization is replaced by design on demand.

2 Main part

"InBetween," my title, is closely related to Greek "meta." This captures everything intermediate and brings into play a second, higher order of the present while connoting the past and the future. The InBetween seems to be characteristic of our postmodern, anthropocentric times, in which different states, conditions or positions exist side by side and coalesce into a hybrid, "continuous beta" (Mühlenbeck & Skibicki, 2007) and "becoming" (Deleuze & Guattari, 2014). Further, this InBetween describes a triad of intersecting lines of methods, tools and processes between material/machinic-, human- and digital/technological interactions (see figure 2), which can be entered like a prism from different sides and contexts.

My research blended performative processes and practices (resonance, affect and matter) with feminist queer and postcolonial theories that propose a new ontological queer-paradigm: the post-digital turn – Crafting 4.0. This paradigm comprises the physical dimensions of spatio-temporal engagement. It reconceptualizes digital technology through experiences of the human body and its senses, and thus emphasizes generative design as a form-giving process, engagement and practice rather than as symbolic, disembodied rationality. Within this rhizomatic research framework (fig. 3), which helped generate the proposed ontological queer- paradigm, I combined four associated theoretical concepts [4] with two practical concepts [5]. Together, these concepts move beyond dualistic assumptions and suggest a collective of human and open digital technologies, machines and nature, theory and practice. This configuration emerges from engaging, thinking and acting through the "middle" (par le milieu) (Deleuze et al., 1987, 293; Stengers, 2003, 187).

This post-colonial research framework enabled investigating performative processes and their potential for immediacy, co-emergence and integrative co-composition with digital technologies. Turning away from agency to relationships and processes, I sought to break

4. The four associated theoretical concepts stem from:

a. Post-cognitive sciences and the "enactive approach" (Gallagher, 2017); (Stephan, 2013); (Noë, 2004); (Varela, 1991); (Maturana & Varela, 1987a) Maturana, 1980) with adaptions from the field of interaction design with the concept of „embodied interaction"(Dourish, 2001).

b. Anthropology and "post-colonial aesthesis" (Mignolo & Vázquez, 2013);

c. Theories around feminist "new materialism" (Bennett, 2010; (Barad, 2007) (Randolph & Haraway, 1997) deriving from phenomenology and philosophy.

d. From phenomenological and philosophical "post-humanism" (Hayles, 1999), (Barad, 2003), (Stengers, 2010).

5. The theoretical concepts were combined with two practical concepts:

a. The alchemic concept of the „Wunderkammer" (Leibnitz, 1646–1716) at the time of the Renaissance. For the Baroque and the post-baroque Wunderkammer approach, which includes new media and technologies, see Anna Munster (2006).

b. The concept of research creation, as developed by the Senselab approach within the Canadian context and involving research network Immediations (Manning, 2014).

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Vol. 7 (2) / February 2020

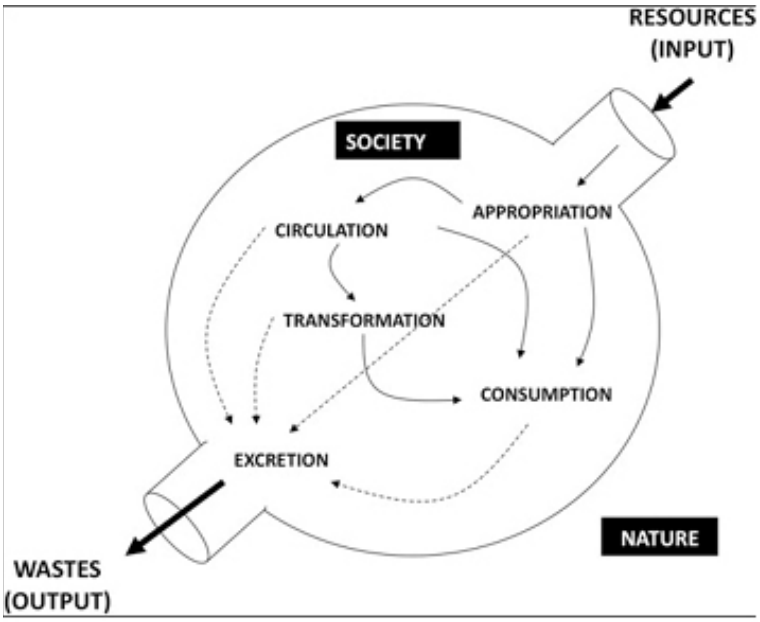

Figure 1.
Metabolism of the Anthropocene
Source Fig.1: rights @Ku Leuven https://www.arts.kuleuven.be/surplus/socialmetabolism (accessed 09.09.2019)

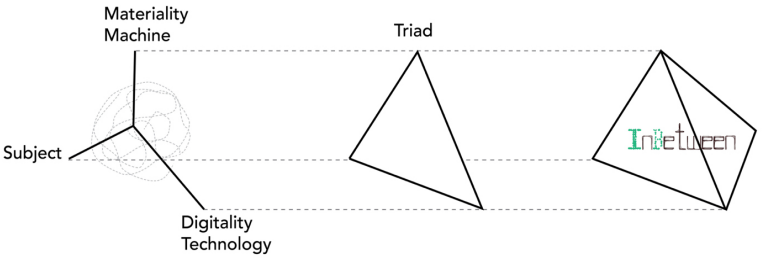

Figure 2.
Triad of InBetween: Intersecting lines of methods, tools and processes between material/machinic-, human- and digital/technological interactions
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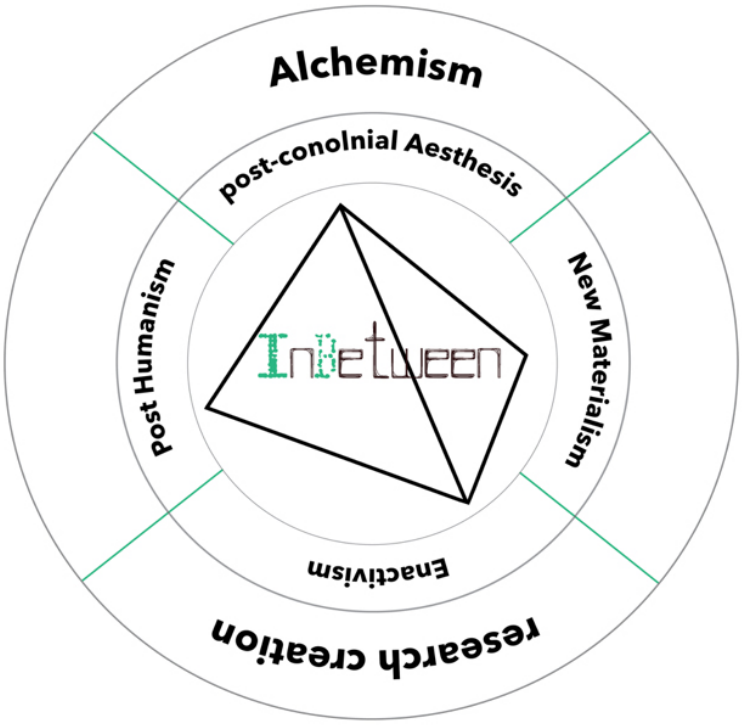

Figure 3.
Ontological queer-paradigm: The post-digital research framework
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Vol. 7 (2) / February 2020

up the predominant "distribution of the sensible" (Rancière, 2006) by redistributing the sensible through a multiplicity of centres and different sources of intelligence as a hybrid, parasitic and collective engagement between digital technologies humans, and non-human knowledge.

3.1 Experience, embodiment and enactment

The classical mind-body problem (Cartesian dualism) determines the ontological status of mental properties in relation to physical properties. As Baudrillard (2008) observes: "Calculating and logical thought only serves to exploit the world while separating us from it" (Baudrillard, 2008; 10). This dualism erodes if we think of natural processes, organisms possessing collective intelligence, the swarm behaviour of animals and biomimicry principles. The original, biologically founded concept of emergent self-organization ("autopoiesis") (Maturana & Varela, 1987) drew on cell biology, highlighted the existence of resonant, unicellular organisms and thus substantiated new cognition theory [6] (figures.4, 5).

By shifting to a sensorimotor account (i.e., enactive cognition) [7] of consciousness, human perception (cognition) arises from a dynamic, physical interaction between living beings and their environment. The "enactive approach" (Varela, 1991) describes a sensorimotor approach to humans that includes physical and cognitive processes (embodied cognition) as well as the specific situation of cognition (embedded cognition). "Enactivism" describes a continuous, dynamic process of participatory, sensomotoric sense formation and mutual interaction, and the coordination of two embodied actants and their mutual causal relationship including the specific environment. Thus, knowledge arises from the interrelation and interdependence of psychological, biological, physical, social and cultural phenomena. It involves shared social reality and the organism as a situational, active (inclusive) and creative participant — rather than as a passive observer (Varela, 1991). Perception and consciousness, as well as the qualia thereby involved, are products originating from cognitive activity. Hence, they do not simply happen, but arise through an organism interacting with its environment (Noë, 2004). Perception and experience in this sense are an "enactive" (ibid) approach to tracing bodily-material effects and their affective force relations, in order to associate discrete elements in a sensible, embodied way as an interlaced assemblage of life (Deleuze, Guattari, 1980). The proposed "enactivst" concept of humans, non-humans and technology understands these entities as different organisms, as different sources of intelligence. This approach has the potential to shift our perspective beyond hierarchical, dominating, colonialized systems and comparisons. Once adopted, it enables us to move beyond human-centred design towards more complex, entangled and assemblage-like un-

6. "Thus, if a cell interacts with molecule X and incorporates it in its processes, what takes place as a result of this interaction is determined not by the properties of molecule X but by the way in which that molecule is "seen" or taken by the cell as it incorporates the molecule in its autopoietic dynamics. The changes that occur therein as a result of this interaction will be those changes caused by the cell's own structure as a unity. Therefore, inasmuch as the autopoietic organization causes biologic phenomenology by bringing about living beings as autonomous unities, a biologic phenomenon will be any phenomenon that involves the autopoiesis of at least one living being" (Maturana & Varela, 1987b; 51, 52).

7. This is the assumption of recent post-cognitive phenomenological approaches (Gallagher, 2017; Stephan, 2013; Noë, 2004; Varela, 1991; Maturana & Varela, 1987a) and of interaction design approaches (Dourish, 2001; Depraz, 2003).

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www.archidoct.net
Vol. 7 (2) / February 2020

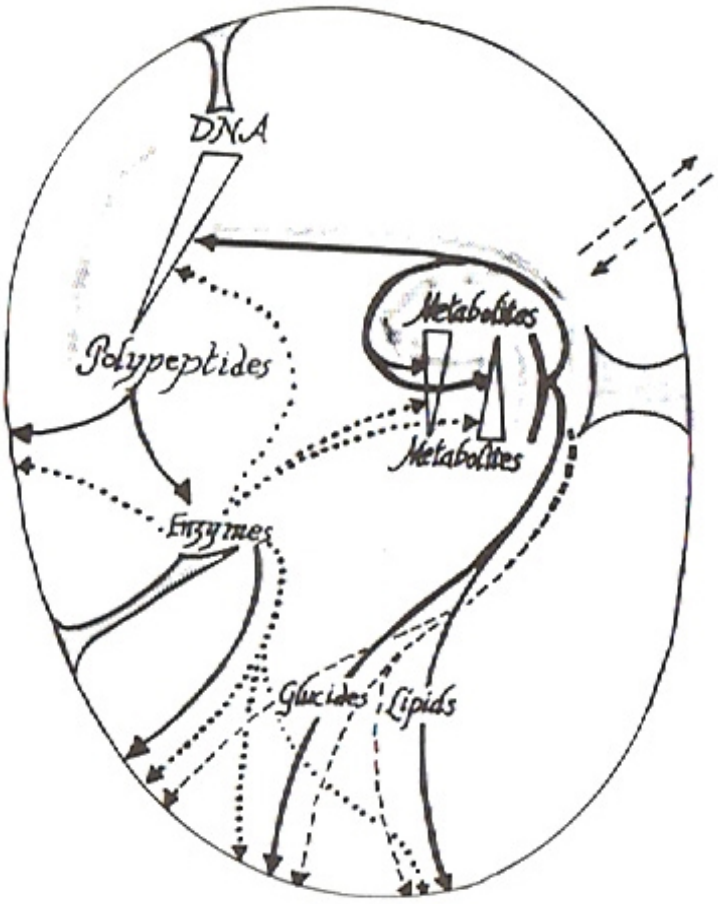

Figure 4.
"Representation of the autopoietic network" (Maturana, 1980, X)

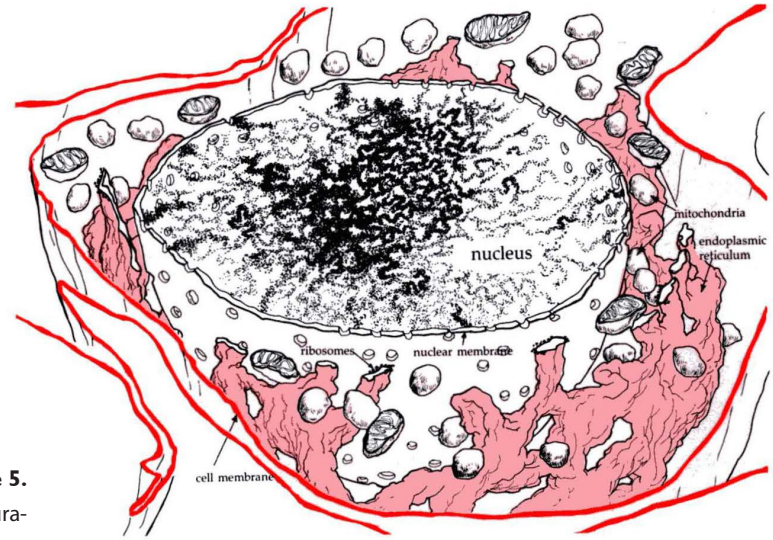

Figure 5.
"Diagram of the main profiles of the leech cell" (Maturana & Varela, 1987b, 52))

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

derstandings of life and of our future coexistence with other kinds of materials and intelligences that blur the boundaries between humans, non-humans and technology.

3.2 The otherness

Today's manifold information and data streams, "the colonisation of everyday life by information processing," tend to become meaningless, to the point where we are losing ourselves and where manifoldness has begun creating an isolated perception of the world (Greenfield, 2017; 113). In this colonial, Biedermeierish view on technology, people focus on domestic, "panoptic" (Foucault, 1976) isolation. Consequently, representations and simulations of things come to replace those things themselfes and active engagement is reduced to clicking a "Like" button (Gordon & Mihailidis, 2016; 38). These constitutive effects of massed media and simulations have created a hyperreality. Therein, we only experience doctored realities such as edited war footage or reality TV, just as the distinction between the "real" and simulations has collapsed.

The concepts of "otherness" (Baudrillard, 1994) or becoming "otherwise other" (Guattari, 2010) discuss the aspect of the "other" — similar to how they describe nature, technology and digitality. The concept of "otherwise" (i.Bid.) or "otherness" (i.Bid.) overcomes the dualism of subject and object and thus enables the alterity of the non-human or supernatural to appear (Braidotti, 2019). Today's hyperreality is by no means a new phenomenon. In Ancient Greece, hybrids in form of supernatural creatures were the Gods of Olympus, an eminent example of how the familiar self and otherness were merged into a single complex being. These hybrids combined the savagery of nature with the intelligence of humans, making them powerful allies. Today, "otherness" (i.Bid.) has begun appearing in different forms of digital cyber cultures, avatars, cyborgs, the quantified self, artificial intelligence (AI), where the digital merges with the physical as a constituting effect of technological mediations.

The Renaissance glorified the human conquest and domination of the world. Ever since, human universality has occupied centre stage, as best displayed by paintings or artificial garden concepts (Kristeller, 1990; 108). In following Deleuze`s (2008) thinking, we might instead imagine a world without axes, yet with different sources of intelligence and a multiplicity of centres (Deleuze, 2008). By embracing complexity and the processes occurring between different sources of intelligence (organisms), this line of thought creates a void that allows for movement and establishes "an intermediate or transitional place or state" (Jardine, 1984; 46). Trusting in multiple mediating natures — "otherness" (i.Bid.) — brings forth different contextual galaxies, each with different flavours, moods, atmospheres or tempers. Objective navigation through data once again becomes possible and makes us digital literates, yet from a personal point of perspective.

3.3 New materialism

In the digital age, with materiality becoming superfluous, materials seem to have lost their relevance. "Dematerialized informatization" (Folkers, 2015; 7), i.e., the "ratio" process that ever since Descartes (1641) has placed the rational mind above sensual perception, the body and nature, alienates and abstracts modern humans from materiality. The current material turn, discussed in the heterogeneous discourse of new materialism, is aware of a new material sensitivity and is shifting the focus back to the meaningful role of materiality and the interactive relationships between technology, humans and non-humans, which together form a holistic experience of reality. Materials bring information into the social fold, where the constitutive, spatial quality of the

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

material enables physically encountering or capturing information and interconnecting hybrid layers of reality. So-called "material agency" (Knappett & Malafouris, 2008; ix) plays its (essential) part in the creative, inclusive source of new formations of knowledge production — as "a multiple and collective affair," as a complex assemblage and equal entity (Braidotti, 2019; ix).

3.4 Affect and resonance and post-colonial aethetics

"Various ecologies" (Stengers 2005; 2010, 40) of discipline-specific practices have become part of affect and resonance. These have gradually erased discipline-oriented working methods and created collaborative (socially, spatially and materially embedded) participation and engagement. Affect, as Deleuze (1990) tells us in discussing Spinoza, is impersonal. While it is not bound to subjects, it nevertheless produces them. Pursuing this logic of affect, Massumi has underscored its autonomy in terms of subjective production, yet without being able to predetermine their becoming. To grasp affect, Deleuze and Massumi (2014), writing from within a Western and colonial context, gesture towards the aesthetic theories and practices of sensation. This, they claim, eludes the (colonial) subject while determining it. Likewise, Mignolo (Mignolo & Vázquez, 2013) contrasts the concept of aisthesis (i.e. the modes of perception) with that of aesthetics. The concept of affect and decolonial aisthesis endeavour to break up the predominant "division of the sensual" (Rancière, 2006). This, as V. Foerster (1985) has shown, is the political dimension of an aesthetic founded in the concept of perception. The principle of responsibility, which is determined by two imperatives. The post-colonial theory of aisthesis is seen as a way of thinking in order to overcome the gap in the discourse of pragmatics and aesthetics, structure and function (Von Foerster, 1985). This means switching the theory of perception from the static view to the dynamics of movements. The focus lies on how aesthesic design practices of "enactive"/interactive systems impact contemporary societal, cultural, economic, environmental, or political movement and social engagements.

3.5 Alchemic experimenting with digital and material processes

The symbiosis of additive manufacturing processes and performative material behaviour, whose interaction creates the final form, is called generative design. Generative design imitates nature's evolutionary approach to development and represents a post-humanist ideology, in which designers are no longer the "creators" of form. Nor do they determine how material is formed, or how it should behave and look. Instead, they become composers who, similar to the old alchemists, conduct analogue and digital experiments to see which phenomena emerge from, become recognizable and crystallize through this process. This generative relationship — between material arrangement and form behaviour —endeavours to work together with the environment. It seeks to use growth — arrangement and stiffening principles (bionics, biomimicry, mathematical principles) to develop a new language of form involving less material consumption, and thus to create a new design aesthetic of things. The proposed post-digital turn encourages a dialectic relationship between embodied interaction and digital, generative design. It suggests that the future of interaction lies not in the interface "disappearing," but in it becoming even more visible or available for a broader spectrum of engagements and interactions, interpersonal relationships, experiences and embodiments. "Thus the call for a more experimental attitude toward reality and the potential for self-organisation is inherent in even the humblest forms of matter-energy" (De Landa, 1997; 273).

Humans may assume the role of the other. Perspectives intertwine in the interaction between

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

the ego and material and digital engagements. This, in turn, integrates individuals and their actions into a general process of experience and behaviour. Generative design can take a new step further into real-world engagement, by profiling, modifying and adapting designs to the lived milieu. It does so, among others, by inventing a new, internal structure and by completely inserting itself in a given situation - "solid and tangible in their particularity" (Barad, 2012; 80).

4 One example of project outcomes and resume

Based on the elaborated rhizomatic methodological framework, I have developed 10 interdisciplinary projects over the last three years and subsequently various interdisciplinary working methods in four different areas (figure 7): 1. research and development; 2. workshop format for experts and laypersons; 3. teaching format; 4. business concept.

Below is an example of how I adapted the rhizomatic research framework to different projects (fig. 8). I sketch one project and its manifold material, digital, technological and machinic interactions.

4.1 Project example "Parametric Sewing patterns"

The emerging field of computational fabrication is making new ways of designing and manufacturing supported by generative design (parametric design) more and more accessible. These new manufacturing methods also allow exploring different algorithms, their differences and the generated results in physical space. The role of designers is therefore shifting. Today, designers need to embrace complexity and processes between different sources of intelligence (algorithms, material behaviour, aesthetics, sewing machine conditions). As a result, they adapt objective initializations of parameters from their own perspective and reiterate these in a symbiotic process between virtual modelling and real-world cutting.

Cut-to-fit software, while state-of-the-art, has limitations as it is based on norms and rules dating from early sewing pattern developments (Butterick, 1871). The human body is not standardizable and has different shapes and aesthetic needs. Hence, surface cutting and parameterization through algorithmic parametrization enable handling doubly curved surfaces (the body) with low distortion on 2D (paper or fabric).

Starting from scratch, i.e. ignoring assumptions about the historical art and rules of sewing patterns, this project starts from an experimental body-centred approach to create individual sewing patterns using off-standard intersection lines. Instead of trying to adapt the body to standardized norms, this project explores the beauty of imperfection, quirks and identity.

This project evolved from collaboration between a mathematician, computer scientist and myself – an architect and textile designer. Using an architectural and mathematical approach to algorithmic, generative 3D modelling and mathematical segmentation, we placed section lines individually on each specific 3D body surface scan, to best subdivide the garment undistorted. Applying this innovative methodology means that the pattern designs are at first virtual spatial and mathematical surface simulations. These, however, need to be tested, adapted and reiterated in a symbiotic process between virtual modelling and real-world cutting, sewing and fitting that also transforms the virtual fashion outcomes as an interactive ecology.

ISSN 2309-0103
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Vol. 7 (2) / February 2020

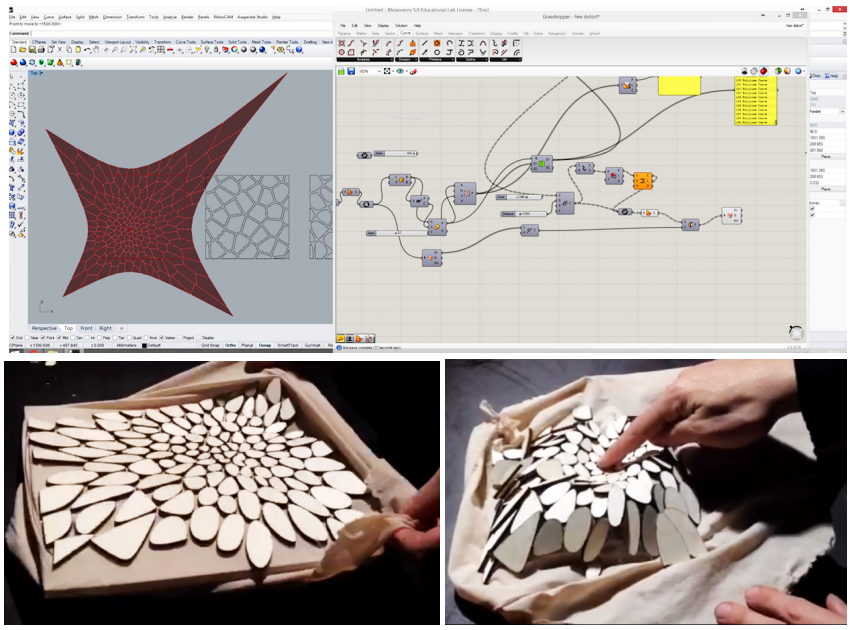

Figure 6.
Digital and material interaction, prototyping
Verena Ziegler (2017)
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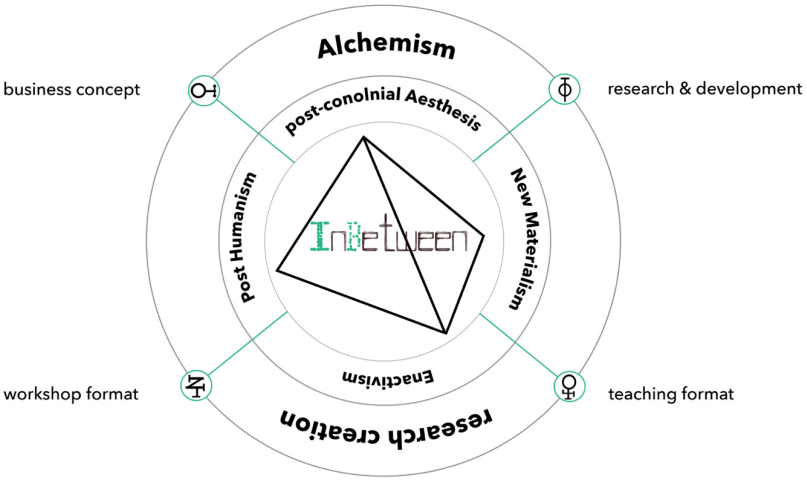

Figure 7.
Development of interdisciplinary working methods for four areas
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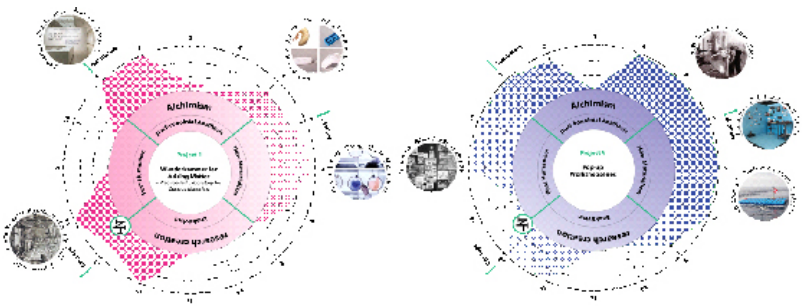

Figure 8.
Rhizomatic research framework adapted to different projects (2019), here two workshop formats, left side developed for experts, right side developed for layperson
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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Many applications of avatar models (in cinema, gaming or VR art) focus on perfect, graphic appearance and performance of avatars, which are rather idealized and can be created virtually. It is already possible to realistically represent virtually designed fashion and clothing items on a virtual model. Garment production methods, however, are based on analogous, conventional pattern creating approaches and methods. The established methods for the virtual development and segmentation of 3D-surfaces are based on visual realism. Thus, they are not realistic models in any physiological sense, but based on a representative visual level in a synthesized virtual scenario. The models are as such not based on real surfaces, but on virtually generated surfaces. Our approach comprises a virtual processing and segmentation method for modelling real, material and physical bodies (3D scan body data) by creating intersection lines for sewing patterns using virtual body topology. This body-centred method of producing sewing patterns makes no assumptions about analogue, conventional pattern creating approaches and methods. In contrast, our method highlights the transferability of virtual pattern development into reality.

Virtual processing of 3D surfaces, generated from human body scan data via a mobile app, will be used to create body-generated clothing. The result is a completely new pattern design technique and pattern design aesthetic. This considers the individual human body and enables creating fitting personalized clothes without distortions, pull lines and gapping. We achieve this by sewing experimentally through prototyping and by iteratively rethinking the manufacturing process. Think local, act global: our technique will support and transform local craftsmanship into a new era of digital craftsmanship 4.0. Our interdisciplinary, iterative and practice-based investigation spanning computer science, architecture, textile design and mathematics, algorithmic thinking and practical exploitation of pattern-form formation, we developed a sustainable approach to reducing waste consumption, among others, by striving to counteract the standardization of S to XL, by excluding disabilities and size-zero ideology (inclusive design) and by genderfying norms and rules.

By way of a brief outlook to a possible future scenario: This algorithmic approach to sewing patterns might not merely entail a symbiotic process between virtual modelling and real-world cutting. It might also involve other sets of data (e.g., digital avatar profiles of phantasy characters, heroes, or utopies, as illustrated by Björk`s recent album Vulnicura and her otherworldly virtual avatar). Thus, in our present context, this alternative conceptualization might contribute to generating an innovative physical approach to pattern creation.

4.2 Summary

This paper has outlined my rhizomatic research framework and highlighted two aspects. First, our "panoptic" (Foucault, 1976) Biedermeier approach to technology has led to (3rd person) abstraction, generalisation and a loss of resonance with the world. Second, the specific demands of capitalism, in particular its acceleration of optimization and consumerism, have created an aggressive human-world relationship, and thus the loss of resonance and meaning. In conclusion, we need a radical shift in thinking, in order to transcend determinism. Prevailing assembly-line thinking and action, as a historically derived, colonial conquest, does not seem well suited to attaining a sustainable future. I have instead argued for an ontological queer-paradigm, which I call the post-digital turn or Crafting 4.0.

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

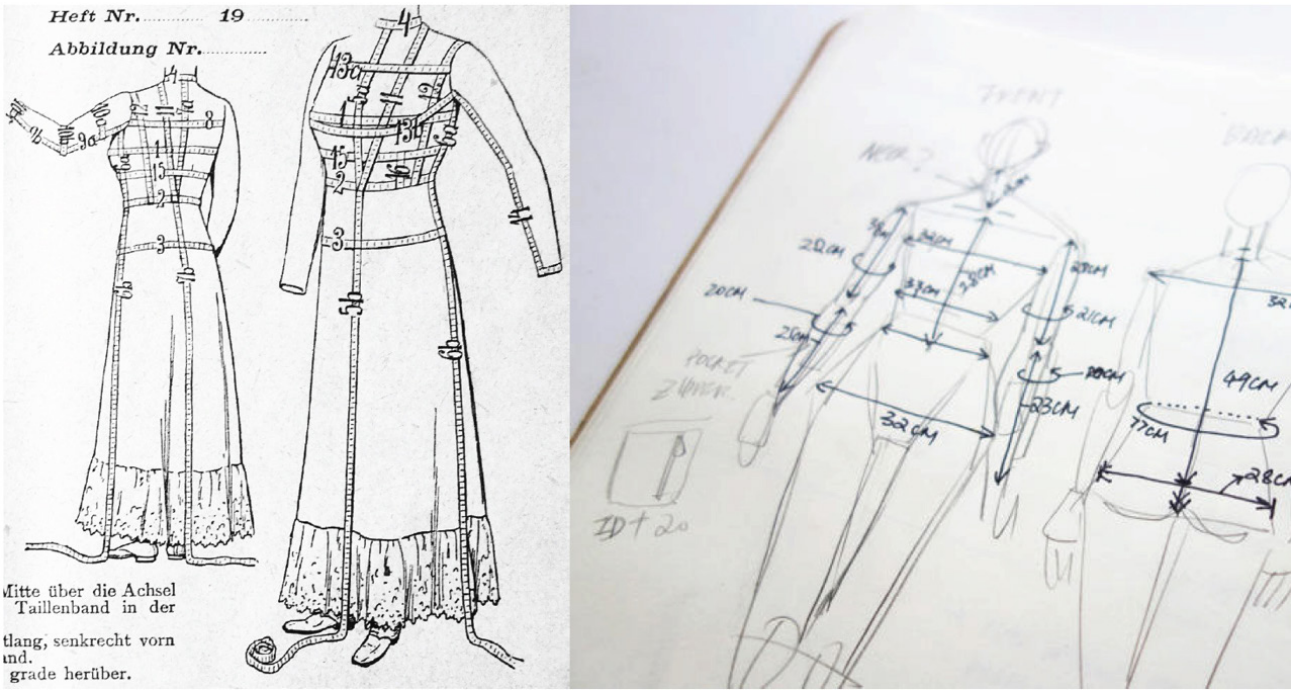

Figure 9.
Original sewing pattern approach after E. Butterick (1871), sketch Verena Ziegler
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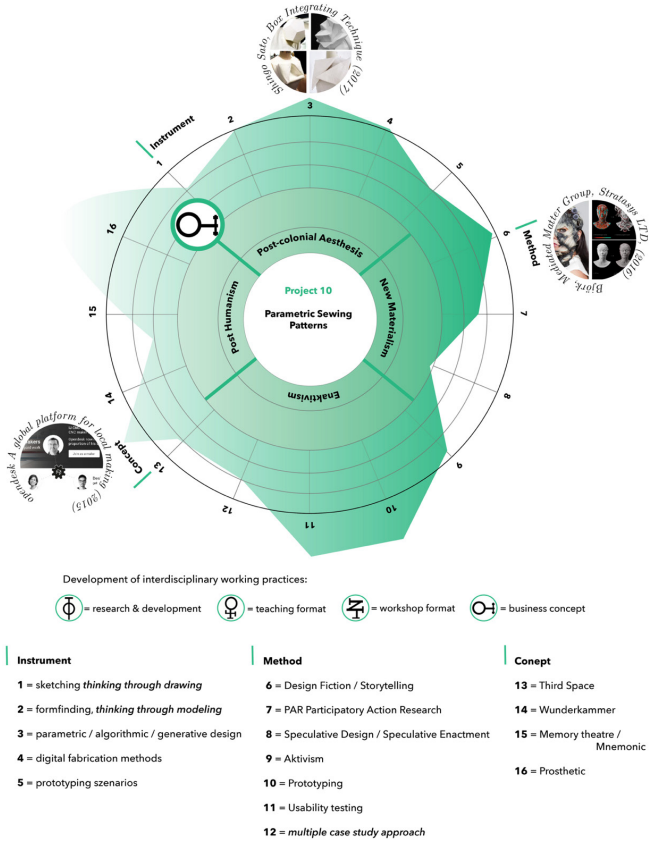

Figure 10.
Rhizomatic research framework adapted to project: "Parametric Sewing Patterns"
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Vol. 7 (2) / February 2020

Figure 11.

: Process from 3D body scan to virtual body topology and tension segmentation

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

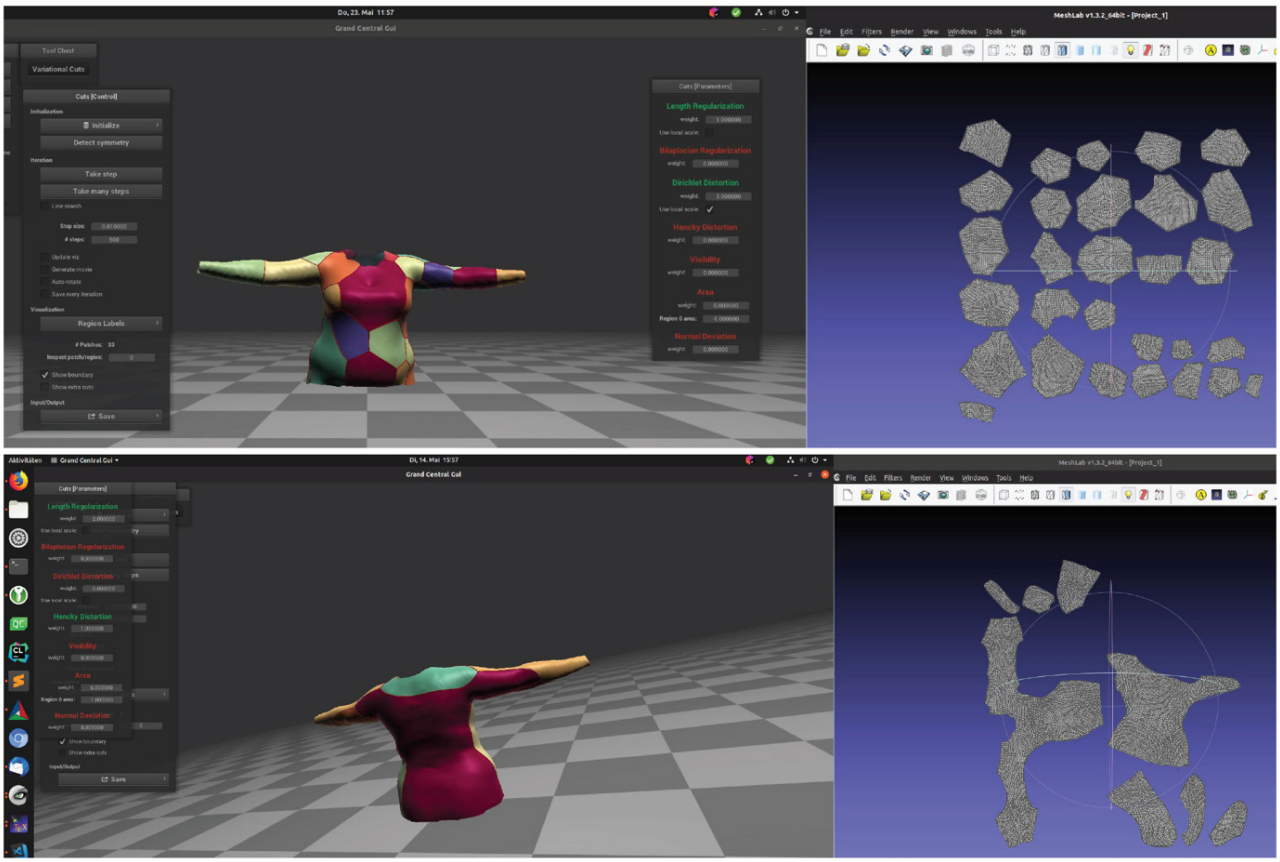

Figure 12.

Parametric, algorithmic segmentation process

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Figure 13.

Prototyping the experimental sewing patterns

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

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ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

98

Next Issue Information //

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The e-journal for the dissemination of doctoral research in architecture.

15

February2020

www.archidoct.net

ISSN 2309-0103

VARIABILITY

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

100

Call for papers //

Variability

Guest Editor: Dimitris Gourdoukis
Adj. Assistant Professor, School of Architecture, Aristotle University of Thessaloniki

The 15th issue of ArchiDOCT e-journal addresses the concept of variability; a concept closely related with two more general ones: difference and change. While constant change is a persistent characteristic of current societies and cultures, it is by no means a property that we first encounter in the 21st century. Already since the 1960s theories of difference – more often than not within a post-structuralist framework – started to emerge and shifted our focus from the concept of 'being' towards that of 'becoming'. The modern idea of certainty, supported by all kinds of standards, was juxtaposed with postmodern processes of fluidity and constant transformation.

However, it was indeed the 21st century and the almost total dominance of digital media that – at least on the surface – brought those ideas into everyday practice. Architecture of course is also affect by that process. One can therefore initially identify three main concepts in relation to the production of architectural form within the context of the fluidity described above.

The first is that of the Variable: Architectural form in this case is produced through the manipulation of variables. Specific properties are identified and then varied in order for different results to arise. The second is Variation: architectural form is produced through constant transformation of an initial form, generating this way an extended family of forms. Variation can be smooth or rough, but the common characteristics persist regardless. The third concept if that of Variety: Architectural form is produced with the aim of the generation of different predefined spatial conditions. The architect envisions those specific conditions and manipulates form in order to accommodate them.

All three modes of operation however, when used separately, function as a repetition of different, existing modes of architectural production. Variations echo ideas of typology where specific characteristics are (pre)defined and the new is created through their alteration. Variables advocate a more scientific approach where architecture is understood as a more or less objective field that can be analyzed accordingly. They result in situations where form is produced within a very limited range of – again - predefined solutions. Lastly, varieties represent the idea of the architect as an auteur, where his/her mastery allow him/her to generate form and authorize it at the same time.

Variability on the other hand – while closely related to all three, both etymologically and conceptually – implies a slightly different property: that of the possibility to be different in an unpredictable way. More specifically, it represents the claim to difference and change through almost illogical and definitely difficult to control actions. While a property that in many cases was typically undesirable

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

– precisely because of its unpredictability – variability might be the key to a new approach to the production of architectural form. An approach that combines the properties represented by Variations, Variables and Varieties and moves beyond the standards and the uniformity ultimately imposed by digital technologies.
The 15th issue of ArchDOCT invites researchers and PhD students to submit essays that examine the concepts of change and difference in all three initial versions of Varia-; and most importantly in their combination in variability.

Important dates
Submission deadline (full papers): 15 March 2020
Review period: 16 March 2020 - 15 April 2020
Revision period: 16 April 2020 - 30 April 2020
Follow-up review: 01 May - 15 May 2020
Final revision: 16 May - 31 May 2020
Publication date: 01 July 2020

ISSN 2309-0103
www.archidoct.net
Vol. 7 (2) / February 2020

Submission Policy

Archidoct is published two times a year, in July and January. The official language of the journal is English. Submitted manuscripts for review should not exceed 4500 words, including abstracts, references and image captions. The referring system will be the Harvard System. Text should be saved in a Microsoft Word or RTF file, while the supporting visual material (images, diagrams, sketches, tables and so on) should be sent as TIFF files with a resolution of at least 300 dpi. All visual material should be clearly indicated and numbered in the text, along with the respective image captions and credits. Additionally, all manuscripts should be submitted in A4 "camera-ready" .pdf format that gives an idea of how a finalized version looks like.

Archidoct only accepts manuscripts from PhD students. In order for an article submission to be considered for publication, the student must be a registered and active member of the ENHSA Observatory (www.enhsa.net/main/observatory), a PhD research portal created to facilitate communication and meaningful information exchange between architecture doctoral students.

Reviewing policy

The peer reviewers are all confirmed educators of architecture coming from different educational backgrounds, with different specialisations and expertise that share the common interest of their doctoral students: to encourage them to publish their work while improving their thinking processes towards academic research writings. Each submitted article is reviewed by two members of the journal's Scientific Committee anonymously.

Copyright policy

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