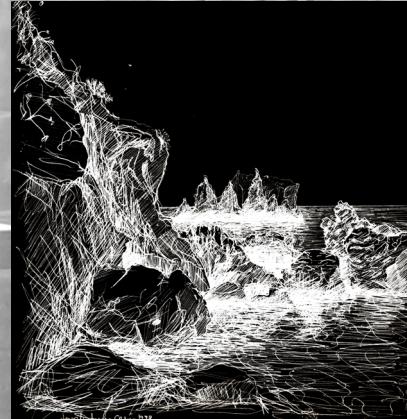


ARQUITECTONICS

MIND, LAND & SOCIETY

ARTIFICIAL INTELLIGENCE AND ARCHITECTURAL DESIGN: AN INTRODUCTION



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Foreword

JOSEP MUNTAÑOLA AND MAGDA SAURA

The aim of this book on artificial intelligence for architects and designers is to guide future designers, in general, and architects to support the social and cultural wellbeing of the humanity in a digital and global environment. This objective is today essential but also extremely large, interdisciplinary and interartistic, so we have done just a brief introduction of the subject. We will start with the argument fixed by the Professor Jonas Langer in his web some years ago, that we have defined as: "The Langer's Tree":

THE THREE-PRONGED HUMAN COGNITIVE DEVELOPMENT BY JONAS LANGER.

My research on the evolution and development of cognition in human and nonhuman primates is currently expanding from two- to three-pronged. The first is on the origins and development of physical (e.g., causal), logical (e.g., classificatory), arithmetic (e.g., numerical) cognition in humans from early infancy on. The second is on the comparative development of these cognitions in humans, chimpanzees, and monkeys. The third, which is entirely new and just beginning, comprises computer simulation experiments to investigate and model aspects of the evolution, origins and development of cognition that cannot be studied in real time with real subjects.

The texts by Sigfried Giedion, one of the leaders of modern design theories, can also be a good starting point. One was written in 1963 in the XV edition of the known book "Space, Time and Architecture", and we reproduce here the main argument of the text:

"In Mechanization Takes Command I intended to show how the gap between feeling and thinking emerges and how each generation needs to find its own solution to the problem, always the same, of how to build this opening between the inside and the outside dimensions of our real world by restoring the dynamic building able to support their affinities"

(Translation J. Muntañola)

This argument was expanded in his posthumous book *Architecture and the Phenomena of Transition* published in English in 1972 and was totally linked with the Husserl ideas about the historical origin of the geometrical systems (Husserl E, 1962) From this viewpoint, architecture is an intersubjective net of relationships, that develops in the human history through intersubjective socio physical transitions, as the one between Greece and Rome. This last book gives to the modernity in architecture a very different meaning than before in previous books by Giedion, and it was almost totally ignored.

We can now to present an example of these intersubjective relationships with the Diagram I (Muntañola J.2016) where arts are organized according to the socio physical artistic intersubjective relations between reality and virtuality. This is an extreme complex topic that perhaps G. Genette (Genette G.1997) has been the only modern pioneer on the subject. It is very easy to see the specific place of architecture among other arts and the almost universal role of design it itself in general terms, that we will describe in the next pages. However in the diagram II the artistic background of the humanity has changed dramatically, just the impact of the cinema , before the computer revolution, modified the traditional classification of diagram I This does not mean that traditional arts disappear, they have been immersed into a new cultural human condition and they have made an huge effort of adaptation, following the seminal theories by Jean Piaget (1982) in his known book "Adaptation

and Intelligence" and according with the development of the Langer's Tree defined above

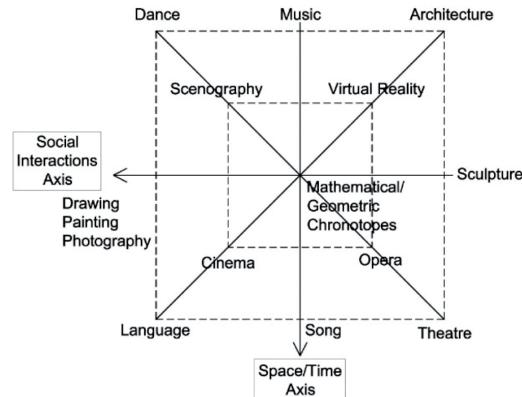


Diagram I. Chronotopic Classification of Arts

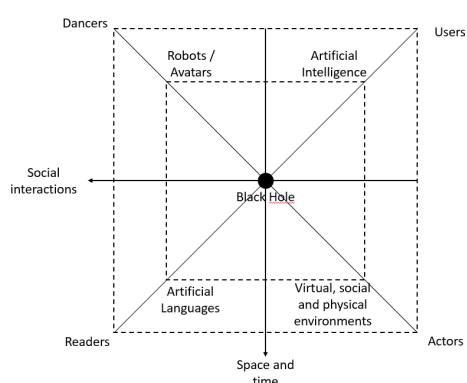


Diagram II. The Digital Impact on the Arts

We can better understand, now, the power of the inter-subjective concept defined by E. Husserl (1962) and underlined by Paul Ricoeur as a key concept of modernity, since it is an interdisciplinary dimension essential in the design practices and theories (Ricoeur P 1969,2000) As Lewis Mumford (Mumford L. 1978) insisted upon changes in geometry are not only changes in mathematics or in use of technologies but in the social cultural interactions too. The whole human life, the "standards" of this life, change and develop in specific new directions. We are used to fast technological changes, but as Aristotle pointed out, we have not enough knowledge upon the meaning of these changes, and we need to think just in the right speed not too fast nor too slow, and this is just what life does. Architecture has always been a key dimension to understand these changes. Because of that, Aristotle defines the fundamental "phronesis" or the practical wisdom, as "architectonic wisdom" because architects can design a building or a city without building them, or without living into them, and often they are dead when the city exists.

In the final references, there are a lot previous analyses of this intersubjective power of the human beings, and in the different chapters of the present book the relationships between the artificial human intelligence and the architectural and urban design practices and theories have been analyzed from different points of view, in order to define step by step in which world we are living and what we need to do in order to be able to adapt architectural and design education to this new human world.

First Part

Practices and Ideas Emerging from the Impact of Artificial Intelligence on the Architectural and Urban Design Practices and Theories of Today

Chapter I.1:

Cognition and sub-symbolic AI¹ Paradigms: Distributed AI as the ubiquitous future blanket for collective cognitive performance

ANA COCHO

Introduction. Intuition and Cognition styles

The concept of Cognitive Style² is normally used in Cognitive Psychology³ to describe the way human individuals think and perceive and remember information. Cognitive styles are an important element of our person that can help us better understand how each person processes information from the environment or from their own thoughts.

In the same way that at the clinical level it is highly relevant to consider that the cognitive style facilitates interpreting reality in a certain way, at the level of algorithmic design, we could consider it to have the same relevance.

1. Artificial Intelligence.
2. For the purpose of this research approach to cognitive styles will be the one of Allinson-Hayes in [1] being mentioned nevertheless in some occasions the classification between adaptors and innovators from Kirton in [2].
3. *Cognitive psychology* [3] the branch of psychology that explores the operation of mental processes related to perceiving, attending, thinking, language, and memory, mainly through inferences from behaviour. For the purpose of this Artificial Intelligent algorithms classification the research will be particularly focused on perception, problem solving, creativity and reasoning.

Thus, in the design of the algorithmic process and its methodology of approaching reality and its interpretation, it should be possible to establish a cognitive classification depending on how these processes interpret and use the information obtained from the external environment or from internal subprocesses, i.e., a person with mainly visual processing will find it more difficult to grasp verbal information and will remember knowledge better if visually focused stimuli are applied.

Hayes et al. [4] in their 2003 review of the CSI⁴ pointed out Epstein's global theory of personality— cognitive-experiential Self-theory (CEST)— that posits that Analysis and intuition are more likely to be separate modes of information processing served by different cognitive systems rather than being stylistic differences distributed along a bipolar continuum as stated in [1]. While Allinson and Hayes recognize that people apprehend reality in different ways, they argue that this reflects degrees of style on a single continuum of intuition-analysis, which is governed by a common set of principles instead of separate dimensions based on different cognitive systems.

Opposite, Epstein in [5] states that the rational system operates at the Conscious level functioning by a person's understanding of conventionally established Rules of logic and evidence. As so the system is:

- intentional,
- analytical,
- verbal-mediated,
- relatively affect-free,

4. From now on Cognitive Styles Index, CSI.

The experiential system, on the other hand, is:

- automatic,
- preconscious,
- associationistic,
- primarily nonverbal,
- very closely associated with affect.

As so we will consider for the purpose of this writing that intuition and analysis are separate dimensions of cognitive style.

Architecture, AI Paradigms and Problems

Definition Domains

Francesco Corea's Artificial intelligence technologies classification, the AI Knowledge Map (AIKM)⁵ from 2018 [7], is a good effort to draw an architecture to access knowledge on AI. The author developed a diagram of the crossings between the AI Paradigms and the AI Problem Domains.

The AI Paradigms are the approaches of AI researchers to solve specific problems while the AI Problem Domains are the problems that AI historically can solve.

The author points out three macro-approaches to AI Paradigms, Symbolic, Sub-symbolic and Statistical,

- Symbolic approach states that human intelligence could be reduced to symbol manipulation.
- Sub-symbolic approach is the one in which no specific representations of knowledge are provided *a priori*.

5. The AIKM was developed by F. Corea for the strategic innovation consultancy Axilo, for activities on their Chôra platform.

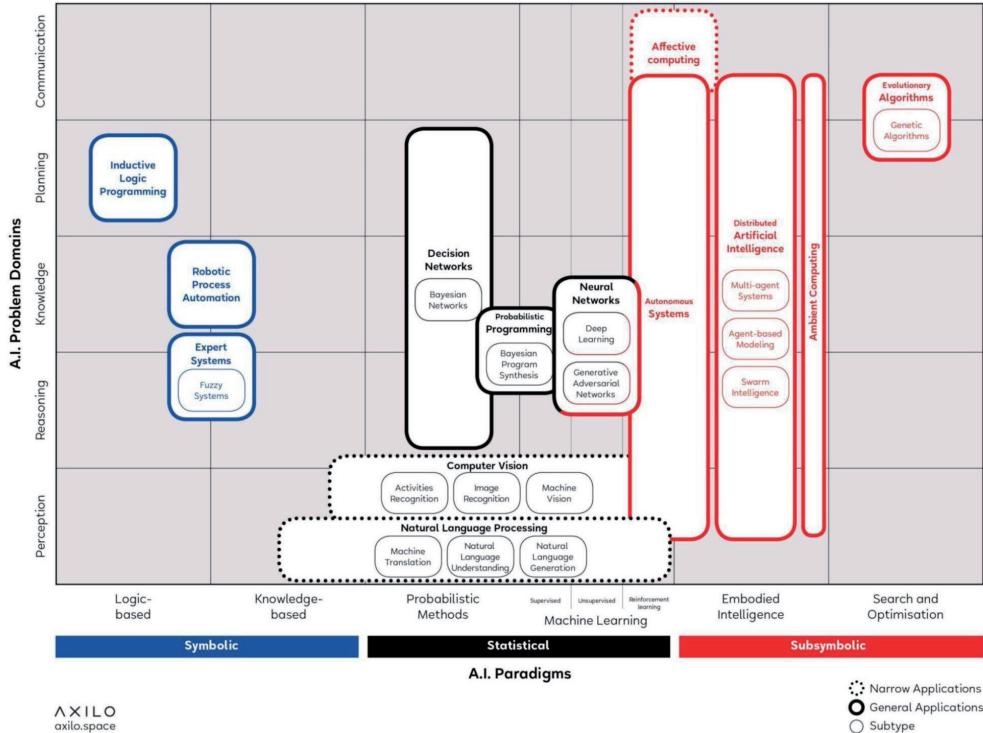


Figure 1. *AI Knowledge Map (AIKM)* [7]

- Statistical approach is based on mathematical tools to solve specific sub-problems.

It can be stated then that within the Architectural discipline will be probably dealing with sub-symbolic approaches as well as some statistical ones (when working with imaginary perceived from the environment).

Also, it will be straight forward to state that domains of perception, communication and planning will be mainly approached when crossing paths.

As so, it can be truly appreciated from the diagram and stated too those autonomous systems and distributed artificial intelligence-based systems are (and will be) the

most adequate ones to tackle the crossing between architectural design methodologies and AI based algorithmic processes.

Architectural Design and Distributed Artificial Intelligence, a methodological approach in design processes

Along the gap between the first Digital Age⁶ and the second Digital Era, chosen algorithms for researching that process were those of searching and organizing.

Genetic algorithms, GAs, (a subset of Evolutionary Computation), were the first AI implementations known in architectonic design processes fundamentally for the purpose of structure optimization i.e., ETH Zurich works on Beijing stadium's structure net optimization in 2005.

As Manovich stated in his 2001 "The language of the new media" [8], new media works created the illusion of reality, addressed the viewer, and represented space. Within Architecture this first approach towards digital new technologies and basic computation was merely focused on formal final expectations for the buildings not achievable or even buildable before the existence of CAD.

With the appearance of parametric software at the beginning of the 2010's, altogether with the availability of bigger databases and microprocessors non-expert friendly, architecture was considered to have entered a second phase approaching the digital new media which relevance Manovich had already predicted ten years before though a whole chapter dedicated to databases

6. First Digital Age is considered for the author the one starting from 1988 with MOMA's exhibition 'Structivist Architecture' till 2010's based and focused on computer allowed new formalisms

analysis. A sample test of that shift to the second approach was Carpo's 2013's "The digital turn in Architecture 1992-2012" where a first attempt of diagramming the shifting approach to digital realities was made.

This second digital approach is methodological one, and as such, a non-formal focus one, as well as focus on exploring the new idea of the built environment being the interface between human and nature.

As such, statistical playing with Deep Learning techniques via Computer Vision images mapping is no more than "the formality game of the second digital Era." A rather old focus on learning parameters on complex final formalities trying to map imaginary which parameters are already well known.

Relevant is too the direct relationship between the accessibility of the databases and the data sorting act as the relevant event to end the era of organizational trees for data and knowledge accessibility established by Carpo in "The second Digital turn" [9].

Architecture as an interface. Collective sentience context aware for an emergent Intelligence and experiential cognition

The built environment can be considered the interface between humans and nature.

The only main element that differentiates that interface architecture is from commonly studied interfaces in HCI⁷ is that the human, the user, is, in the case of

7. *HCI, Human Computer Interaction*, is a multidisciplinary field of study focusing on the interaction between humans and computers. HCI has expanded to cover almost all forms of relationships between technology and human beings.

Architectural Design, part of the interface, the built environment, as humans inhabit it.[6]

While ambient⁸ and affecting computing⁹ are not developed deeper and Natural Language Processing keeps being a merely statistical method sub-symbolic AI Paradigms will be the ones defining and guiding the two disciplines' crossings.

Rational System is yet the predominant system that our current design protocols' mimicking "can" focus on and, as so, Weak/Narrow AI, ANI, is on what we can nowadays aim.

Strong/General AI, AGI, meaning algorithmic processes so terribly complex that they are aware of themselves, is by now, just a theoretical form of AI used to describe a certain mindset of AI development. The algorithmic process having a self-aware consciousness is not (yet) a tangible reality. D. Juliano states in [11] that sentience is required for generalizing intelligence, basing it on the minimum sentience conjecture¹⁰. As so Strong AI depends upon sentience and is not possible without being realized over a cognitive architecture. [12]

As Juliano explains, Sentience is necessary, but not sufficient, for generalizing intelligence as it does not directly address the sapient aspects of a cognitive architecture: "Sentience and intelligence are related but orthogonal (and thus independent); an entity may be

8. *Ambient Intelligence, AmI*, is a pervasive computing environment that enables interaction with humans and responds appropriately to them in that environment. That capacity is enabled by unobtrusive embedded devices in the environment able to sense, perceive and respond and natural user interfaces (NUI). i.e widely known Google assistant Alexa.
9. *Affecting computing* deals with emotions recognition, interpretation, and simulation.
10. *Sentience* is the ability to feel. The main hypothesis presented here is that cognitive consciousness depends on sentience, but not vice-versa.

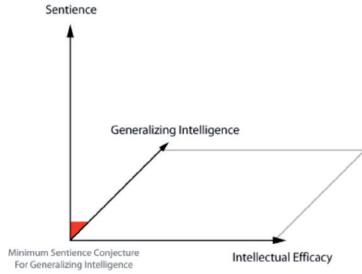


Figure 2. shows the orthogonal relationship between sentience and generalising intelligence process [11]

sentient but have low or almost no “intelligence” by various standards. The opposite is also true: some processes achieve effective results without being sentient.”

As so we can state that without sentience general moral or emotional intelligence is not possible. But then we can focus not on machine intelligence but on machine capacity to provoke the emergence of collective intelligence.

Distributed AI and Architecture: Multi-Agent systems, MAS, and Agent-based modelling

It is clear then that Emergent Intelligence, as the most common outsource for Embedded Intelligence algorithms like Self-Organizing Agent Systems, SOAS, can be the adequate and merely unique nowadays path towards a “distributed social Cognition”.

In fact, it is just now, from the early times of Space Syntax initial definition procedures, that some questions are arising about how to map initial perceptions on distributed intelligence systems like, the Hillier one, for aiming a collective intelligence within which communication procedures for the agents as well as their own language and channels of communication have not been eliminated.

It is believed by the author that new Experiential systems can emerge from experiences of collective intelligence reaching a collective cognition style regarding the perception of the built environment.

Typical agent-based models that are dynamic (as being time dependent processes) will be more adequate in some cases than those models designed for optimization purposes.

Mainly an Agent-based system has three elements:

- A set of agents, with attributes and behaviors.
- A set of agent relationships/interaction rules (as an underlying topology of connectedness defines how and with whom agents interact)
- The agents' environment. [13]

An agent is autonomous, self-contained, social (as it interacts with other agents) and also has a state that varies over time.

The Foundation for Intelligent Physical Agents, FIPA was founded in 1996 and since then efficient and scientifically validated models have been developed in mostly all known scientific disciplines. From sociology to commercial trading or to modelling the adaptive immune system [15].

Some of these applications are small but elegant models, which include only the essential details of a system, and are aimed at developing insights into a social process or behavior and that is precisely what proposals like Space Syntax are lacking.

It is precisely that topology of interactions the fundamental one missing in all human architectural design-based systems anulating not doing so any possibility of emergence of any collective intelligence and experiential system perception.

In fact, any agents' interaction directly with a physical environment and not through their topological space cannot be considered a proper MAS.

From the 70's models using Cellular Automata as patterns for interaction we have realized that knowledge

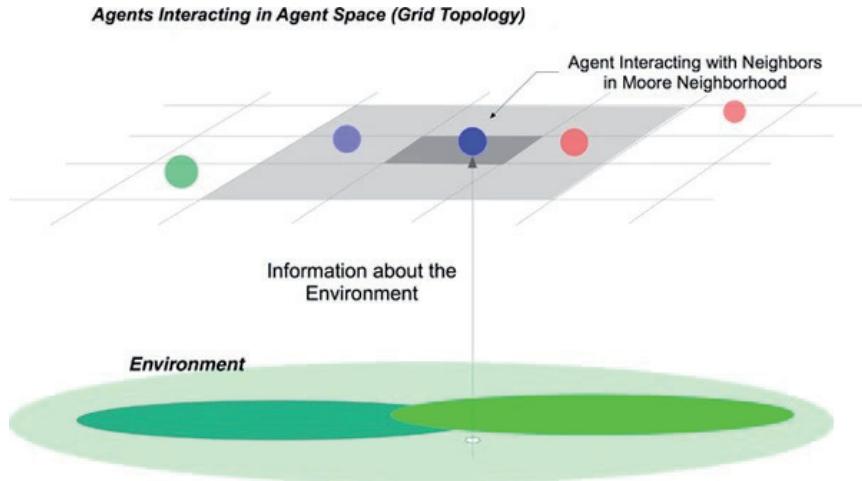


Figure 3. The structure of a typical agent-based model Sugarscape[14]

may arise from collaboration or several individuals whose expertise might be or is clearly limited.[16]

In the 1990's Epstein and Axtell [14] proposed the idea of growing entire artificial societies through agent-based simulation in the grid-based Sugarscape model. By then behaviors were highly suggestive of a (despite rudimentary) society.

Nowadays large-scale simulations in real time physical allocation with GIS can be developed over realistic social spaces like social networks that allow much more complex relationships and behaviors than those early grid-based models.

Topological maps of these interactions are of fundamental relevance, but architectural space is not usefully or easily conceptualized as an environment of forced choices. Also, many agent-based models include agents interacting in multiple topologies.

Obviously, the semantics of communication in the way in which people communicate via speech and gesture, are by far more complex than the ones of input devices on a merely software based system.[6]

Other relevant problem can be also pointed out: regarding humans' relationships are not static but dynamic, they keep constantly changing. Humans and societies continue to change their relation between them and the spaces they inhabit.

As Kirsh states in [6] referring to Caggiano et al [18] and Holmes and Spence work [19] there is an important cognitive difference when acting in peri extrapersonal space regarding perspective as buildings are for humans "spatio-temporal immersive experiences" that can result and evolve in very different dynamic sets of relationships.

Temporal Networks or how to map human changing relationships' dynamics

As stated so far, the development of a topological space, that will be able to cope with the variability of human relationships and the idea of the variable human-nature interface the built environment is, can be stated as a key milestone for the use and evolution of DAI systems within the field of Architectural Design.

In a graph¹¹ of a networked system, nodes might represent people, cells, neurons, virtual or physical sites, and their interactions are not bound to be static but are rather evolving, with nodes and links, which appear and disappear over time [17] as it happens for example in social networks.

11. A graph is a mathematical object that is formed by a set of vertices(nodes) and a set of edges that represent the nodes that are interacting with each other.

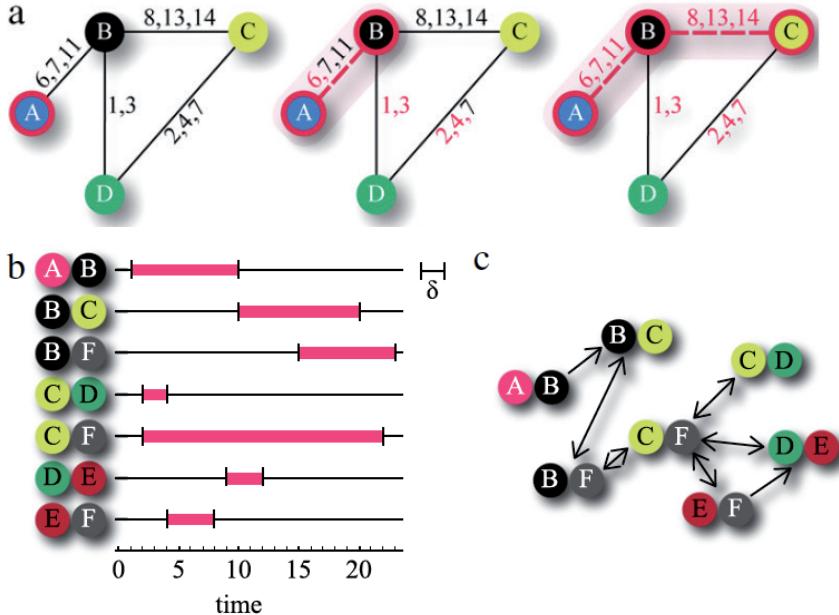


Figure 4. Shows a contact sequence as in [20].

(a), the times of the contacts between vertices A-D are indicated on the edges.

In (b) where a line corresponds to an edge in (a) and the active intervals indicated.

The derived transmission graph is illustrated in (c).

Holmes and Saramki introduced the new field of Temporal Networks in 2012 [20] for addressing the variability characteristic of complex structures. As so they proposed a type of network in which their edges are not continuously active.

These networks seem a priori to be a good path for understanding and trying to create dynamic topology of human changing relationships. Also characteristic of human relationships appear to be able to be tackled by these types of networks. That is the a priori appearance of independence between consecutive interactions that nevertheless form patterns in the end due to intrinsic correlations or fluctuations of human activity.

Making a big effort to propose a new way of representation the authors used as a starting point the inclusion of a variable representing the timing the contact is taking

place as in Figure 4b. A transmissions graph will be then implemented, Figure 4c, being its main advantage, over the pure line graph, that they encode the directionality arising from the order of non-concurrent relationships. As so, correlation between temporal and topological structure is assumed.

Temporal networks will be able to describe social processes then with great accuracy to try to understand how single interactions may lead to collective phenomena, as long trains of busy events, or the emergence of the complex social structure.[17]

Chapter I .2:

Genetic Algorithms and the Hyperdimensional Design Space

DIEGO NAVARRO

Genetic algorithms (GAs) represent an opportunity for the architect, a mechanism for introducing complexity and generation at different levels of architectural design. They enhance –but do not replace– the reasonings and intuitions of the designer.

Like the mechanism of evolution, GAs recombines a series of designs in successive generations, while applying a selection criterion. The result is a constantly adapting range of variations found in? the so-called “design space”.

Computation and biology

Chronologically speaking, genetic algorithms (GA) are relatively old. Although their origins can be traced back to the 1950s (Barricelli, 1957), it was not until a decade later that different branches appeared to address the problem with a certain level of maturity: Evolutionary Strategies, Evolutionary Programming and Genetic Algorithms (Holland, 1992; Back, Hammel and Schwefel, 1997a; Fogel, 1999). Later, in the 1990s, these branches were consolidated in the field of evolutionary computation (De Jong, 2006).

However, the democratization of parametric design through tools such as Grasshopper or Dynamo during

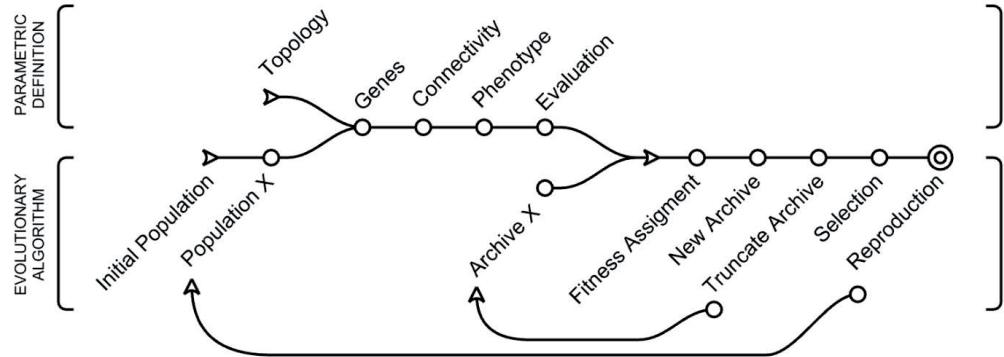


Figure 1. Workflow diagram explaining the combination between parametric modeling and evolutionary algorithm (EA).

the past decade have led to a resurgence of these biomimetic approaches. The possibility of undertaking evolutionary processes in parallel with CAD programs, which are the tools most used by architects, offers new workflows. And reciprocally, it would not be wrong to think that optimization in general has been a driving force in the adoption of parametric modelling.

In its integration, the digital model establishes the parameters to be recombined (genes), and most likely the formalization of the geometry and analysis of the objectives. The GA, for its part, manages this combination through selection and reproduction processes. Figure 1 shows a proposal based on this integration, including the biological vocabulary of Evo-Devo science to describe those elements external to the algorithm (Navarro-Mateu, Makki and Cocho-Bermejo, 2018).

Based on the biological analogy, GAs is grounded in a series of concepts such as the size of the population, the genes (properties) that define the individuals, the number of generations, the way in which these genes recombine, the “distance” of the relationship between individuals, the elite to be preserved, the mutation probability, the strength with which this mutation is expressed, etc.

In accordance with these concepts, the parameters of the algorithm are adjusted so that its behavior is the most appropriate for the task at hand (exploration or optimization). It is therefore crucial to understand its implications from a quasi-biological point of view.

For example, with respect to the individual-population dichotomy, Mayr defends the value of variations and their distribution in the population, denying the existence of the individual representing a collective (or the project that exemplifies a typology).

“An individual that will show in all of its characters the precise mean value for the population as a whole does not exist” (Mayr, 1997) p.29.

It is a question of understanding the intrinsic value of the robustness of the population. Even though we may sometimes be interested in a single specimen, its potential will always be influenced by the rest of the population over successive generations. The greater the variety and opposite extremes, the more likely that new combinations will appear. This would include the recommendation to leave room for the appearance of designs that would be considered absurd or useless, since their value would lie in their potential to recombine with other individuals (the so-called helpful monsters). Conversely, a highly homogeneous population optimized for a single task will have trouble adapting to a changing environment (Lacy, 1997).

In computational terms, GAs is considered meta-heuristic processes (from the Greek εύπιστειν: to find, to invent), known for their usefulness in solving generic problems where they provide a good enough solution to an optimization problem, especially with imperfect or incomplete information. In other words, capable of approximating problems that are not fully understood.

This last characteristic is especially relevant for architecture, whose field cannot be reduced to a universal mathematical formula; architectural design is not a deterministic exercise. While GAs are known for their tendency to be slow (even inconclusive), the robustness and plasticity to address complex has encouraged their use over the years in multiple fields (Branke et al., 2008; Rothlauf, 2011).

“The most significant advantage of using evolutionary search lies in the gain of flexibility and adaptability to the task at hand,” (Back, Hammel and Schwefel, 1997b).

However, there are two aspects that make them particularly valuable from the perspective of design and architecture:

- Compatibility with conflicting (multi-objective) adaptations.
- Generation and navigation of a hyper-dimensional design space.

Multi-objective algorithms and the Pareto front

MOGAs (multi-objective genetic algorithms) are based on the premise that the evolution of the design can serve more than one objective at the same time, and that these objectives may conflict with each other.

If we take the Grasshopper ecosystem as a reference, we find several examples of these add-ons: Galapagos (included by default), Octopus, Wallacei, Optimus, Biomorpher, Opossum and Design Space Exploration. Each of them has strengths that make them unique, but most of them have the quality of being multi-objective. Of course, within the MOGAs, numerous algorithms

have their own name and characteristics, NSGA-2 or SPEA-2 being some of the most widely used (Zitzler, Laumanns and Thiele, 2001; Luke, 2013).

In contrast to other disciplines that tend to seek unique and optimal results (finding the perfect solution to a problem), architects are inclined to maneuver in a relentless search for balance where all the design inputs are perfectly weighted, being aware of the existence of more alternatives that could be equally suitable as an answer to the premise.

This conflict is often explained by the impossibility of choosing the perfect car: horsepower, price, speed, comfort, or flexibility are aspects that can never coexist as maximums. The urban equivalent would include values such as density, health, sunlight, accessibility, public space, etc.

The number of aspects that define architecture and the enormous complexity of their relationships turn MOGAs into the perfect tool for architecture development (Cichocka, Browne and Rodriguez, 2017).

That said, how are the best individuals selected in the face of such a wide range of contradictory options? The Pareto front (Zitzler, Laumanns and Thiele, 2001; Legriel et al., 2010) enables calculating the superiority of individuals over others, describing a geometry that selects those that stand out in a certain aspect.

It should be taken into account that an individual who excels at one aspect may be bad at another, while there are individuals who perform relatively well in all aspects (Deb et al., 2002). Again, extremes are useful to feed back into future combinations.

This is where the hyperdimensional problems arise. If a Pareto front resulting from two objectives is represented

as a curve, when it results from three objectives, it becomes a surface. If there are more targets, and in architecture there always are, other graphic elements such as color or scale are being introduced.

It soon becomes clear that one cannot rely on the graphical representation of these fronts, and that it is necessary to rely on the various numerical analyses offered by the programmes. In other words, we enter a process of “evaluating the evaluation,” either by means of a simple calculation, such as fitness average or relative difference, or by using artificial intelligence, such as k-means clustering.

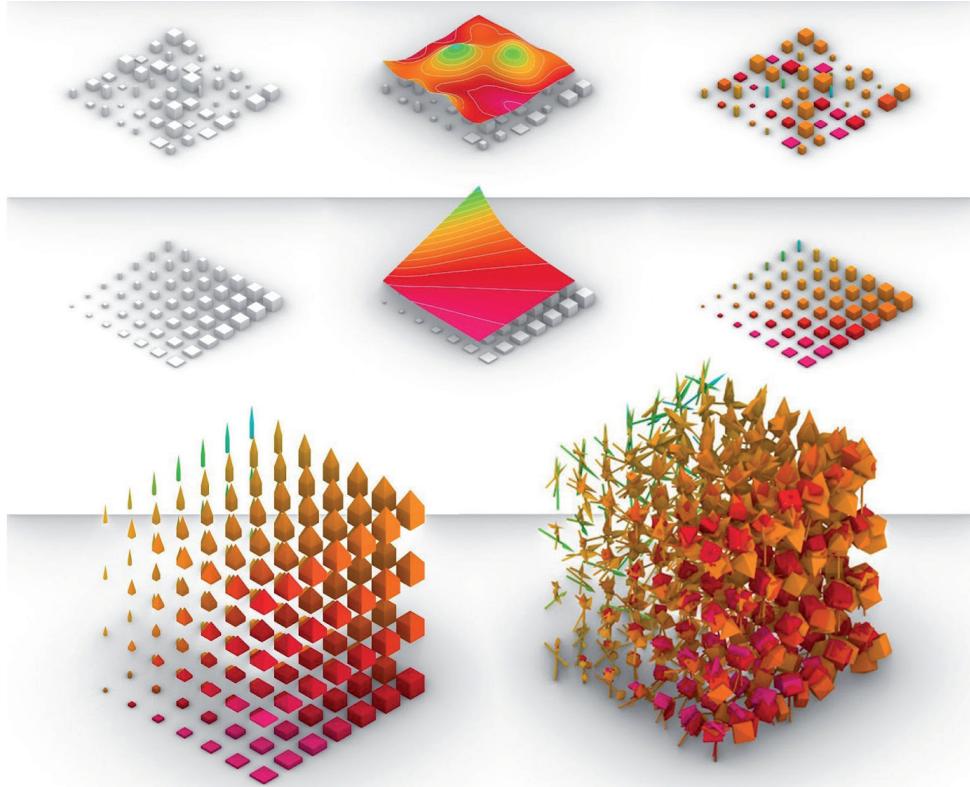
On the other hand, the architect will also have to deal with hyper-dimensions in the generative process, thus connecting this narrative with the design space.

Considerations regarding the multi-dimensional design space

The design space -which is not exclusive to this algorithm- should be understood as the accumulation of possible options. Or, following the biological analogy, as all those species that existed, and will exist. Accordingly, impossible, or non-existent combinations, considered as negative space, are excluded.

The design space contains an extra dimension for each changing quality of the design, which are usually much larger than the number of objectives. For example, in the figure below (Fig.2), the slenderness of a prism, defined by the size of its square base (X^2) and height Y , is evaluated.

In the first row, randomly distributed, the so-called “fitness landscape” is shown. It measures how slender each of the elements is and is applied by means of



colour in the last column. In the second row, we observe the same fitness landscape, adding a gradual distribution of the X and Y.

The third row includes a third value (a roof) in the image on the left, adding a new dimension and creating a three-dimensional design space. The image on the right adds a support in the form of a column, pushing the design space into the fourth dimension, which is already difficult to represent.

It is still interesting to try and understand this hazy, multi-dimensional space where all the possible combinations

Figure 2. Graphical representation of the design space and its adaptation—based on the slenderness of a geometric object the complexity of which increases

and variations of the project coexist. This is the unnavi-gable space that only the GA can try to solve, guided by the gravity of the “fitness landscape” It is not devoid of its own difficulties.

Architects are no strangers to this kind of investigation, constantly testing the possible variables of the original idea, rejecting, and improving. However, constrained by time, what certainty is there in the selection of the final version? Imagining this fascinating design space is possibly a task doomed to failure. Limited in its visualiza-tion, we will be at the mercy of the multi-dimensional and its exponential growth.

As with any algorithm that makes use of the benefits of parametric, the size of this design space will depend primarily on two aspects:

1. The flexibility of the design (how different its formalizations can be).
2. The detail of its formalization (how dense the range of precision between each possibility is).

This means that ultimately the creation of these spaces and the definition of the objectives are highly affected by the decisions made by the architect who, when posing the problem - thus inserting his/her preconceived pre-mises - can drastically modify the development of the al-gorithm.

Therefore, despite the apparent automation of the pro-cess, the correct execution of these algorithms requires a thorough analysis to understand what is happening. If the development of the process cannot be evaluated, the validity of the result cannot be certified.

Thus, the architect plays with two aspects: the configu-ration of the algorithm and the parametric design itself.

Based on the foregoing, it would be normal to seek a balance for the algorithm strategy to be both explorative and optimizing at the same time.

However, it may occur that the user's objective is extremely explorative, uncertain of the generative possibilities; or optimizing, proposing a very limited design space, and only interested in finding the best combination. In any event, these processes can be introduced from the volumetric inception up to the exploded view of a façade. Simple, universal definitions tend to produce varied and unexpected results, while those that describe things in a specific and detailed manner will be oriented towards optimization, -and will hardly be able to go beyond what is established.

Likewise, narrowing the limits or increasing the gradients will have an exponential impact on the design space and on the performance of the algorithm.

Wicked problems

The use of any algorithm implies the necessary condition of "digitizing" architecture. In the case of GAs, everyone is evaluated and is assigned one or more values according to its adaptability to the objectives set. Adaptability is reduced to a list of numbers ordered from highest to lowest.

Reducing architectural quality to a single value is certainly a provocative idea. However, the detractor will discover that in attempting to describe and deconstruct architecture in parametric geometry and numerical analysis, one also learns about the projective exercise. Interpreting the successive errors of the GA in an attempt to develop what a priori seemed logical can shed as much or more light than the optimization process

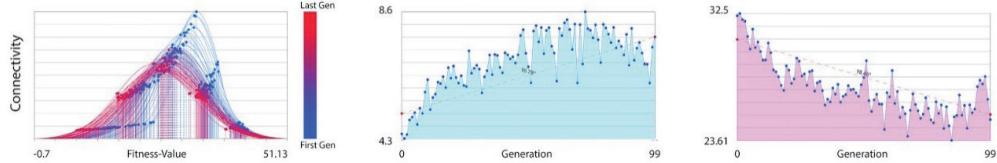
itself, and spark a healthy interest in the shape grammar a posteriori (Radford and Gero, 1987).

However, we should not forget the danger of excessive synthesis or abstraction. Historically, we have seen how statistics and equations can distort reality, justified by a false scientific rigor (Rittel and Webber, 1973). Any abstraction of higher concepts will lead to a biased view, and therefore requires strict verification.

In this regard, it is possible that the emergence of Big Data will promote a more accurate simulation and the appearance of regression formulas. Extrapolating geometric and mathematical relationships from real data, associated with physical and social behavior could legitimize a parametric architecture and urban planning, closer to the ideas of the city as a complex system suggested by Jacobs or Simon Herbert (Jacobs, 1961; Simon, 1997)

More and more advances are also being made in favor of improving the criteria and evaluation systems of GAs. Beyond the quantification of adaptability, especially supported by disciplines such as architecture, the aim is to analyze the composition of the candidates (genotypes) and their geometric formalization (phenotypes). The objective is to find methods that encourage the generative and explorative aspect of the algorithm, increasing diversity in the later stages of optimisation, or to introduce hybrid methods that allow manual selection or unquantified evaluation (Jaszkiewicz and Branke, 2008; Yousif, Yan and Culp, 2017)

About shortcomings, GAs have unfortunately not incorporated the latest advances in the field of biology, such as the introduction of Evo-Devo science, or epigenetics. These advances present a series of tools and similarities with digital modelling, and have much to contribute in the compositional and formal aspect: spatial order,



subdivision, Boolean logic, etc. (Leroi, 2003; Carroll, 2005).

As far as the selection process of any GA is concerned, while straightforward, it is still relatively opaque. The lack of connection between the architect's intention and the GA's criteria makes a meticulous analysis that ensures (or at least indicates) a correct selection process over successive generations necessary.

Standard deviation, trend lines, or histograms are some of the basic tools that will help us to corroborate that the algorithm makes logical progress throughout the recursions, or that can explain if the relationship between the objectives is redundant, and therefore unnecessary (Fig. 3). They are like a mathematical catalogue that facilitates the architect's decision-making.

However, apart from using generation and optimization, MOGAs allow the architect to work with multiple lines simultaneously when faced with the uncertainty of the design and its analysis. Enabling decision-making to be postponed till the end of the process, especially the more subjective decisions, which could unintentionally influence the project with preconceived ideas, thus limiting the design space.

Figure 3. Screenshot of graphs generated by the Wallacei add-on after running the GA.

Chapter I.3:

Using Space Syntax Analysis in Detecting Pathologies in Historical Open Spaces

JULIA BELTRÁN

In the metamorphosis of the shape of the city, some spatial problems or urban pathologies arise. These can be detected and explained analyzing the transparencies between modern design innovation and history of the place. When we identify a spatial problem, simultaneously, we can observe that the mechanisms of social cognition of users, designers and architects disappear with the pathology.

A paradigmatic case study to observe these big socio-physical transformations are open spaces on the outskirts, where new infrastructure affected the public space of old fortifications, or where public space has turned into private housing lots. Instead, when there is a confluence between the design and the history of the place, an original, unique, and universal work of art may appear (Bakhtin, 1997; Bagnato, 2017; Muntañola, 2021).

The paper will follow the space syntax method, developed by Bill Hillier and his colleagues at the University College London, in the analysis of two composite cities with old fortification walls: Morella and Montblanc, in Spain. Space syntax will prove useful to uncover places where there is a lack of transparencies between design and history. To uncover when and why the socio-physical space problems arise, the method has to be complemented by historical documents and social surveys.

Introduction

The expression “the architecture of the city” can be used to explain the characteristic or appropriate appearance of buildings and open spaces in cities, but also to uncover the deep structure of the city itself as a material object. This paper is about the second meaning.

Aldo Rossi's *Architettura della città* (1966) is one of the most influential architectural works, not just in Italy during the second half of the 20th century, but also internationally. With this book, Rossi started for the first time a theory of understanding the urban object as an autonomous reality. In the words of Bill Hillier: “Aldo Rossi was, I believe, the first author in modern time to advance a theory arguing that the material form of the city is intrinsic to its sociological, cultural and psychological reality” (Hillier, 1989, p. 5).

Through his book *The Social Logic of Space* (Hillier and Hanson, 1984), Hillier develops a theory about the deep structure of the built form of the city, as an autonomous reality, but also as an essential component of a dynamic process. In this book, he takes a position that starts from Rossi's theory and goes further. He tries to prove, empirically and theoretically, the autonomy of the urban artifact. Then he argues that if we understand this autonomy, we can understand why the material form of the city is an intrinsic aspect of their social existence. Hillier begins by studying the “laws of the generation of the urban object itself” but points out that it is not enough for an understanding of the city, but also to know the social “laws from society to urban form”, and the “laws from urban form to society”.

In this way, we accept the argument that architecture is made up of three disciplines, not one: *firmitas* (configuration), *venustas* (prefiguration) and *commoditas* (refiguration). These three axes also represent the hermeneutic

philosophy of Paul Ricoeur, the three hermeneutic dimensions of the human knowledge: the configurative power embedded in the buildings and cities; the prefigurative level or the poetic power of our imagination, of the design in our case; and, finally, the prefigurative power of the use of buildings and cities already built, able to transform permanently the meaning and the social use of architecture and planning. (Muntañola et. All, 2021, p.34).

Architectural and planning ideas by Bill Hillier, Spiro Kostof, Mikhail Bakhtin, Paul Ricoeur, Josep Muntañola, and others, support this theoretical and practical viewpoint, in the sense that, in between the design poetic prefigurative act, the morphological configurative studies of cities and the anthropological refigurative surveys of the users, specific emergent powers develop in the making of the cities, in a socio-physical and space-time structural manner (Muntañola et. All, 2021, p.51).

Laws of the configuration of the urban form

The works developed by Aldo Rossi and Bill Hillier, with wide global repercussions to nowadays, are born from the same point, from the architecture as a contextualized social culture and not universal, from a formal or functional point of view. There is a continuity between Hillier and Rossi, in the way of connecting the morphological structure of the city as an autonomous reality, within a dynamic process.

Following these ideas, Hillier affirms that architecture is theory applied to building. He argues that, although we know the difference between architecture and building, there is no hard and fast line to be drawn. Either can become the other at any moment. Taking a broader view which encompasses both, he says that in the

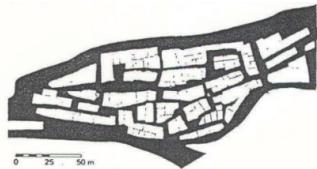


Fig. 1. The open space structure of Gassin in the south of France shown in black with buildings shown in white (Hillier, 1989, p. 9).

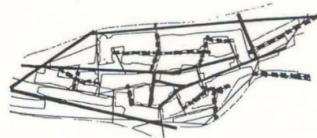


Fig. 2. Axial map of Gassin with the integration core shown in heavy black, and the most segregated lines shown dotted. (Hillier, 1989, p. 11).

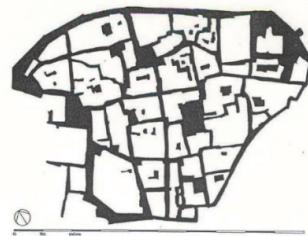


Fig. 3. The open space structure of Apt in the south of France shown in black and the buildings shown in white. (Hillier, 1989, p. 9).

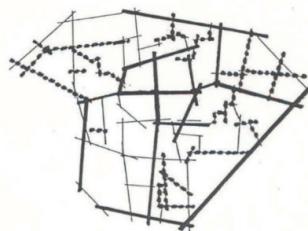


Fig. 4. Axial map of Apt with the integration core shown in heavy black and the most segregated lines shown dotted. (Hillier, 1989, p. 11).

evolution of building we note two ways in which things are done: in obedience to a tradition, or in pursuit of innovation. According to Hillier, building contains architecture to the degree that there is non-discursive invention, and architecture becomes building to the degree that there is not. Vernacular innovation is therefore included within architecture, but the reduplication of vernacular forms is not: "Architecture is therefore not simply what is done but how it is done" (Hillier, 1996, p. 36).

As I see it, the configurative structure of the city has always represented a balance between introducing changes and the preservation of tradition and local culture. As Magnaghi argues in his book "*Il progetto locale: verso la coscienza di luogo*", in the future, this balance must be guaranteed, given that when only innovation is promoted, the city is in danger of useless destruction, but when only tradition and preservation are promoted, the city could become a museum. Last, a dead city cannot even function as a good museum. (Magnaghi, 2010).

Space Syntax, as a theory as well as a method, is currently an important tool for connecting the material form of the city and its social reality. On the one hand, Space Syntax is a set of techniques for analyzing architectural and urban space and foreseeing functional outcomes. On the other hand, it is a theoretical model of human space that tries to explain how it is structured, how it works, how it is understood and how it is part of society. The underlying belief of Hillier is that you can't have the first without the second: foreseeing functional outcomes at the design stage depends on having a theory that connects the two: a form-function theory (Hillier, 2014, p 2).

Hillier investigated the laws of the configuration of the urban form in several small historical towns in order to give explanations about its deep structure: as Gassin (Fig. 1) and Apt (Fig. 3) in the south of France (Hillier, 1989).

Using the program DepthmapX, which is the main tool of Space Syntax, he visualized that both cores have taken the form he calls a “deformed wheel”: a semi-grid of lines in the interior of the settlement is linked by lines in several directions to peripheral lines, the “edges”. The segregated lines are then clustered in the interstices formed by this wheel structure. Underlying the differences in size, location, and topography, the two settlements share the same “deep structure” or genotype.

DepthmapX is very useful in establishing a hypothetical connection between the physical characteristics (form and geometry) of a space and the social characteristics (interactions and occupations) that can be established. This is possible thanks to the mathematical integration of the geometry of space, which allows us to abstract which specific points or areas have greater (or lower) visual accessibility, intelligibility, spatial connectivity and, ultimately, greater social interaction.

Obviously, this is a tool that can complement a set of other methodologies to assess the socio-physical quality of the space. Therefore, cannot be considered, in any case, as the only evidence since which presents some difficulties. Specifically, it does not allow any non-visual information to be incorporated into the study. Other conflictive reasons are the focus on a single element of urban form, the absence of three-dimensionally: topography and building volume, the influence of limits on the results of analysis, the predominance of form and space over function, and the process of construction of the map.

Despite its limitations, theories such as that developed by Bill Hillier, the so-called configurational theory of architecture, continue to demonstrate the existence of a relationship or link between the geometric characteristics of the form and its ability to allow or avoid different social behaviors.

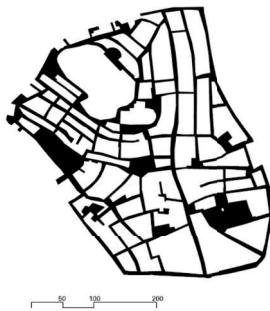


Fig. 5. The open space structure of Montblanc in the Catalonia is shown in black, with buildings shown in white.



Fig. 6. Axial map of Montblanc with the integration core shown in red, and the most segregated lines shown in blue.

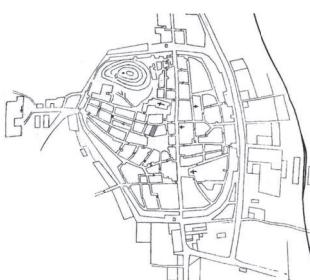


Fig. 7. Map of Montblanc from 1908. Author: Ejército Español. Archivo "Servicio geográfico del Ejército", sección de documentación, acuartelamiento "Alfonso X", Madrid.

Studying urban form configuration from historical maps and current cartography in Montblanc

Montblanc is a mediaeval city in Catalonia that still preserves the city walls and gates. Comparing maps from three different periods of time, we have scrutinized the laws of the urban form configuration. This research will be useful to discover features of the nature of the urban object and the structure of the city itself. The space syntax analysis is based on three maps of Montblanc from different periods (2022, 1910 and 1802) and is focused on the space inside the city walls. Analyzing the current integration of the historical core of Montblanc (Fig.6) we can see that the core has taken the form of a semi-grid of lines in the settlement's interior (shown in red the most important lines) linked by lines in several directions to the edges (shown in blue).

Comparing the axial maps (Fig. 6-8-10) we realize that the hierarchy of the main vertical and horizontal axes has changed in the evolution processes of the urban settlement. The first axial map (Fig.6) shows that the horizontal axis had currently more traffic and social activity. Looking at the second axial map (Fig.8) we can deduce that this second axis has increased his priority when some private housing lots have been removed to create a new public space on the west side of the old city. Probably, the vertical axis had a greater importance in history as we can see in the third axial map of Montblanc (Fig. 10).

At the end of the main axes there are the main city gates of the historical city of Montblanc, and hierarchy of these gates is still a current topic of discussion. Ceremonies at city gates, especially for arriving important visitors, have a long history and memories of these arrival rituals still survive. In the lower part of the maps (south side of the city) there is a city gate in the old

fortification wall called: "Portal de Sant Francesc", now in reconstruction. Previous design transformations at this place disregarded and demolished parts of the historical gate. Furthermore, in the dynamic process of metamorphosis of the urban form, public space next to the old fortification walls had turned into private housing lots, transforming open space into private buildings. Space Syntax analysis demonstrates that this kind of transformations change not only the physical urban form, what is more important, the structure of the city itself as a material object. In consequence, it is also modified the transparency between the present of the place and the history of the Catalan Kingdom in the XIV and XV centuries A.C.

The criteria for conservation of architectural heritage can become controversial if architects, archaeologists, historians, and other technicians do not consider the context in an interdisciplinary way. In 2020 there was a controversial discussion about the reconstruction of the "Portal de Sant Francesc", that was reflected in different newspapers (La Vanguardia, 26th August 2020; Info-camp, 07th September 2020). On the one hand, Montblanc City Council technicians was defending the architectural design of reconstruction of the gate with an entrance and two side towers, supporting the idea in archaeological evidence. On the other hand, other architects were questioning the existence of the two towers, arguing that there was not enough evidence, and for this reason they did not give support to the reconstruction of the lost heritage.

In the conference "Debat portal de Sant Francesc de Montblanc" developed at the *Real Academia de Belles Arts de Sant Jordi* on December 16th, 2020, Magda Saura said that the idea of recovering the lost heritage is interesting, but it is not enough if it is supported only by archaeological evidence. Other types of knowledge are needed to assess the impact of the new design, and



Fig. 8. Axial map of Montblanc with the integration core shown in red, and the most segregated lines shown in blue.



Fig. 9. Map of Montblanc from 1810. Author: Joseph Maria Tomàs. Published on Francesc Carreras i Candi, *Geografia general de Catalunya*, Volum 11, pp. 512-535.

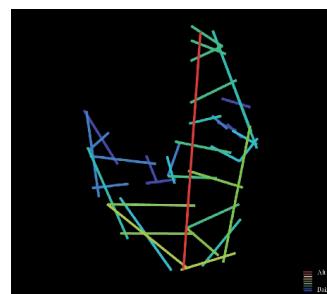


Fig. 10. Axial map of Montblanc with the integration core shown in red, and the most segregated lines shown in blue.



Fig. 11. Convex map of Montblanc with the best integration shown in red, and the most segregated areas shown in blue.



Fig. 12. Convex map of Montblanc with the best visibility shown in red. We can observe the "Portal de Sant Fransesc" in red color.

architectural and urban studies should be taken in account. She also argued that the criteria for architectural intervention must be justified because they may damage or falsify the cultural heritage (Saura, M., 2021, p.222).

To "read" the shape of the city and the cultural heritage, we must relate the physical form of objects to the knowledge of the precise cultural conditions in which it was generated. A Royal gate can be considered an historical architectural typology formed by the ensemble of three spaces: tower + gate + tower. As Kostof explains, the old fortification walls were not only a matter of defence, but rather of royal loyalty: only privileged royal municipalities were defended by walls (Kostof, 1992). Examples of royal city gates are Sant Miquel de Morella, and the royal portals of Poblet, Mallorca, València, and Napoli.

Our contribution based on the space syntax analysis is a demonstration that architectural evidence about the morphological structure of the city can prove the main character of this old fortification gate, demonstrating the structural importance of integration of the street that crosses by. Other DepthmapX maps (visibility graph analysis) which analyze integration (Fig. 11) and visibility (Fig. 12) and proves the same fact.

The nature of city walls and city gates in Morella

Contrary to what could be interpreted from the current imaginary, in the past, a city gate was not a barrier or a border, it was a connection in between the land and the city. As Spiro Kostof argues, the gates were of critical importance in a walled city because funneled highway traffic into the city. The gates in walls served to regulate commerce coming into cities, often being the place in

which taxes were collected. Though they shut closed, they also served as sites for unregulated development in the city; informal markets selling black-market or un-taxed goods sprung up nestled against them. As Alberti demands the walls had “a very handsome open space both within and without the walls, and dedicated to the public liberty, which should not be cumbered up by any person whatsoever... under very great penalties” (Kostof et al., 1992, p. 37).

According to Sennett, walls, in physical terms, are structures that inhibit passage. Referring to the massive medieval walls, he states these walls functioned much like cell membranes, both porous and resistant. The existence, location, and position of a city gate in the historical wall determine the spatial organization of certain places. In contrast, in modern urban planning, a less solid “wall” such as an urban highway represents an inert and closed boundary. (Sennett, 2014, p. 35).

Morella is another mediaeval city in the *Comunitat Valenciana* which still preserves the city walls and gates, but the public space near the city walls has inevitably been transformed from being a boundary to a border or barrier. If we go along the street Pujada dels Llavadors, which runs along the wall on the inside part, we can see that the facades in front of the wall have no urban activity on the ground floor. There is a pedestrian path separated from the road by a metal bullet, which is an impediment to the free movement of people. This pedestrian exclusion and car priority is reproduced in all the perimeter of the walls, which currently form the border because they do not generate a quality public space.

Analyzing with depthmapX the current integration of the historical core of Morella (Fig.14) we can see that the core has taken the form of a semi-grid of lines in the interior of the settlement (shown in red the most



Fig. 13. The open space structure of Morella shown in black with buildings shown in white.



Fig. 14. Axial map of Morella with the integration core shown in red, and the most segregated lines shown in blue.

important lines) linked by lines in several directions to the edges (shown in blue).

The space syntax analysis is based on three maps of Morella from different periods (2022, 1920 and 1840) and is focused on the space inside the city walls. If we focus on the current open space structure of Morella, in figure 14, an important red line goes from Town Hall in the city's core to the perimeter area. In this place at the border, there is no public life. Through a simple visual inspection, we realize that at this place there are no activities for people in the open space, there are not opportunities to stay, to observe, or to enjoy. It is a priority car street. On one side of the street there is the fortification wall and on the other side, the ground floor of a housing building, whose construction was completed in 2004. From the depthmapX graphics, we can conclude that there was a pathology -or a spatial problem- there, because there is a contradiction between the physical and the social results of the analysis. The red line shows the best visual integration, therefore, a good visual control from far away to this point.

We can see in historical documents, military maps, and engravings, that in this place there was a city gate that has disappeared and an important road outside. This was the nearest gate to the town hall, where there was also the prison and the judicial power of the city. Besides the historical images and plans, visual exploration is essential for locating the gate. If we look at the old fortification wall next to the tower, we can find some stones of the destroyed arch of the city gate, and outside there is a water source. This arch is currently five meters below street, so it is easy to deduce that the street has been raised to improve the car's circulation. In the municipal archive of Morella, we have found the memory of the urban Project of 1934 of the creation of a highway for cars that was designed, not for people who live in Morella, but for people who carry on his way

by car that and do not want to stop in the city. The creation of this road for cars supposed to break the old fortification wall at one point and to raise the level of the street, hiding the old gate of the "Portal Alòs".

Comparing the axial maps (Fig. 14-16-18) we observe a different hierarchy of vertical and horizontal axis in the city's core. Historical plans are a representation of the city, not the city. They are simplified, understandable images and were made in a specific cultural period. For this reason, the structure shown in red has variations. In the first axial map (Fig.14) an important red line goes from Town Hall in the core of the city to the perimeter area, where there was the destroyed city gate "portal Alòs". In the second axial map (Fig. 16) the main axis goes from the church to a city gate called "portal de Sant Mateu". This axis is perceived as the most important in the current structure because the city gate has been well preserved. In the last axial map (Fig.18) the deep structure is the same but, maybe because some plots are inverted, we can't identify any city wall.

When applying Space Syntax analysis on a hypothesis of historical growing of the city, we see that each new street that appears changes the complete structure of the city. The disappearance of a historic road that arrived from countryside affects the entire street's structure. The interesting thing about Space Syntax is that it is a specific tool that measures changes, not intuitively, but in a more scientific way, from a systems theory.

Conclusions

Space Syntax method proves to be a relevant tool to uncover spatial problems or urban pathologies generated in the metamorphosis of the shape of the city and to understand the deep structure of the urban form. A prerequisite shown in this paper claims the need for an



Fig. 15. Map of Morella from 1920. Author: unknown (Biblioteca de Catalunya).

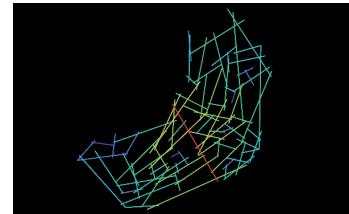


Fig. 16. Axial map of Morella with the integration core shown in red, and the most segregated lines shown in blue.



Fig. 17. Map of Morella from 1840. Author: Salvador Gaspar, 1980.



Fig. 18. Axial map of Morella with the integration core shown in red, and the most segregated lines shown in blue.

accurate choice of historic maps and ethnographic reports, data previously gathered at a qualitative, interdisciplinary level.

The complementarity between space syntax methodology, the morphological and historical analyses and the phenomenological spatial studies is the key to the understanding of how human cities work and are shaped. The mutual reinforcement among these three different approaches could uncover better the complexity of human physical places. There are lots of examples about the complementarity between space syntax analysis and the morphological school studies. Therefore, the biggest challenge for the space syntax research is doing new links with the social phenomenology. Future studies are needed to predict the impact of new infrastructure and architectural design on cultural heritage and upon social life.

On the one hand, from Morella we can learn that a reconstruction of the past is not necessarily the best solution to a spatial problem, and sometimes it is not possible because the environment has changed a lot and is highly consolidated. Nevertheless, the future urban design in the place could consider the history and improve the relationships with the cultural heritage and improve the social life. On the other hand, through the example of the twin towers in Montblanc, we realize that when an architectural design proposes a reconstruction of an old structure, the criteria for architectural intervention must be justified because they may damage or falsify the cultural heritage. In both cases, it must be guaranteed a balance between introducing changes and innovation and the preservation of tradition and historical image of the city, including all history and periods until nowadays.

As Hannah Arendt says the processes of action are not only unpredictable, but they are also irreversible; there is no author or maker who can undo, destroy, what he

has done if he doesn't like it or when the consequences prove to be disastrous (Arendt, 1995, p. 106). Specially working in places where historical and symbolical buildings are very relevant, the architect need more tools -as space syntax- to predict future socio-physical pathologies in the urban form and to avoid useless destructions of heritage.

These examples are useful to think in the hermeneutic relationship between what could be and was not and what happens; or between what is left of what was and is not considered. Finally, to reinforce the final purpose of this research we can remember the words of Ricoeur about memory: "Et il me semble que c'est la gloire de l'architecture de rendre présent non pas ce qui n'est plus mais ce qui a été à travers ce qui n'est plus" (Ricoeur, 2003; p.10).

Chapter I.4:

Xenomateriality: Designing with Hekate

MARIA VOGIATZAKI AND CONSTANTIN SPYRIDONIDIS

How have recent appreciations of materiality impacted architectural contemplation, practice, and pedagogy? What architecture and what pedagogy can best reflect the questioning of the ontological dualisms, such as human/nonhuman, life/matter, body/mind, natural/artificial, and life/matter, established in anthropocentrism? The vitality of matter calls for redesigning architecture and the human that will design and inhabit it. Xenomateriality, the term proposed, implies a materiality to be invented, extracted, constructed, machine-mediated and recomposed through existing by-products of the human and nonhuman activity towards a new strategy, a new emerging ecology for Gaia; an innovative geo-political perspective, looking towards not the future of the existing, but the prospect of its becoming. Two case studies demonstrate the potential for an updated and innovative pedagogy of design in its broader environment.

A new Architectural Interregnum

It is an ontological constitutive of architecture to define itself as an ongoing act of contesting the familiar and the established. Either by justifying itself as serving the human or by acting as the harbinger of novel ideas, the aspiration of architecture has been to construct the new, the other, the unfamiliar, the 'xenon'. For this, architecture needs to debunk the existing. Opening new

horizons in thinking and practicing is thought to be attainable ultimately through the differentiation between what is coming and what already exists. Architecture as a critical agent in its pursuit for the new, is in a constant *metaxu* - in-between state- that sees off the death of the old, whilst ushering the arrival of the new. In this manner, it constructs its own interregnum¹ in which novelty is its perpetual aspiration, shaped and confirmed through narratives that initiate new hierarchies of values and principles, new priorities and visions, new utopias or heterotopias, new addresses for the 'xenon' to become commonplace. The history of Architecture is, ultimately, nothing more than an alternation of interregnum in each one of which it experiments on newness.

Gramsci assimilates the interregnum with crisis and discerns between its (political) outcomes the appearance of morbid symptoms². In the case of Architecture, a (value) crisis, reflecting a social and political crisis, fuels novelty either conceived as a progressive incremental recurrence or as a revolutionary formal technical and conceptional recombination, in the sense of a return to basics or, even more radically in recent times, as an *ex nihilo* creation³. An Architectural interregnum is a laboratory of experimentations that throws back, or rather re-jects⁴ the established worldviews and throws ahead,

1. 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.
2. 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."
3. Michael North, (2013) in his "history of the new" traces the diachronic contemplations on Novelty to conclude that novelty seems to arise from either recurrence or recombination, both of which form the ground on which nowadays, the idea of originality is grasped.
4. *Jeter* in French or *Jetere* in Italian means to throw. Jeter is used for the word pro-ject to signify a look (throw) into the future, something that is thrown ahead. Similarly, re-ject uses the prefix-proposition 're' to mean what is thrown behind or rejected, and

or rather projects conceptualizations of novelty as an object (throw towards) reflecting a different appreciation of a subject (throw under) addressed to appropriate it. In other words, the claim for the new as a constitutional self-consciousness of Architecture is formulated based on a critical reconsideration of an established world-view, which introduces a new abstraction on the perceived and conceived reality towards an operational anticipation of a desired future. A project as a manifestation of a social, spatial, and temporal potentiality, is based upon a new abstraction on the 'perceived' and imprints, with no exception, a statement about the human and about the project's outcome, the artificial, the human-made, the nonhuman.

In recent times, a new interregnum is poised between inward-looking old powers and recalcitrant, emergent ones. The *Zeitgeist* suggests that "everything that had been taken for granted in the modernist grand narrative of progress, is fully reversible and it is impossible to trust in the clear-sightedness of anyone"⁵. The human, the natural and the artificial, as the key constituents of a worldview, have been radically revised. This revising is founded on questioning all the ontological dualisms, polarities and dialectics established throughout anthropocentrism: Human/nonhuman, human/nature, life/matter, body/mind, natural/artificial, will/determination, organic/inorganic. Architecture and design education, relying upon these dialectics, constructed their contemplations and practices up until the early nineties, when a shift was motivated by the assumption that the world was not a whole created by utterly heterogeneous parts but "at the best a fragile, revisable, and diverse composite

subject uses the prefix-proposition 'sub' to mean what is under or below.

5. Bruno Latour, "An Attempt at a "Compositionist Manifesto", *New Literary History*, (Baltimore: The Johns Hopkins University Press, vol. 41, no. 32010), 41: 471-490.

material"⁶. In this 'materiality', there is no distinction between human and nonhuman, nature and culture, given and constructed. Recent technological developments and scientific advances in computation, molecular biology, quantum physics and robotics blur the lines of demarcation. A "mono-logical account of emergent, generative material being,"⁷ framed by a monistic and geocentric worldview founded on the self-organizing, auto-poietic force of the living matter constitutes a new challenging worldview, as new as this may be, given that it originates from Spinozaean philosophy⁸. This appreciation forms the basis for the emergence of a promising newness in the contemporary interregnum.

Material agency

The consideration of Gaia as a self-organizing, living matter directly questions the established polarisation between life and matter, according to which the only source of vitality is the soul or the spirit. It fuels contemplation on material formations like edibles, commodities, artefacts, or machines, but also physical phenomena and materials. All these impact on our wills, desires, decisions, and behaviors, but also on our mental and bodily structures and identities, our lives, our social structures, institutions, ethics, aesthetics, and politics. This context renders them all vital materiality, equally responsible for Gaia's survival. These vital materiality form other lively powers with which all agents are involved and need to establish symbiotic relationships for the survival of the threatened planet.

6. Ibid., 474.

7. Cf. Diana Coole and Samantha Frost (Eds), *New Materialisms. Ontology, Agency and Politics* (Durham & London: Duke University Press, 2010), 8.

8. Maria Vogiatzaki, "Architectural Materialisms: Nonhuman Creativity", in *Architectural Materialisms: Nonhuman Creativity*, ed. Maria Vogiatzaki (Edinburgh: Edinburgh University Press, 2018), 4.

The cornerstone of this emerging new materialism is the premise of continuity between the Cartesian *res extensa* and *res cogitans*, against oppositional ways of contemplation⁹. By opposing oppositional thinking, new materialisms accelerate a compositional, speculative thinking primarily concerned with striving for the recuperation and the recovery of Gaia's fragile, revisable, diverse, composite materiality which is not appreciated as an existing inactive entity in need of protection, but as an entity that is to be slowly re-composed, piece by piece. By introducing a geocentric universality, new materialism promotes careful (re)arrangements of assemblages composed by and composing the heterogeneous entities of the Cartesian notions, both understood as agents of a permanent and unpredictable becoming of the planet.

Despite the emergence of this new materialism in the current interregnum, its dominant orthodoxy is still to be established; its principal theoretical and philosophical hypotheses are defended through scientific research either on the matter embodied in the alive, conducted by all branches of biology, or on the characteristics of the vitality of matter carried out by all branches of natural sciences¹⁰.

9. Oppositional thinking nourished the rational thinking of modernity, which embraced the almost religious attachment to the transcendent reason as a vehicle towards the progress of humanity. The same oppositional premises backed the critical thinking of postmodernity, revealing the real world behind the veil of appearances, headed to its constructed reality by debunking social, cultural and political prejudices. The creative thinking of the nineties was again motivated by oppositional thinking, as it was focused on the generation of innovative abstractions and associations able to ostracize the old and to redefine a newness by looking attentively to the old.

10. Maria Vogiatzaki, "Architectural Materialisms: Nonhuman Creativity", in *Architectural Materialisms: Nonhuman Creativity*, ed. Maria Vogiatzaki (Edinburgh: Edinburgh University Press, 2018), 5.

The idea of the vitality of matter is not at all recent. Contemporary scholars like Bennett and Braidotti pose different versions of questioning the ontological dualism life-matter in the philosophical concepts and claims of thinkers like Epicurus, Spinoza, Nietzsche, Thoreau, Darwin, Bergson, Driesch, Adorno, Foucault, Serres, and Deleuze. However, the new materialist ontology is extensively strengthened by the technological acceleration in the realm of planetary computation. It invites scientific investigation to evolve through trans and cross disciplinary encapsulations of the material reality to better appreciate the urgent contemporary challenges related to the environmental, demographic, geopolitical and economic changes our societies are facing. This material vitality is not so much about determinism, in-built purpose or finality but rather about becoming and transformation¹¹.

Humans, materiality, and intelligent machines are no longer considered as different entities either enacting or representing. They all constitute an inseparable and embodied ecology exposed to random stimuli of the environment and entwined with the production of identities and new forms of subjectivity so that it no longer makes sense to be separated from the human subject. This very exposure to randomness and unpredictability forms the ground for new abstractions, new patterns, and new formations to emerge. The predominance of the idea that matter (including that part of matter that is human embodiment) is intelligent and self-organizing, destabilizes the established sovereignty of the human over the nonhuman. Matter is no longer conceived as just the substance of any artefact but as an agent in the 'arranging', or in Latour's (2010) terms, 'composition process'. As an agent of a broader ecology, matter is neither dialectically opposed to culture, nor to

11. Rosi Braidotti, *The Posthuman* (Cambridge and Malden, MA: Polity Press, 2013), 91.

technological mediation, but is continuous with them¹². The rapid development of computation enhances material agency. By accelerating research towards quick and flexible responses to the randomness of any kind of stimuli, computation, instead of implementing pre-defined patterns, can use this randomness as the creative ground from which new patterns can emerge.

The architecture of xenomateriality

The context that shapes the emerging worldview, questions, and affects the fundamental disciplinary and ethical assumptions upon which architecture was founded in anthropocentrism: the conception of the human and the appreciation of nature as drivers of architectural design processes. Architecture after the Renaissance was primarily based on the assumption that the mind is the fundamental trait of the architect/human, nourished by the conceptual polarities of mind versus body and life versus matter. Following this assumption, architecture was not conceived and created by the master builder in real time and space, but on the abstract space of representation through abstractions and constraints imposed by the available drawing tools. The architect, as human, thinks, expects and transcribes anticipations into architectural ideas or concepts to be translated into operational and meaningful forms. Form, as an intellectual construct, overpowered materiality.

The arrogant preoccupation of architecture in anthropocentrism to design for the human as the exclusive occupant of the planet, intentionally neglected the accommodation of nonhuman agents and ignored their material power over the human. The magnitude of the material power of the nonhuman proved to be capable of augmenting or destroying humans, enabling, or

12. Ibid., 350.

disabling them, ennobling, or humiliating them, impeding, or hindering their will, and finally determining their designs and decisions. By conceiving matter as passive, opaque and inert plenitude, architecture underestimated or, even more, neglected matter's modes of self-transformation, self-organization, auto healing and directedness that render materiality as indeterminate, continuously forming and reforming in unexpected and even unpredictable manners. It assumed that matter was about being and not about becoming¹³ and for this the main concern was the materiality of architecture and not the architecture¹⁴ of materiality.

Even though building materials have always been inseparable and embodied with architectural forms, up until recently they were conceived as the assistants of form and the allies of structure¹⁵, thus maintaining an inferior position as compared to form. Anthropocentric architecture conceived materiality as passive, mute and inert, formed by any kind of 'forces' imposed beyond its proper nature as a form of hierarchical command from above¹⁶.

13. Cf. Jane Bennett, *Vibrant Matter: A Political Ecology of Things*, Durham (NC: Duke University Press, 2010), Maria Voyatzaki, "Architectural Materialisms: Nonhuman Creativity", in *Architectural Materialisms: Nonhuman Creativity*, ed. Maria Voyatzaki (Edinburgh: Edinburgh University Press, 2018), 3.
14. Architecture here is meant, in each broader sense, to be the way in which mental constructs shape new appreciations of this new materiality. Architecture as the invention of the structure of an ecology that influences the relationship between its parts.
15. Catherine Slessor, "Material Witnesses". *The Architectural Review*, Issue 207 (2000), 43. The use of a limited palette of building materials such as metal, glass and concrete with known properties and known structural behavior indicated the positioning of standardized and mass-produced repetitive components. The postmodernity attributed to materials a new and enhanced role in the design process, that of the agent of meaning. Materiality becomes one of the possible signifiers with which the architect 'syntaxes' the meaning of a building.
16. Maria, Voyatzaki, "Creative harnessing of matter". ELSA (Environment, Land and Society: Architectonics), vol. 3. III-IV ISSN 1662-5870, ISBN 978-2-8399-1168-9, Vol. 3: III-IV "Logics of Space, Architectonics and Engineering Knowledge", (2011): 69-92.

The assumption that matter -including that part of matter that is human embodiment- is 'intelligent' and self-organizing, does not only destabilize the established sovereignty of the human over the nonhuman, but also brings the materiality of architecture in the epicenter of the contemporary design contemplations and experimentations. Architecture is challenged to generate new discourses and practices that can formulate legitimizing narratives, new mythologies, to drive design activity into the new panorama of ideas and speculations on the ontology of materiality emerging from the new interregnum. Architecture is updating its axiomatics based upon the creative potential of materiality through which it redefines its ethical-aesthetic project to enact effectively for the becoming of Gaia.

In posthuman times, architecture is launching a new project: to sense the world differently through machine-mediated experimentations, to generate new temporary and circumstantial axioms and updated abstractions that operate as speculative spatial-temporal organizations. Two different tendencies are followed by the contemporary experimentations in different research and educational environments: experiments with materiality, and within materiality.

In the first case, experiments focus on new materials, new fabrication methods, new techniques, thus predicated the emergence of new design processes. In this way the focus is shifted from the form to the technicalities of the construction, strongly related to engineering and computation. Implicitly, these approaches are allied and aligned with the positivist myth that top-down technological development can save the world and can resolve problems and contemporary questions related to the built environment.

In the second case, experiments within materiality start from the critique of the top-down logic of the first case

and are oriented towards the creation of possibilities for emergent spatial-temporal material constructs. This approach is very close to being trapped in a misleading optimism which dictates that everything that emerges from the bottom up is efficient and therefore appropriate. It also tends to completely ostracize (human or human-constructed) reason which can only be an active agent in the process of becoming.

Our premise is that for any experimentation on the materiality of architecture to be valid and relevant to the new project of architecture, it will have to alleviate oppositions and to combine top-down and bottom-up trajectories, 'an abductive inference that synthetically manipulates parameters'.¹⁷ This experimentation is about materials, but also about speculations on what architecture can do to cope with existing conditions and problems through its intentionally arranged materiality. It is about the ways in which qualities and ethical-aesthetic values can be embedded in this material and formal experimentation, but also about the ways in which new qualities of crafting can be discovered by working with intelligent machines. Furthermore, it is about the exploitation of the granularity (dustism) that large data sets can provide. Following our assumptions about matter, the impact of the nonhuman can affect and revise design reasoning, based upon the repositioning of culture as a speculative force¹⁸.

17. Reza Negarestani, 'The Labour of the Inhuman', in Robin Mackay and Armen Avanessian (eds), *Accelerate: The Accelerationist Reader* (London: Urbanomic, 2014), 436. The crucial part is that this discourse takes place within the abstract mode of thinking, that is, logic. We can find here both Whitehead and Peirce arguing for the abductive premises of logic. Whitehead argues for the ingress of eternal objects within the actual occasion, which forces that occasion to be speculative about its future.
18. Maria Vogiatzaki, "Transmythologies", in *Architectural Materialisms: Nonhuman Creativity*, ed. Maria Vogiatzaki (Edinburgh: Edinburgh University Press, 2018), 308-311.

The new mission of architecture may have to cross-infect human and nonhuman for a symbiotic creativity that would yield new materials whose potential to self-organize would create flows of heterogeneous spatial-temporalities and variations. This heterogeneity, a pursued abstraction related to the 'other', the 'xenon', could be achieved by fading in and out material trajectories. 'Xenomateriality' is a materiality to be invented, extracted, constructed, or recomposed through existing by-products of the human and nonhuman activity with the perspective of implementing and following a new strategy related to the earth as a new emerging ecology, an innovative geo-political perspective, looking not towards the future of the existing, but the prospect of its becoming.

Xeno-materiality could be thought of at a micro-scale, such as dust that can 'powder' and granulate geometries, producing random otherness thereafter. Algorithms are like managing and manipulating matter in its dust existence. Dust geometries are a cognitive construct; they are abstractions. The big data idea and its relationship with materiality allow us to consider thousands of particles at the same moment, in a way that ordinary, limited, and small data sets could not achieve¹⁹. By moving down scales we observe an unprecedented reality of matter that redistributes and reconstructs materiality, a new aesthetic vocabulary as Parikka²⁰ would

19. Particles not only change under observation (particle waves) but also in the way they observe and interact with other entities. In a sense 'intra-action' is prior to interaction following Barad's statement. Think of intra-action as the analogue, the event, the matter prior to the digital, the objects and their relations, the material. Interview with Karen Barad, 'Intra-actions' in *Moussee* 34, Special Issue dOCUMENTA (13) by Adam Kleinman, (Milan, Summer 2012)76-81.

20. Jussi Parikka, 'Earth Forces, Contemporary Land Arts, Technology and New Materialist Aesthetics', in *Cultural Studies Review*, 21.2 (2015), 47-75.

<http://epress.lib.uts.edu.au/journals/index.php/csrj/index> (last accessed 12 January 2020).

suggest; hence, a new architecture altogether, away from the tyranny of the grand geometers. The ontological indeterminacy is coupling with our epistemological uncertainty, and this forces us to invent new orientations in construction and fabrication²¹.

A world can be constructed and approached at a scale radically different from the human scale. A domain for the construction of new conceptual resources is now wide open. By pulverizing, we aim to revise our concepts, or to re-cut the world and to allow for the constitution of new events, new materials, new construction methods, new scales. Machines provide us with a new sensibility. As Bratton states, 'new technologies do not allow for new forms, but new technologies allow for new models about what is to be made'²².

Experimenting with the xenomateriality in design education

New speculative axioms aspire to a new earth, the returning Gaia, by experimenting with its dust, constructing new perspectives on matter. It is experimentation with the 'other', the 'xenon' that aims at proposing a new way of forming an innovative view of earth by redefining its geopolitics and territorial disputes, from polluted waters that travel through nations to micro particles in the air. Architecture is working on 'xenomateriality' to define new policies, new spatial-temporal assemblages with specific demands. Architecture is working on the construction of a new worldview, on a reconstruction of

21. Maria Vogiatzaki, "Transmythologies", in *Architectural Materialisms: Nonhuman Creativity*, ed. Maria Vogiatzaki (Edinburgh: Edinburgh University Press, 2018), 310.

22. Benjamin Bratton, "On Speculative Design", in *Dis Magazine*, February 2016.

<http://dismagazine.com/discussion/81971/on-speculative-design-benjamin-h-bratton/> (last accessed 12 January 2020).

a returning Gaia and on a re-construction of the user, be it human, posthuman or nonhuman. Gaia's return reunites and reconciles Prometheus and Epimetheus together, in ecologies of the myths they have created: that of nature, the alive, the machine, technology, culture, the human, matter and the environment.

The idea of constructing the architecture of materiality, a xenomateriality, has become a design pedagogy experimentation on the following premises:

The environment

As environment we refer neither to the exclusively physical or natural, nor the human-made context in which architecture is conceived and constructed. The narrative of the environment as a physical entity in peril that can survive with manipulations of its local crises is questioned. Environment is defined instead as the broader geopolitical, ethical, aesthetic context that confronts architecture-to-be conceived and constructed²³. In this environment the human and nonhuman users must renegotiate their own relationships to, with, against and within it.

The design questions

New species of design questions are invented that in turn construct a new species of design processes, capitalizing on the creative power of matter and of human and nonhuman creativity, towards finally constructing a new species of designers, who through their approach

23. Pier Vittorio Aureli, *The Project of Autonomy: Politics and Poetics Within and Against Capitalism* (New York: Princeton Architectural Press, 2012).

to design will construct new species of users be it human or nonhuman²⁴.

By identifying an existing problem, through speculations, the problem is redefined to offer unexpected, novel, and transdisciplinary-derived responses that do not intend to solve the problem but to redefine it²⁵. Two cases are presented to illustrate the method. Both cases are scenarios revolving around a problem that have accumulative or instant effects on all involved agents. Design is the catalyst and creative agent that redefines the problem, whilst proposing alternative spatiotemporal constructs.

The users

Designers must appreciate for whom they design; the subject's political actions along with the technologies that reform it. The subject becomes another agent in the schema earth-cloud-city-address-interface and user; be it human, nonhuman, plant, animal, machine and/or information²⁶.

The aim is to reinvent the nature of the subject as ecologies of human and nonhuman entities that affect one another and become the center of (the political) action.

24. All student design experimentations are a test tube of the compulsory theoretical research students elaborate for a semester, prior to their design. The theoretical/critical dissertation they deliver has equal weight to the assessment of their final design proposal, interconnecting the two as a research-by-design activity, and as a curricular innovation in its entirety.

25. Francois Roche, "Reclaim Resilience]stance//.....R2", in *Log*, (25), ed. Cynthia Davidson (2012): i-5.
<https://thefunambulist.net/architectural-projects/architectural-theories-extension-du-domaine-de-la-lutte-log-25-reclaim-resiliencestance> (last accessed 12 January 2020).

26. Benjamin Bratton, "User Layer", in *The Stack: On Software and Sovereignty*. (Cambridge, Massachusetts: The MIT Press, 2015).

Technologies, as nonhuman agents, can creatively mediate in this re-invention.

The design

What drives design follows Aristotle's political view, that appreciates society as a polity that shapes the public realm, as opposed to conceptions of urbanization of private initiatives driven by economy. Cities are reinvented as ecologies of 'small islands', following Aureli's idea of the 'archipelago'²⁷ that appreciate local intervention with clear boundaries and distinctions.

Experimentation 1: (S)alt_ernatives

The environment

The environment of the project is a highly touristic island that despite its precipitation has no potable water. Currently, construction enterprises are exacerbating the problem by increasing accommodation facilities. The solution of desalinating sea water is costly and damaging to the local ecosystem, while the return of surplus saline brine disturbs sea life. A natural reserve attached to an abandoned salt-lake in peril accumulates water that is left unused. The human and nonhuman agents include the local inhabitants and visitors, local authorities, the flora and fauna of the reserve, salt, water, local economy, hygiene.

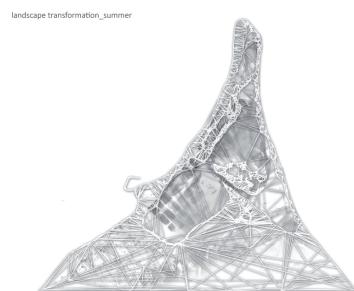


Image 1. Design parameters (Credit: Chatzipantazi, Chalkia).

27. Pier Vittorio Aureli, *The Possibility of an Absolute Architecture (Writing Architecture)* (Cambridge, MA: The MIT Press, 2011).

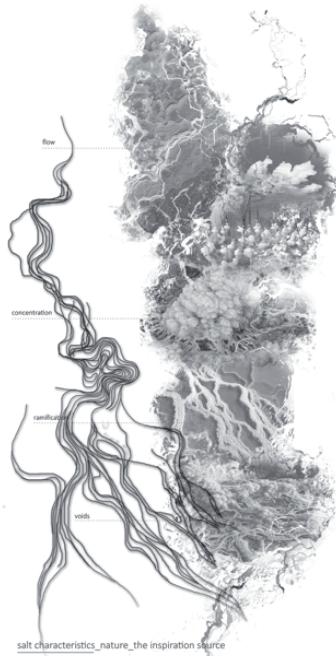


Image 2. Salt processes and material formations in time (Credit: Chatzipantazi, Chalkia).

The design questions

While 'traditional' desalination is ruled out as an option, architecture comes to redefine the crisis by proposing an unconventional desalination unit whose by-products can be used to build the infrastructure of the unit in real time. At the same time the unit hosts workshops where the creative power of salt is coupled with human and nonhuman creativity coming from robotics and 3d printers resulting in a research process about salt as a material for artefacts at various scales. The unit is a live museum of salt, where the up-cycling processes are on display for educational purposes. The infrastructure used to access the unit further enhances the reserve by allowing locals and visitors alike to be acquainted with this neglected natural treasure.

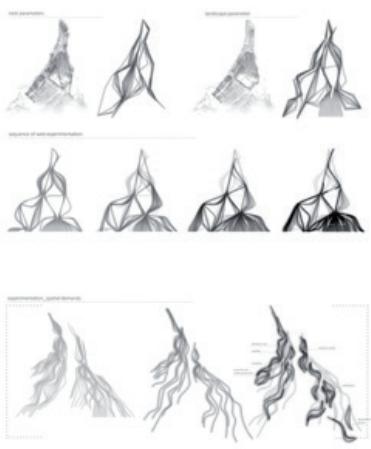
The users

Locals now become live actants responsibly involved in managing natural resources that affect both their day-to-day life and the island's economy. Their acquaintance, further and future involvement with their island's natural, human and nonhuman resources, mediated by new technologies, reinforces their live participation in the process of defining the future of their island.



The design

A branching organization system was used to create the substratum onto which the heterogeneous nucleation of salt would occur. The substratum acted as the pole onto which the first molecules of the crystal were attracted. There is already evidence of salt-based materials that are used for 3D printed solid salt blocks that confirms salt's structural potential²⁸. The salt is deposited on the substratum through spraying drones²⁹. Experimentation to test the rapport of crystallization and the substratum included the crystallization of salt on thin strings and nets. The simulation of the trajectories proposed several spatial constructs that were tested at various scales towards designing built forms that would accommodate the desired infrastructure.



28. Salt's active component is water which reacts with the maltodextrin (starch Grains) to strengthen it and enhance its structural properties.

29. Mud-spraying drones to coat messes in clay are a precedent. Salt-spraying drones could follow a similar process. Drone-driven salt spraying processes as a building method can become a substitute to conventional ones.

Experimentation 2: Assembling Narratives

The environment

The environment includes a major river that separates Greece from Turkey, runs to the Aegean Sea, and rejects industrial byproducts, polluting the water that is used for farming in the bordering countries. The river is also a passageway for refugees that try to enter the EU. Therefore, the environment is also formed by their movements, the high number of casualties caused by the water, the international measures continuously revised to prevent this human flow. On a different scale, the rise and fall of water levels transforms the topology of the area: materially through the deposition of mud, geopolitically through the alteration of the borderline, ethnographically through the transformation of the periods of farming and means of crossing the river.

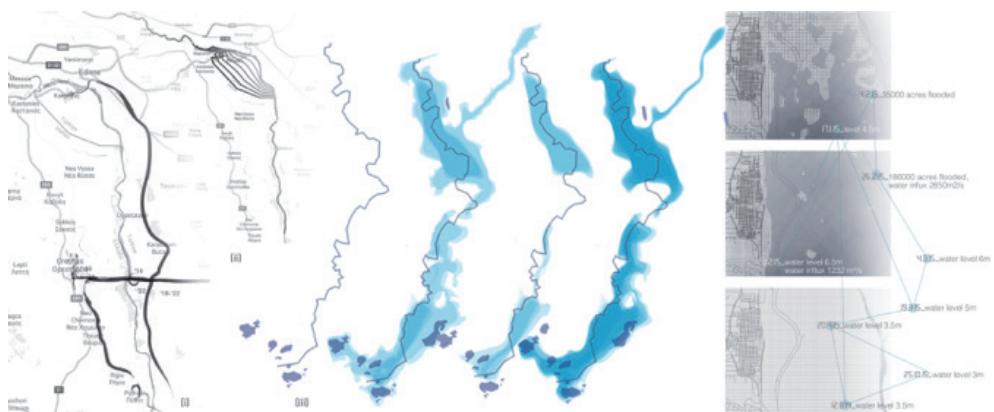


Image 7. Topological Transformations: migration routes (i), borderline (ii), materiality (iii). (Credit: Toursoglou-Papalexandridou).

The design questions

The formulated design question was how the needs of the farmers, of the refugees and of the environment could be addressed simultaneously. This question involves different time frames, different scales and, maybe most importantly, different political agendas and aims. Therefore, the main issue is to discover co-operation and co-existence where one would normally see conflict; how materiality could act as a key agent in that process was the core question.

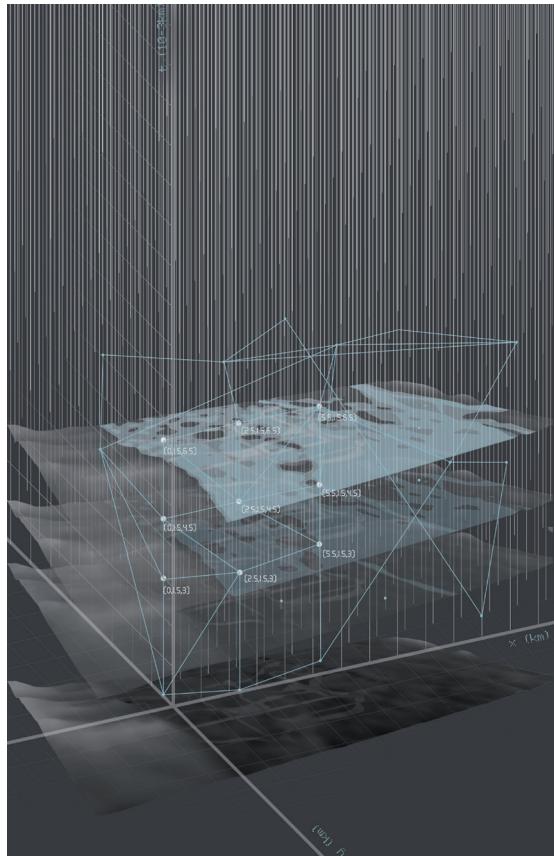


Image 8. Points of Spatiotemporal Grid, within which the alternative scenarios are explored. (Credit: Toursoglou-Papalexandridou).

The users

As already described, the list of possible users includes the locals, farmers on both sides of the borders, the refugees, and of course a large array of nonhuman actors that constitute the environment. To that one can add NGO volunteers, local authorities and even the refugees' traffickers. A complex net of relationships is formed along with an even more complex set of actions – some to be supported while others to be discouraged.

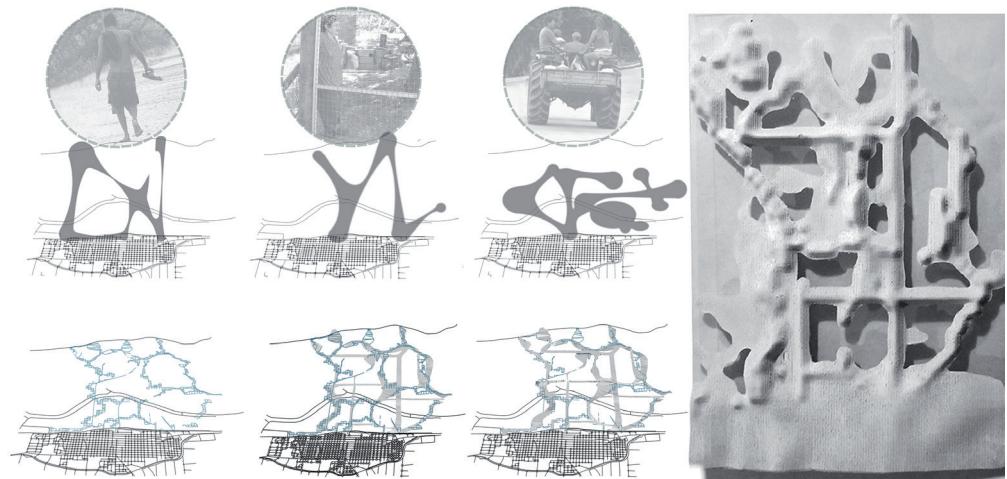


Image 9. From Individual Routes to a Single Ground.
(Credit: Toursoglou Papalexandridou).

The design

Materiality becomes the catalyst for the project: Mycelium is used. It is a material capable of transforming agricultural waste into construction material and is produced locally in the riverbanks. With the presence of water, its life as a construction material is limited to one month, before its biodegradation. With it, routes that can accommodate human flows are created. The structure is (in)formed in real time by the levels of water and the mycelium, whilst filtering the polluted water of the river. The grid of the adjacent agglomeration is deformed to a network of fibers, functioning as a joining element. It follows the river flow, the population flows, and the distinctive routes of the groups of distinctive users. Materiality creates affective relations between nature, the farmers, and the refugees.

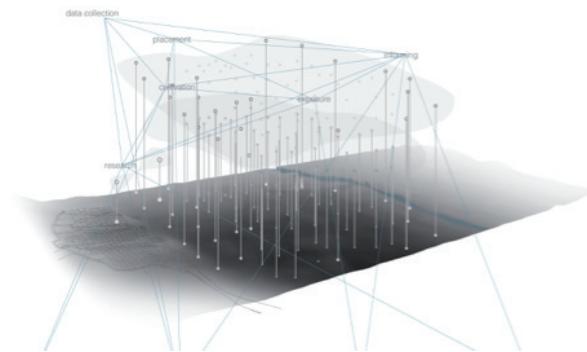


Image 10. Mycelium as an ever-changing material. (Credit: Toursoglou Papalexandridou).

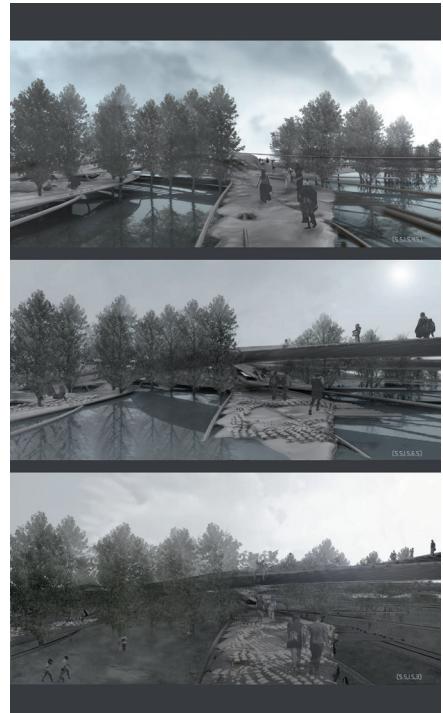


Image 11. *Temporal Transition (captions along axis of Spatiotemporal Grid)*
(Credit: Toursoglou Papalexandridou).



Image 12. *Caption on [5.5, 1.5, 4.5] point of the Spatiotemporal Grid*
(Credit: Toursoglou Papalexandridou).

Designing with Hecate

Architectural education is not, historically, affiliated with interregnums. Due to its institutional nature, it is called upon to serve the established and the conventional, and by default, looks at novelty apprehensively and suspiciously. For this, the quest for radical novelty has been, at times, even more of a stowaway on the vehicle of architectural education, when, in fact, it could be the very catalyst and accelerator of its slow receptiveness and update. As the first part of the paper claims, the ontological and epistemological reconsideration of materiality brings together, in an affective relationship, agents that wouldn't, otherwise, interact. Materiality becomes the key in making them work together, symbiotically, affecting one another. It merges and blends different human and nonhuman actors, different timeframes and, in the case of architecture, different genres of users and different scales that directly and radically affect design contemplation.

This 'xenomateriality' is neither the passive material substance of a created machine, as architectural creations were appreciated in modernity, nor post-modernity's semiotic denotation of a composed meaningful text. It is a whole host of actors and agents which not only interact but, most importantly, morph into one another becoming an altogether different entity – neither human nor nonhuman. This new 'entity' is no longer a rigid, crystallized form, but rather an ever-changing one. In this environment, we understand the new mission of architecture to be an agent that transforms problems into possibilities, and can revise, update and reform a new genre of human, and new genre of user, and through education, a new speculative genre of designer that is on a perpetual transformation process, in a permanent state of becoming.

The ultimate and persistent ambition of anthropocentric architecture and design was to redesign the human, backing it with the pretext for serving the human needs³⁰. That redesigned species, the offspring of modernity's ambition, ended up being the one that 'systematically designed its own extinction and seems to be getting close to accomplishing the goal'³¹; a species either redesigned in the Promethean logic, looking forward and creating myths of its future, as it was the case of Modernism, or following the Epimethean premises, looking back and contemplating on existing mythologies, as it were the case of Postmodernity. Architecture is now invited to redesign another species, embedded in Gaia, affected and affecting its complexities, being in a permanent transformation, and in a polyvalent and unpredictable becoming. Maybe, it is time for Architecture to sideline Promethean and Epimethean narratives, and to be associated with Hecate, another goddess of Greek mythology³², who embraced unpredictability, randomness, dilemmas, and the magic, or in other words, controlled the slider between the good and the evil of humans.

30. This is one of the main arguments of Beatriz Colomina and Mark Wigley in their *'Are we Human? Notes on an Archaeology of Design'*, (Zurich: Lars Müller Publishers, 2017).

31. *Ibid.*, 15.

32. Cf. Jean-Pierre Vernant, *Myth and Thought among the Greeks* (New York: Zone Books, 2006), 185.

Chapter I.5:

The spirit of design distilled

MARIA VOGLIATZAKI AND CONSTANTIN SPYRIDONIDIS

Either as nouns or as verbs, both 'Design' and 'Change' constitute two of the essential traits of human nature. Human life is motivated by the aspiration to become, which constantly challenges comfort zones -who we are and what we could do- towards an aspired becoming to be designed and constructed. Humans are a species in a permanent under-construction state, a design animal that designs changes. Our values lead to our wish to become. Values are continuously revised, generating new expectations, targets, strategies, and paths towards their manifestation in spaces and artifacts.

Nowadays, the notion of intelligence has become a buzzword that accompanies every possible action, process, or product. We have argued elsewhere¹ that there are two closely related considerations that render intelligence a keyword in contemporary contemplation and practice. The first is that in the post-human turn, intelligence is no longer considered exclusively human. This is an ontological mutation of the concept of intelligence, from its appreciation as the exclusive function of the human to its definition as a property emerging from a specific set of conditions in which a human or a non-human entity could exist. The second consideration, also based upon the new philosophical context, is that intelligence is no longer understood as the outcome of one entity's or center's function. On the contrary, it is

1. Cf. Vogiatzaki 2018:6.

defined as the emergent property of the symbiosis and the respective interaction and affects between 'brain(s)' -human or nonhuman-, body(ies), and the environment(s) that breed these symbioses.

Intelligence has been extensively deployed to enhance control, management, and performance and notions of sensing, abstracting, learning, decision-making, and performing in either a human or nonhuman manner. In other words, it encompasses all aspects of design activity. We will define design intelligence as the intangible trait of the dynamic interconnection and symbiosis between the critical agents involved in the design activity. We understand the intellectual tectonics of the design intelligence to be composed of four critical agents: The worldview valid in a period, the conception of the human to whom architecture is addressed, the design tools deployed, and the matter and materiality of architectural creations. Each of these design agents establishes multiple interactions and affective relationships with different environments like the social, geo-political, economic, environmental, and technical in which they exist and evolve in dynamic ecologies. We also consider that the concept of design intelligence is potentially a tool that enables past architectural experiences to unpack fewer known interconnections among the leading agents forming design intelligence.

Our central (hypo)thesis is that design intelligence is the spirit distilled from the dynamic and unpredictable sympathy amongst the agents of an assemblage relating to the creation of space in a continuous process of forming and transforming architectural design values. The unpredictability and the dynamism of design intelligence is the driving force to create newness. This essay elaborates on architecture of an emergent design intelligence as the effect of the sympathy between an under-construction worldview, a mutation of the anthropocentric conception of the human, advanced computation

tools and learning machines, and the new conception of matter and materiality in architectural creations and construction techniques.

In its 2500 years of history, architecture considers the human as the final recipient of all its creations. Architecture always designs the new, having in mind a perception of the human: what that human is, what values must guide social life, what needs, and desires are to be fulfilled, what priorities must be considered, what the worldview in which those human lives in is. This is the 'abstract' that architecture is invited to render tangible and manifest spatially. This is the 'Project' of Architecture². The foundation of architectural newness is profoundly philosophical.

The philosophical foundation of spatial manifestations is also directly linked with two critical agents of architectural design creation: The design tools used to elaborate and experiment on social spatiality and forms and the materiality that constructs and materializes this social spatiality.

The elaboration of physical models by skilled carpenters in the Renaissance to experiment and visualize buildings, their language, and structural performance put modeling and representation on the pedestal of the development of prestigious buildings. Physical models and drawings became powerful tools to express values, priorities, and narratives to signal prosperity and social superiority.³ Since then, design tools, techniques, and means have defined a regulatory context in which architects invent to think, conceive, and experiment for the

2. We use the term 'Project' in alignment with Aureli's (2011) suggestion to distinguish the project from the design. Design is, according to him, a 'managerial praxis' of building something, while the project is the aspirational strategy on which the design praxis will bring this 'something' into presence.

3. Cf. Frommel (2018).

genesis of novel projects. In distinct paradigms in the history of architecture, this context is dominated by the deployment of various articulations and biases of geometry⁴.

A distinct appreciation of materiality also connotes the cognitive background of these paradigms. Following Piicon's view (2004:107), our appreciation of materiality is not synonymous with matter, but the relationship we, humans, develop with matter, a relationship which is a cultural construct. Materiality is the strategic alliance between the choice of the construction materials to be used, the conception and meanings of the tectonics that, through materials and methods, articulate meaningful space, and the relevant building technology deployed for the appropriate (matter)realization of architectural creations. As a constant and critical accelerator of the quest for the new, technology is a critical agent that shapes cultural values that drive the genesis of the new. The development of technology has never been a mere technological advance. Technology is catalytic to the aspirations for a social becoming to be designed and constructed to reflect cultural values and world-views.

The design intelligence of the observing eye

The intellectual constructs of anthropocentrism positioned the human in the epicenter of its contemplations and dethroned the divine that was domineering them since antiquity. The Renaissance and Classicism established a human that manifested the power of its spirit and culture through its art(e)facts), emancipated from

4. For extended monitoring of the diachronic connections of different versions of geometry with the changing world views and conceptions of the human across the history of Architecture, cf. Spiridonidis (2019).

the supremacy of the divine determinant of human survival. The Renaissance human observed the tangible reality to appreciate it, experiment with it, and glorify the divine and the human acts.

The shift from attributing to the divine the power to shape the Universe to the human entity's capacity to explain how the Universe was shaped, empowered the observing eye to become the most vital human organ to serve this quest (Savignat, 1981). Emancipated from religious preoccupations, the sensorial domain of the human eye fueled the human intellect with observations that generated knowledge in the quest for the objective truth. The ideal human was a curious polymath whose intellect could master, through observation, a broad spectrum of skills spanning from the arts, crafts, and discourse. The physiognomy of the architect could be traced back to the 15th century, in Alberti's 'Ten Books of Architecture.' Choay (1980) defines this historical point as the appreciation of architecture as a discursive practice that fosters a new design intelligence. The architect, as an observer, thinks and conceives buildings as they would be seen, and experienced through the eye, from outside to in, attributing to the elevation the focal point of the design process, and to orthographic projection of the power of a tool to explore ideas as they are 'seen'.

The Renaissance human was conceived not only as intelligent but also as sublime. The proportions of the human body reflected and defined what natural beauty and harmony were and how design should glorify them by reflecting their virtues in architectural forms. To substantiate this new, for its time, socio-cultural project, architecture needed a professional legitimization stemming from the human intellect. This explains the fundamental division between contemplating an idea and its making, a division that was crucial to the history

of western civilization. This division attributed superiority to anthropocentric intellectual constructs.

The need to accurately depict an idea prior to construction is an endeavor of human-centered architecture that marks its development until the present times. To work in the virtual realm, urged for an abstract version of the conceived reality onto the drawing board. Design became the hallmark of professional practice that distinguished intellectual from manual work, a new division of labor, attributing to design a political and an ethical dimension. Since then and throughout modernity, architecture's social project has been to manifest the sovereignty of the human spirit and culture onto the natural world. To create forms and spaces that reflect this conception, with all its social and political meanings, and to affect the practices, the aesthetics, and the intellect of those using and experiencing these spaces⁵.

Appropriate design tools and processes had to be invented to manifest these understandings spatially. The crosspollination of understandings and tools was evident. For anything to be built, it needed to be drawn in advance, which meant that what could be built was what could be drawn.⁶ While offering accuracy for an idea to be built, orthographic projection was not representative of how the human sensorial domain of seeing reality would perceive. The discrepancy between an orthographic projection and reality was remedied with the invention of drawing in perspective, which was initially achieved by sketching from physical models⁷.

The perspective glorified the anthropocentric world view and the human intellect and vision, not only because it was a consistent and accurate presentation of what the

5. Cf. Spiridonidis, Vogiatzaki (2020).

6. Cf. Savignat (1981: 25), Carpo (2011: 31, 75).

7. Cf. Frommel, S., (2018).

observing human eye could see. But because it was a symbolic representation of the infinite, defined for Christianity as the divine⁸, which was taken from the heavens, the end of the Gothic spire, and was iconoclastically located in the drawing as the meeting point of parallel lines, the vanishing point⁹. Tools were, once again, designed to reflect the worldview and conception of the human of that time. Their bias was, in turn, formulating a specific design intelligence.

Till the Middle Ages, the capacity of masonry to build robust forms of large scale, as an expression of gratitude to the divine or as a proof of the supremacy of the elite, was later challenged in the Gothic, with the human-centered ambition to reach the skies. However, human intelligence would often harness masonry while introducing itself to question its comfort zone by embracing error when the human was trying to reestablish certainties. However, the glory of gothic cathedrals is a testimony of human sovereignty over the recalcitrance of the earth's material base.

The design intelligence of the 'res-extensa'

The Enlightenment questioned the validity of the eye to reveal the truth. It progressively became unreliable, both for its limited capacities, but above all for the subjectivity, the values, the prejudices, and the mental limitations that governed the human that possessed that eye. A new ideal of the human was emerging, the rational human in a constant battle against its subjectivity.

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 worldview.
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."

This conception emerged from a worldview distinguished for its epistemological dialectics and binaries between material nature and non-material minds, objectivity, and subjectivity, reality, and appearance. Contemporary scholars critically describe this distinction as a 'bifurcation' (Whitehead: 1964), an 'epistemological obstacle' (Bachelard: 2002) or an 'epistemological break' (Althusser 1969), that associated the Enlightenment with an entirely new view of anthropocentrism.

The radicalism of the dualistic ontology of the new worldview found its definition under the Cartesian terms or 'res-extensa', a natural and inanimate entity devoid of any meaning or possibility of agency, producing its effects only through the power of its causes, opposite to the term 'res-cogitans', a subjective and value-based substance but void of any reality¹⁰. Human intelligence should seek objectivity, instrumentalizing sciences as the solid ground to reveal the undisclosed objective truth by attributing effects to causes, which become new causes for new effects. The rational human was a scientific construct and the result of the objective study of natural laws and the study of the needs of humans whose fulfilment signified progress and prosperity. The Kantian human of the Enlightenment now replaced the polymath empiricist human of the Renaissance.

This new emerging worldview and conception of the human directly impacted design intelligence. Architecture's new project now was to design (for) the rational human; To design and realize its material artificiality capable of hosting the objectively defined-by-science human needs. Designing (for) the rational human was no longer about prioritizing aesthetics and the abstractions made by the observing eye, but the needs of that species called human. The human was progressively pushed to the realm of res-extensa, no longer

10. Cf. Bruno Latour (2010: 481)

distinguished for its appearances, gender, identity, to become 'The Human' with capital 'H'. Ergonomics, dimensions, proportions, and anatomy would determine the spatiality that would accommodate its functions.

As the ongoing shifts of the crucial agents determining design intelligence affect the design process, the building of the Enlightenment was conceived not to be seen but to function, to organize space and functions rationally. The building's mission was to function since the entire cosmos should¹¹. All its parts were organized so that the whole would fulfill its ultimate finality, to host -a specific understanding of- the life of the human. This teleological thinking encompassed all parts in a top-down finality to be organized by design intelligence, putting them together in place, composing them towards affirming what was confirmed in the life of a human, namely the biological needs of the species. Design intelligence was no longer focused on perceiving but on arranging and organizing. It prioritized the arrangement and organization of the inner part of the building, setting it not only as the starting point of the design process but also as the generator of the elevation, which was now tasked to reflect the inner organization.

In the first part of the 20th century, the idea of a modular system based upon the metrics of the human body and its proportions dominated design intelligence. Modularization nourished the anthropocentric dogma by extending the request for further rationality holistically. Beyond its inherent 'rationality', the modular defined the design grid, the assembly rules, and the -industrial-production process. Eminent representatives of this tendency, such as Gropius, Le Corbusier, and Buckminster

11. 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 and later on the formation of the alive. This way, it introduces its machine-based understanding of the Enlightenment and its study through physics.

Fuller experimented on evangelizing this specific design intelligence.¹²

This shift rendered the perspective an obsolete drawing tool.¹³ The design tools were now turned towards drawing techniques freed from the eye and its inherent practical and ideological flaws. The principles of orthographic projection and descriptive geometry were embedded in the design process¹⁴. The Euclidian visual cone was replaced by the geometric beam of parallel lines of those geometries that depersonalized representation but also moved the human eye from the experienced world to the infinite, with all its insightful connotations and symbolisms¹⁵. The human, from the observer of the infinite divine creation, with the support of the sciences, was (re)finding its proper location at the infinite that nourished its new imaginary, what Harari (2016) defines as 'Homo Deus'.

In the 1960s, the rational organization of human activities in space shifted design intelligence towards computation to further rationalize this organization process. The perception of distinct spaces as units/modules of specific dimensions, relations, and proportions, envisaged in computation as an appropriate design tool with

12. Chaillou (2029:11) presents the Modular System as the approach which prepared the ground on which the relationship between computation and architecture was built.

13. 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 to take measurements from them (Ackerman, 2001:29). 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.

14. 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. Saving (1981).

15. Cf. Spiridonidis 2019:23.

combinatory capacity toward infinite configurations. The design process's rationality implied a transparent, linear process of distinct steps, or what was known as the Glass Box approach to design. The design process of that period, to remain rational, had to be oblivious to the progress made by cyberneticians of the same period, as their approach was more subjective, as were the processes of other creative disciplines, taking place in a black box.

The rational spirit and the quest for progress fused technological development in the anthropocentric era. Bridge building and railway infrastructure that enabled the transportation of materials, revolutionized construction methods, and emancipated buildings from the availability of local resources. The industrial revolution profoundly affected the materiality of architecture. The development of new materials such as concrete, steel, and glass fueled mass production of parts, enabled by the capacity of the building industry to achieve speedy and flawless reproduction. Design intelligence focused on rational ways of accommodating the workforce that inhabited industrial cities by building fast and tall. Prefabrication enabled urban inhabitation at speed.

The rationality of the design intelligence was further explored in the rationality of the building parts distinguished into load-bearing and non-load bearing, expressing their structural role in a building's structural performance. The building was a machine for life, an assemblage of load-bearing and non-load-bearing elements. This distinction became the new tectonics and language of rationalism in the design intelligence of the *res-extensa*.

The design intelligence of the culture

The ambitions of the design intelligence of the res-ex-tensa that embraced an englobed artificiality were to be later criticized for depriving the human of its natural and cultural derivations. In addressing the global urbanites as equals, anthropocentrism failed to recognize and address their differences. Despite its strength in solving problems, rationality lacked the sensitivities to appreciate the role of culture and the social element that shaped humans' identities, individualities, and specificities. The essence of democracy, as intellectuals in the modern movement evangelized¹⁶, was not about providing what was common to all but about respecting their differences and their right to be openly expressed.

This critique to the negligence in addressing individuality gave rise to a new conception of the human. The radical shift to a human as an entity of social stratification shifted the toolkit of the design intelligence from the sciences to the humanities, from systems to structures, from the common to the different, from global to local, from anticipations for the future to nostalgias for the past, from a quest for the 'objective' to a quest for the creative 'subjective', from a functional organization to form syntax. The 'new' had to be established on the appreciation of the different and the. The building was no longer conceived as a machine or a container of human life but as the meaningful 'text' manifesting its context.

Rationality, functionality, and the objectivity of the scientific toolkit were no longer compatible with the appreciation of the human as a social entity formed and transformed by culture. Socio-cultural particularities were founded on the subjectivity and intuition of social groups

16. Cf. Rachel Potter (2002) and Potter (2006).

and appreciated through culturally defined rules of meanings. Meanings were not to be arranged but manifested through expressive forms. A form and its cultural meanings were the foci of the design intelligence of culture. Sociology, ethnology, geography, psychology, and history but above all semiotics, were the epistemological toolkit of this approach, a clear shift from the sciences to the humanities. This turn reinstated the importance of the subjective, the cultural, and the intuitive, an aphorism to modernism. What Stengers (1997) defines as 'the war of sciences', and Ordine (2017) elaborates as the 'usefulness of the useless,' acknowledged the emergent value of new terms, promising to open new perspectives to our appreciations of the world.

Moving from systems -studied with specific properties- to structures -studied with internal laws between their components- structuralism¹⁷ attempted connections and continuities between the human with its broader -social- environment without obliterating its anthropocentric underpinnings. Even terms broadly used, such as 'context' or 'syntax', originated from linguistics -the study of language- as the unique characteristic of the human species. The meaning was the connector between space, culture, and society. Similarly, the quality of a form was defined by its capacity to encapsulate, convey, and communicate meaning. The form did no longer follow function, but by coming to the epicenter, the function would follow form.

The significance of form demanded the deployment of tools for its exploration. While ordinary software enabled faster and more accurate representation and reproduction of drawings, computation and coding opened new avenues for exploring forms. Computation, no longer focused on proposing and organizing

17. We understand structuralism as built upon the Linguistic theories of Ferdinand De Saussure and the anthropology of Claude Levi-Strauss.

infinite configurations, enabled the generation of complex and compelling forms.

The fast and unstoppable development of computational power, the growing capacity to store data, and the improvement of user-friendlier interfaces and interoperability between software and hardware enabled the creation of generative software, which impacted the Design Intelligence that focused on formal experiments. As Chaillou (2019:13) states, this evolution could assure a rigorous geometry control and boost design's reliability, feasibility, and cost. 3D Design tools facilitated and eased collaboration, interaction, iteration, visualization, and simulation.

Furthermore, generative tools deployed non-Euclidian Geometries¹⁸ to explore complex forms and their transformation in time, introducing time as the fourth dimension and change in time the fifth dimension of design. Non-Euclidean, differential geometry, calculus-based topology, and the study of curves, splines, and vectors imported complex mathematical relationships that could be scripted and then translated into visual output. As Picon (2011, p. 33) states, calculus, at its profound structures, had to do primarily 'with the consideration of time instead of dealing with purely spatial dimensions'. Architecture, till then, conceived the building as static, an obsolete conception in this revised design intelligence.

By the end of the century, the de-codification of DNA divulged the uniqueness of the identity of every human entity that emerged from its unique genetic information. The appreciation of the human was now based on its individuality. This conception does not compromise the social and cultural sense of belonging of humans.

18. Calculus, Convex and Discrete Geometry, Algebraic Geometry, Fractal Geometry, and Computational Geometry to some of them. Cf. Spiridonidis 1919:26-27.

However, it explains the continuous and perpetual transformation of the social and cultural collectivities due to the agencies formed amongst the interacting individuals.

The building of this design intelligence is an information carrier with embedded intelligence that controls its performance. Interactive and adaptive are terms borrowed from biology to signify the architecture in transformation and continuous variation¹⁹. The information embedded in the design of buildings could only be controlled with coding. Sophisticated software has been used in the last three decades towards iconic buildings of signature practices that coin the term Parametricism²⁰ to describe the generation of forms through the manipulation of their coordinates.

With design intelligence focusing on the scenography of meaning and appearances, materials acquire a new and pivotal role in the design process, that of the agent of meaning. Materiality becomes one of the possible signifiers with which the architect 'syntaxes' the meaningful scenography of a building. This new relationship between form and its materiality renders the building material an expressive agent of form. Their concurrent elaboration in the design process is a creative challenge for the designer. This perspective drives the creation of new building materials deploying chemistry and nanosciences that operate at a supreme granularity and offer unprecedented possibilities for performative and dynamic forms. Building materiality appears to be involved in the design process as a career of meaning.

19 . Cf. Kas Oosterhuis (2007).

20. For a recent collection of statements and research outcomes, visit the link <https://www.parametricism.com>.

The design intelligence of the nonhuman

All domains of contemporary contemplation have profoundly questioned the anthropocentric worldviews and conceptions of the human established after the Enlightenment for the past forty years. The recent philosophical debate reveals the challenging impact of anthropocentrism on our social, emotional, and political life²¹. Philosophers express their concern about constructing a worldview founded upon binary oppositions and polarities that biased and inhibited contemplation, language, habits, and appreciation by imposing fragmented views and artificial clear-cut distinctions. The underlined binary oppositions prompted by rationality and objectivity presented a fragmented world and obscured the fundamental and essential agencies and effects between parts, particles, living substances, and materiality as part of a symbiotic world. Terms like sympathy, symbiosis, affect, immanence, agency, assemblage, emergence, difference, and ecology, to state a few, progressively immigrated from philosophy to many other domains and spheres of contemplation.

Sustained by this philosophical debate, epistemology, the philosophy of science, following the aspiration of an interconnected world, questions the fundamental premises of the sciences, anthropocentrism, and of the practical repercussions that fragmented knowledge had on the appreciation of the world based upon a conception of autonomous and autoregulated systems. Against this fragmented view, an image of an interconnected world is emerging. The appreciation of the world's interconnectedness propels scholarly research toward the investigation of new types of relationships among the agents of reality, away from the rationality of the sciences in their systems-based worldview or from the

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

power of the semantics in the humanities in their structure-based worldview.

This interconnectedness results from appreciating the continuum between materiality and the alive. The decodification of the DNA put information on the pedestal of life and 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. The alive is also material, and the material has life. Both depend on their environments and ecologies, composed of unpredictable agents that follow their own rules, idiosyncrasies, and affects, understood as information exchange. Information acquires a central position in the new epistemological shift that blurs the lines of demarcation between sciences and humanities, establishing a trans-disciplinary understanding of the world progressively.

The role of information as a unifying notion across sciences and humanities is one of the most critical aspects of the posthuman logos and praxis. In epistemological terms, information plays the same role in the construction of the contemporary intellect played by the notion of system in the modernist epistemology of the fifties and sixties and the notion of structure in the structuralism(s) of the seventies and eighties. By introducing the binary form one/zero, information can transgress all the above polarities and establish a standard mental map capable of embedding all the crucial agents that form and transform the earth, organic life, materiality, and abiotic actors.²²

Understanding this interdependence between material and alive, human and nonhuman, natural and artificial, also contributed to appreciating the harmful impact of the humans' power -stemming from their intellectual

22. Cf. Spiridonidis (2019) p.24.

superiority- over the natural environment, totally underestimated in modernity. Based on this appreciation, the emerging worldview's ethical and geo-political dimension introduces new ethical values and principles for actions. The catastrophic effects of our recent times not only are far from the promises of prosperity that modernity pledged as a result of the 'progress' it would bring about, putting us, however, at risk of extinction as a species. The 'Anthropocene' as a construct of human intelligence, an alert for an immediate threat to human existence, ought to consider other equally efficient forms of nonhuman bits of intelligence. That presupposes that human accept that **intelligence is not only human**.

The second-order cybernetics was the theoretical basis empowering research on information transmission machines towards the processing of the transmitted -or to be transmitted- information, and the development of artificial forms of cognition like self-organization, learning, intelligence, and life²³. The acceleration of information technology and computation highly supported modernity's anthropocentric project of the sixties and seventies to artificialize different forms of cognition as a sign of human superiority and sovereignty. Computing machines, digital devices, and applications formed progressively a new artificial environment that, by the end of the century, appeared to threaten human sovereignty and the degree of its dependence upon human control. The capacities of intelligent machines allow them to substitute a broad spectrum of human mental and practical activities and sensing speedily and effectively. However, the detachment of the human bodies from these activities directly alienates them from their perception. Humans develop new skills, but they also seem to fall behind with skills that used to make them unique, such as memorizing, calculating, writing, seeing, and

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

finally, abstracting and thinking, which is the basis for the genesis of ideas.²⁴

Computation tools do not only extend human abilities over time as conventional prosthetics but also disable some other human abilities. However, through their planetary governance, intelligent machines also introduce humans to new abstractions and speculations, disrupting human reasoning and guiding human actions, decisions, and choices within the spectrum of the biases inherent to technological means²⁵. With planetary computation, climate change, pandemics, finances, and even wars can be audited, observed, measured, modeled, and ultimately assessed and managed. That means that all fundamental geo-political issues cannot be reckoned without the geotechnical dimensions that recent intelligent developments detect, define, and perceive.²⁶ The geo-political and the geo-technical are in a continuum. Blurring the lines of demarcation between human and nonhuman intelligence brings nonhuman intelligence to the forefront of a revised worldview for the human.

In this revision, the emergent contemporary contemplations focus on Gaia as a living organism, an ecology of more ecologies in symbioses, with human entities as part of these ecologies. The concept of Gaia advocates the reconciliation of obsolete polarities founded in anthropocentrism and recognizes continuities and symbiotic interconnections. The human is no longer conceived as the dominant agent and controller of all-natural elements and artefacts or the sole intelligent entity that can safely form and transform them (Voyatzaki, 2018, p.12). The self-organizing capacity of the

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

25. As Ramsay (2011) sustains, "Algorithms are Thoughts, Chainsaws are tools".

26. Bratton, (2019: 66)

material and immaterial entities of Gaia is the new design intelligence.

As matter is no longer passive, opaque, inert, and not about being but about becoming,²⁷ it is the power of its vitality that renders the materiality of architecture an irrelevant pursuit. The vitality of matter, instead, is about the architecture²⁸ of materiality. The idea of Gaia as living matter emerges from the contemplation of material formations like edibles, commodities, artefacts, or machines, but also physical phenomena and materials. All of this impact our wills, desires, decisions, behaviors, mental and bodily structures and identities, our lives, social structures, institutions, ethics, aesthetics, and politics. Intelligent machines accelerate work on the architecture of these vital materiality that are responsible for the survival of Gaia.

The new Architecture of the design intelligence

Nowadays, Architecture is challenged to generate new discourses and practices that can formulate legitimizing narratives, and new mythologies to drive design activity into the new panorama of ideas and speculations compatible with this worldview and conception of the human. Even though the new design intelligence is still under construction, we can define several issues that we estimate will be its cornerstones.

The contemporary geocentric worldview operates in a transdisciplinary information realm. Debunking human intelligence for designing its extinction, is now

27. Cf. Bennett (2010) and Vogiatzaki (2018).

28. Architecture here is meant, in each broader sense, to how mental constructs shape new appreciations of this new materiality. Architecture is the invention of the structure of an ecology that influences the relationship between its parts.

empowering nonhuman intelligent machines and nature to take over and offer their creativity through speculations of a world to be. Intelligent machines are apt to learn their way and speculate on viable and unforeseeable futures, informed by the granularity of the emergent relationships.²⁹

The epistemological shift from the humanities of post-modernism to the trans disciplinarity between the sciences and the humanities is the new ethos of contemporary design intelligence. Top-down determinism or bottom-up emergence meet in the middle and no longer recognize notions such as design concepts³⁰. The design process is in osmosis, and in a continuous feedback loop between humans and learning machines.

The polarization of the design process as either a 'glass box' cognitive mechanism of modernism or a 'black box' of post-modernism give way to a 'grey' hybrid box of human and nonhuman speculation, creativity, and radical novelty, deeply rooted in the ethical and the political.

The new participatory approach to design gathers bits of intelligence, these human and nonhuman bits of intelligence that contemplate speculatively towards reconstructing the new human, its revised social underpinnings, and its new aesthetics.

Novel responses to architecture speculated by this human-nonhuman creativity are scaleless and often not conventionally defined as architecture. Lacaton and

29. For a comparative example of the implementation of artificial intelligence application on architectural design cf. Chaillou (2019: 25–75).

30. The preparation for this new intelligent design ethos started well in advance by the mid of nineties. Cf. Foreign Office Architects (1996: 58).

Vassal's refusal to redesign when they do not see the point, to responding to the collapse of rivers in the woods of Oregon by reintroducing wolves and not dams and human-made controlling constructions are offering new opportunities for the future of a speculative discipline tasked to improve human life. The improvement of human life is only attainable in contemporary times through its respect for the nonhuman. The design intelligence of our times can only become relevant and topical again if it leaves behind the arrogance of its past glory and sovereignty of the implied human to co-author with its nonhuman counterparts.

Skepticism, by default, will always challenge change and radicalism. However, this new approach will not extinguish but will re-write, re-edit the human constructs, and revise their ethos and skillsets. Pangaro (2019:7) proposes the term conversation borrowed from cybernetics. Communication is the ground for collaboration and cooperation. For agents to communicate they need a common 'language' but not necessarily the human-biased language. The human element of the new design intelligence needs to speak the same language as its nonhuman counterparts. The appropriate age threshold for humans to acquire coding skills is dropping drastically. Coding, associative, and relational thinking must become the 'native language' and skillset of all, not only for the design process but also for any process conducted in contemporary life.³¹ Only a common language for communication can sustain co-authorship between humans and nonhumans, away from any technophobia of an envisaged future dystopia.

31. Pangaro, considers Conversation as the foundation of any community. It can be assured only if there is an appropriate context, a common communication channel, an engagement of the agents, an agreement on the exchanged data, and a (trans)action. Cf. Pangaro, P. (2017), Conversation is more than Interface. <https://vimeo.com/207866146>.

The post-human design intelligence introduces a different understanding of the building's life. The building of tomorrow will no longer be considered something tangible, perceived, or presented to the senses (objectum) thrown ahead of us (ob-'on the way of' + jacere-'to throw') as an object. It will no longer be understood as finite 'όλον' exposed to our experience as indisputable material, completed, factual or objective and present to function and serve regardless of whether it is liked or not. On the contrary, it will be conceived as a continuous part of a bigger 'όλον', a broader assemblage of other entities, and alterity³². In this alterity, the building will be open to establishing multiple, unstable, unpredictable, and emergent relations with the other entities of this complex and dynamic environment. As part of this assemblage, the building will no longer be constrained by its materiality. It will become an interface in a dynamic system of relationships depended upon and defined by a flux of information and data, a point in a point cloud. There will be a continuum between its proper substance and its alterity: a *syn+eheia* (έχω-eho: to have).

By shifting the essence from its internal elements and relationships into the complex, dynamic and fluid assemblages, it -or its parts- can be part of the building and will be understood as the temporary result of a continuous praxis emerging from the information flux, a 'πράγμα', a thing in Greek. As an outcome of this dynamic praxis, the building will be conceived as a thing in the making, a becoming. A building that will be a transformable 'πράγμα' that needs energy and information to interact, self-engage and get self-organized in an affective relation with its intruder and with all other agents involved from its design to its fabrication, to its inhabitation, to its survival, mutation or even death. In the context of this conception, the act of creating architecture will aim at the becoming of a building as an

32. Cf. Guattari, F. (1995).

‘όλον’, as a ‘πράγμα’, a thing attached to a series of transformable interfaces that form its ecosystem. The building as a carrier of information will cease to exist unless it is in symbiosis with this information flow in its body and its broader ecosystem. To exist as a thing, a building will have to be able to establish dynamic relationships with other agents of this ecosystem towards forming a specific assemblage of agents, a machinic assemblage, a syn+praxis.

In this new form of assemblage, the agents will have to act so that the assemblage could be syn-bio-tic. At the same time, they will have to sustain the results of the actions of the others so that the assemblage will become syn-pathetic. The building will no longer be an artificial and mute object in these permanent dynamics of active and passive relationships. It will become an intelligent, alive and affective system and environment. Not in metaphorical terms that all other architectural ‘paradigms’ followed as a reference point for their design proposals; neither in animistic terms attributing to the building a kind of anima, but in biogenetic terms as a proto subjectivity that carries, uses and (trans)forms information as it evolves and develops. The building will be created to resemble nature through the information it will be carrying, blurring the boundaries between the natural and the artificial in a sym+biosis.

Beyond its belonging to a broader assemblage, the building of tomorrow will also constitute an assemblage of things-components. These components are linked among them with relationships tied to values and articulate the ethics of the building. A new aesthetics or rather aeth+ethics attune to this value system. The beauty that will shape the architecture of the future is no longer the beauty defined in romanticism terms. Beauty will be an affect, a contemplation, a pre-individual sensation, converging and diverging resonances, beauty as sympathy, among things. A new aesthetics that comes from

a neo-material philosophical detour that does not see computational design as the new stylistic idioms of digital architecture but to unleash its futurity³³. Beauty emerges among the agents/patients of cosmos. Beauty as sym+pathy³⁴.

The building of tomorrow will not be designed from scratch. It will always be consciously considered that at the beginning of its creation, there will always be rejection, approval, doubt, problem, a condition to be redesigned³⁵. The building of tomorrow will not only constitute a look forward but also a look backward. It will not only focus on anticipating the future but also on contemplating the past. The building will bind its temporality and futurity, these two seemingly opposing and polemic binary understandings of human contemplation that nourished cultural creation for time immemorial. To think before or to think after the 'myth'? This way, the building++ will open its 'doors' and will give 'space' to both Prometheus + Epimetheus³⁶ to anticipate, contemplate and inhabit it as part of a broader ecosystem. Material+ Immaterial, Natural + Artificial, Techne + Chronos,³⁷ Past + Future will be syn+chronic.

33 . Cf. Parisi (2013).

34.Cf. Spuybroek (2011).

35.Cf. Latour (2018)

36.Cf. Amis (2009)

37.Stiegler, B. (1998) *Technics and Time; The fault of Epimetheus*, Stanford University, California: Stanford.
http://books.google.co.uk/books/about/Technics_and_Time_The_fault_of_Epimetheus.html?id=uJdoW2MLdQgC

Chapter I.6:

Peoples' values and feelings matter: Participatory heritage management using social media

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Abstract

Social media has been increasingly used by various communities to express their opinions, values, and feelings about cities and, in particular, built heritage. Social media platforms, interactive technologies used by virtual communities and networks became an important source for recent innovative studies on participatory heritage management. Amongst them, the application of artificial intelligence (AI) methods to analyze social media data for heritage management, in particular peoples' feelings and their relation to cultural significance (values and attributes), is seldom explored. This chapter explores the potential of social media content as a data source and artificial intelligence methods to analyze people's feelings and opinions about the cultural significance of built heritage. The city of Yazd, Iran, was taken as a case study, with a specific focus on windcatchers (architectural element used for natural ventilation), a key

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urban attribute also conveying outstanding universal value, ever since inscribed on the UNESCO World Heritage List in 2017. This chapter details: 1) the state of the art on participatory heritage management using social media; 2) the methodology to extract values and sentiments assigned to windcatchers on Instagram and Twitter posts over the last ten years; 3) and last, the preliminary findings on the values of windcatchers, sentiment and emotion analysis, and the association analysis between the values of windcatchers and emotions. Results indicate the most and least addressed categories of values and emotions. Moreover, some potential relations between values and emotions (e.g., economic, ecological, and scientific values with trust) are revealed. Besides, it became proven that negative sentiments over windcatchers of Yazd are scarcely expressed (e.g., critiques) in social media. This study confirms the potential of social media for heritage management in terms of (de)coding and measuring the values of heritage attributes and related feelings. This research is useful to the windcatchers in Yazd, but also replicable to other case studies and scales.

Keywords:

Social media, artificial intelligence, public participation, cultural significance, sentiment analysis, emotions

1. Introduction

People observe, experience, and interact with their environment, expressing their values and feelings (Pitsilides et al., 2012; Gorz, 1984). There has been a growing interest in including people's opinions in planning fields, and particularly in the heritage field, through a participatory approach (Landorf, 2009). A participatory approach is often positively associated with socially inclusive innovation processes, cultural value creation (Nakagawa, 2010; Sasaki, 2010), and a shared sense of identity (Biondi et al., 2020).

This fundamental change in the relation between heritage and the public is promoting collaboration, sharing interests, views, feelings, and sensitivities (Dodd, 1994), which reinforces their place attachment for being a member of a community, and growing ownership on heritage. Linked to a sense of living, heritage is dynamically recreated by communities in response to their interactions with nature and history, generating a sense of identity and continuity (Silberman et al., 2012).

Online communities have increasingly used social media platforms to share their opinions and create discussions over buildings and cities, particularly built heritage. The activity of diverse groups of people in social media leads to an interactive practice of 'remembering together'. It is more than simply individually sharing information because it encompasses discussing (e.g., (re)posting, responding) diverse experiences, understandings, feelings, and values about events with particular significance (Simon, R., 2012). Accordingly, van Dijck (2007) claims social media facilitates the culture of connectivity. Consequently, forming a collective memory in social media platforms offers new ways of public participation in heritage management (Simon, 2012).

In fact, social media posts shared through online conversations provide opportunities for smart technologies (e.g., Artificial Intelligence - AI) and techniques (e.g., Natural Language Processing - NLP) to capture and decode public voices at an unprecedented pace, which can potentially dynamize the dominant planning power structure (Tayebi, 2013). Besides, social media can reduce costs and upscale the involvement of stakeholders in urban planning (Ye et al., 2021; Kleinhans et al., 2015).

Social media platforms have been recently applied for participatory heritage management (Silberman et al., 2012; Giaccardi, 2012). Decoding cultural significance by distinguishing attributes (resources to be conserved) and values (the reasons to conserve the resources) is growing in attention both by research and practice, as endorsed by UNESCO Recommendation on the Historic Urban Landscape (UNESCO, 2011). Diverse scholars have been using social media to conduct innovative research to engage people and interpret their opinions and sentiments. They already analyzed people's feelings (Liang et al., 2021; Joseph, 2021; Abdul-Rahman, 2021; Alizadeh et al., 2019) and their values (Ginzarly et al. 2019) related to spatial areas and heritage properties using AI models. However, no paper was found exploring the potential relations between sentiments and values.

Social media and artificial intelligence (AI) is, therefore, yet to be further explored in this topic. Even if widely addressed, there is a lack of research and heritage-specific tools to decode the cultural significance of built heritage, distinguishing and relating values (Bai et al., 2021). In addition, literature often focuses on the scale of country, city, and neighborhood (Monachesi, 2020; Ginzarly et al., 2019; Alizadeh et al., 2019), rather than specific attributes of cities, architectural elements such as the windcatchers. Hence, this chapter aims to

investigate the potentials of social media as a data source and artificial intelligence methods for revealing the cultural significance (values and attributes) of built heritage: in particular, windcatchers of the city of Yazd, Iran was taken as a case study.

2. Method

This research is conducted in four steps: data acquisition, data pre-processing, data analysis, and results (see Figure 1).

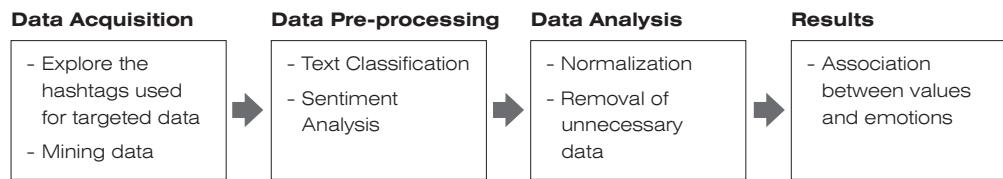


Figure 1. Overview of the research process.

2.1. Data acquisition

Related posts to the windcatchers of Yazd were mined from Instagram and Twitter. Various Persian and English hashtags are used referring to windcatchers including “badgir”, “wind-catcher”, “windcatcher”, “wind-tower”, “windtower”, «یاریگداداب», «امریگداداب», «ریگداداب», «ریگداداب», «زی_یاریگداداب», «زی_ریگداداب». This research retrieved all posts using these hashtags by WebHarvey software (23,899 posts). No time limit was applied to scoping the dataset.

The content of the data includes user name, post, time (time posted), number of likes, number of users' posts, number of users' followers, number of users' followings, and users' bio. The data do not cover the demographic characteristic of users, including age, gender,

education, and professional status, because mostly these are not provided by the users. Moreover, this research considers ethical issues by only processing the comments expressing heritage cultural significance and not using or storing any sensitive personal data. Personal data will not be disclosed at any research stages, and the users' identities will remain anonymous.

2.2. Data cleaning and pre-processing

The gathered posts not mentioning windcatchers and Yazd were excluded. To find these posts, the different forms of the word "Yazd" (both in Persian and English) were normalized to "yazd" with lowercase, and all posts that did not include "yazd" were excluded from the dataset. In the end, a total number of 3,346 sentences were analyzed. In addition to text normalization, unnecessary data (e.g., mentions, emojis, punctuation marks, website links) were removed to facilitate the data analysis.

2.3. Data analysis

After the data cleaning and pre-processing, the dataset was ready for automatic content analysis. The content of each post was analyzed and assessed through automated quantitative content analysis and qualitative categorical analysis. The quantitative analysis revealed the most and least frequent words. The qualitative analysis showed how users refer to windcatchers and associate them with values and sentiments. Values are the reasons that people want to protect heritage resources. Sentiments are people's feelings attached to heritage resources.



Figure 2. Cultural Values Framework (Pereira Roders, 2007)

2.3.1 Values analysis

The addressed values were analyzed on eight scales (see figure 2) - social, economic, political, historic, aesthetical, scientific, age, and ecological - using the cultural values framework (Pereira Roders, 2007). The multi-class text classification analysis of values was undertaken using Python libraries, including Numpy (for calculation analysis), Pandas (for research on the data frame), and Bert model (word embedding). This research used the cosine similarity method for the multi-class text classification, because the distribution of labels in the available train dataset differed drastically, and there were not enough available trained datasets.

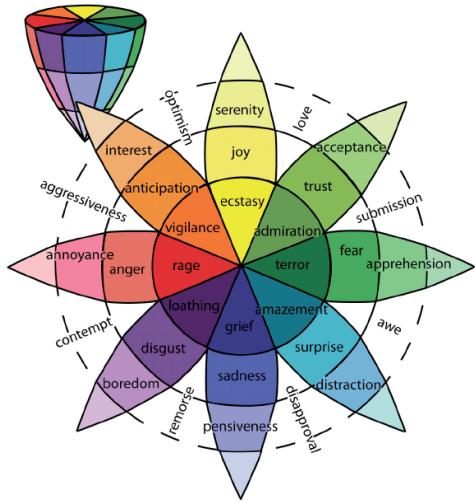


Figure 3. Plutchik wheel of emotions (Donaldson, M., 2017)

2.3.2 Sentiment analysis

The overall sentiment of posts was analyzed on five scales, from very positive to very negative, using the transformers library to load a pre-trained transformer model and the Bert model, developed by Devlin et al. (2018), to create the Word embedding. Word embedding encodes the words' meanings into vectors, and the terms that are closer in the vector space are expected to be similar in meaning. The embedding fed into the Gated Recurrent Unit (GRU) model to predict sentiment. Despite the algorithmic limitations, the results' reliability was confirmed (accuracy: 94%, precision_value: 72%, and F-measure: 77%). To reveal more details on sentiment analysis, emotions within each group of sentiments were conducted on the data set, using Plutchik's wheel of emotions (Robert, 1980). This theoretical framework clusters emotions in eight basic emotions, which are four pairs of opposite emotions: joy and sadness; anger and fear; trust and disgust; and surprise and anticipation (see figure 3).

3. Results

3.1 Values of windcatchers in Yazd

Most of the posts (66%) conveyed at least one of the eight values to the windcatchers of Yazd. The most frequent values are respectively age (26%), historic (18%), social (16%), aesthetical (14%), economic (10%),

2. **Accuracy** :
$$\frac{(\text{TruePositives}_1 + \text{TruePositives}_2) + (\text{TrueNegative}_1 + \text{TrueNegative}_2)}{(\text{TruePositives}_1 + \text{TruePositives}_2) + (\text{TrueNegative}_1 + \text{TrueNegative}_2) + (\text{FalsePositives}_1 + \text{FalsePositives}_2) + (\text{FalseNegative}_1 + \text{FalseNegative}_2)}$$

Precision_value :
$$\frac{(\text{TruePositives}_1 + \text{TruePositives}_2)}{(\text{TruePositives}_1 + \text{TruePositives}_2) + (\text{FalsePositives}_1 + \text{FalsePositives}_2)}$$

F-measure :
$$\frac{2 * \text{Precision} * \text{Recall}}{(\text{Precision} + \text{Recall})}$$

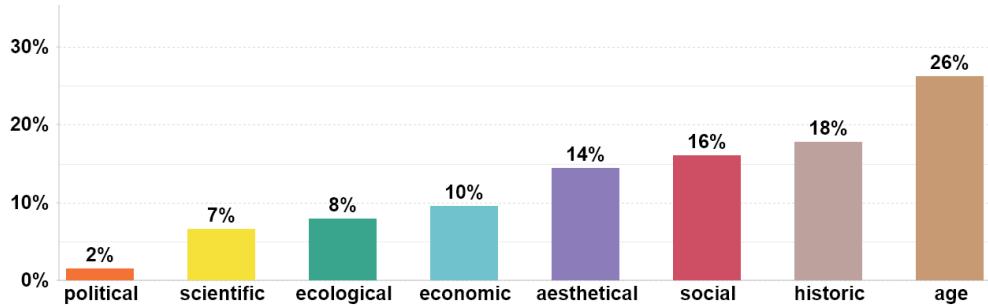


Figure 4. The frequency of values in all the collected posts.

3.2 Sentiment analysis and relation with values

Sentiment analysis revealed the dominancy of posts with very positive and positive feelings (86%) followed by posts with neutral feelings (14%), and only 14 posts were found expressing negative feelings. These findings contradict the scholars concluding that people often use social media to complain and generally be pessimistic about urban issues (Resch, Summa, Zeile, & Strube, 2016).

To disclose more details on sentiment analysis, emotions within each group of sentiments were analyzed. The dominant emotions expressed by posts, as expected, are positive (joy, trust, surprise, and anticipation). While among these positive emotions, dominant ones are respectively joy (45%), trust (30%), and surprise (21%), anticipation is rarely addressed.

The association analysis between values and only the dominant emotions (namely joy, trust, surprise) was explored because other emotions are rarely mentioned. This analysis shows some relations, for example, While 73% (the maximum percentage in diagram 5) of posts conveying aesthetical value express joy, only 12% (the minimum percentage in diagram 5) express surprise. This can show a strong relation between aesthetical

value and emotion of joy and a weak relation between aesthetical value and emotion of surprise among people posting about windcatchers of Yazd.

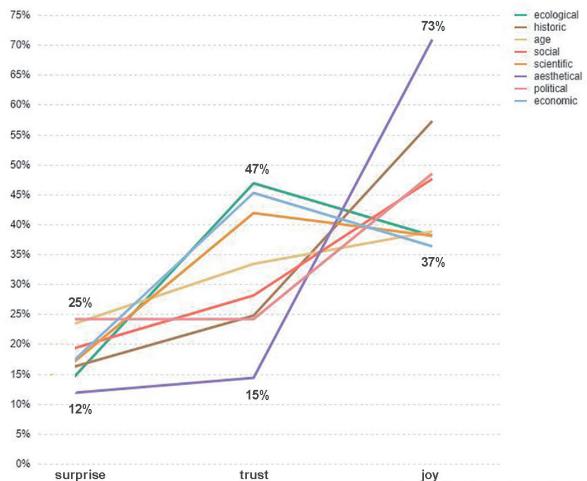


Figure 5. the association between the dominant emotions and the values.

Surprise has the minimum association with all the values among the most common emotions (e.g., *"It is well known as the city of windcatcher an amazing piece of ancient tech!"*) as the minimum percentage of posts refer to surprise (from 25% to 12%). Interestingly, aesthetical, historic, political, social, and age values are more linked with joy than trust (see figure 5). For example, the word "beautiful" associated with aesthetic value conveys joy as emotion (e.g., *"We loved exploring Yazd from its secret rooftops... From there, you get a view of its beautiful windcatchers..."*). On the other hand, economic, ecological, and scientific values relate more to trust than joy (e.g., *"windcatchers are engineering elements used to create natural air conditioning"*) (see table 1). To better understand the association between values and emotions in the analysis, more exemplary quotes are shown in table 1.

Exemplary quotes	Values	AI logics	Emotion
We're visiting one of the most <i>beautiful viewpoint</i> in the world! From #arthouseyazzd you can see a panoramic view of #yazd and it's magic #windcatcher and #dome! #tourguide#privatetour #traveltoiran #privat-guidedtours. (guidepersia, 2019)	aesthetical	beautiful (aesthetical),	joy
Beautiful <i>historic</i> city of Yazd, the Zoroastrian temple, the city of windcatchers, very <i>beautiful</i> and <i>historic</i> , with hospitable people. (m.akbari2000, 2019)	historic, aesthetical	historic (historic), beautiful (aesthetical)	joy
<i>Beautiful</i> architecture of #dowlatabad garden and the world tallest wind tower (#badgir) in the UNESCO registered city of #yazd. (seeyouinyazd, 2019)	aesthetical	beautiful (aesthetical)	joy
We loved exploring Yazd from its secret rooftops... From there, you get a view of its <i>beautiful</i> windcatchers (badgir) designed to cool homes, poking out of the baked-brown labyrinth of lanes. (maryzeuk, 2016)	aesthetical	beautiful (aesthetical)	joy
This house is noteworthy in terms of using the <i>traditional</i> Iranian architecture ... its two-floor windtower(BADGIR) is unique and awesome. The <i>antiquity</i> of this house dating back to <i>Qajar period</i> . (dreamtrip2iran, 2016)	Political, historic, age	Zandieh and Qajar period (Political), history of 270 years (historic, age)	joy
<i>Beautiful</i> rooftop view of the old part of Yazd, with all its badgirs (windcatchers) and blue domes. (svenpunkt, 2020)	social, age	traditional (social, age)	joy
windcatchers are <i>engineering elements</i> used to create <i>natural air conditioning</i> (ifilmenglish, 2018)	aesthetical, age	beautiful (aesthetical), old (age)	joy
Badgirs are in shape of high structures designed to <i>cool</i> the inner environment of the houses by receiving the wind; <i>cooling</i> it; and directing the stream of cool wind into the inner spaces. ... (khavartravel.en, 2019)	Scientific, ecological, economic	engineering elements (scientific), natural (ecological), air conditioning (economic)	trust
A windcatcher (windcatcher) is a <i>traditional</i> Persian <i>architectural element</i> to create <i>natural ventilation</i> in buildings. (smm870508, 2015)	economic	cool (economic), cooling (economic)	trust
The famous Yazdi wind-catchers/badgirs, <i>ancient</i> system of <i>natural air-conditioning</i> designed to <i>catch even the lightest breeze</i> and <i>direct it to the rooms below</i> (batakoja, 2016)	economic	traditional (social, age), architectural element (scientific), natural (ecological), ventilation (economic)	trust
... #BADGIR is a #traditional #handmade <i>engineering</i> architectural #masterpiece to deal with the unbearable heat of the central #Iranian desert. ... (who_loves_iran, 2017)	age, ecological, economic	ancient (age), natural (ecological), air-conditioning (economic)	trust

Exemplary quotes	Values	AI logics	Emotion
It is well known as the city of windcatcher an amazing piece of <i>ancient tech!</i> (emmeandeffe, 2020)	social, age, scientific	traditional (social, age), engineering (scientific)	trust
<i>Qajar and Zand governments</i> built the world's tallest brick tower (wind catcher) the interior view of dowlat abad mansion's clay windcatcher , yazd , iran. ... (handycraft, 2020)	age	ancient (age)	surprise
A windtower is one of the most famous elements in the <i>traditional</i> Iranian architecture. ... (beautifulworldoftravel, 2020)	political	Qajar and Zand governments (political)	surprise
... The program that can be considered as "the most treacherous acting against Iran's <i>national identity</i> " is a brazen attempt of the UAE sheikhs to inscribe "Iranian windcatcher " as " windcatcher and Arabic heritage" in the United Nations and this obvious theft is soon to be recognized. ... (amlakbank, 2019)	social, age	traditional (social, age)	surprise
... Probably windcatchers cannot function properly as a <i>traditional</i> architectural element. (moudi.forouhi.photo, 2020)	social	national identity (social)	anger
We're visiting one of the most <i>beautiful viewpoint</i> in the world! From #arthouseyazd you can see a panoramic view of #yazd and it's magic #windcatcher and #dome! #tourguide#privatetour #traveltoiran #private-guidedtours. (guidepersia, 2019)	social, age	traditional (social, age)	sadness

Table 1. Exemplary quotes and addressed values

Overall, the result item shows that both Instagram and Twitter users have been actively sharing their opinions over why windcatchers are significant (or not), assigning positive or negative feelings. This was made possible by decoding their views into classes of values and sentiments. The analysis of emotions and their associations with values is seldom investigated in the literature. This gap has started to be filled up in this research, which indicates that sentiments could be at the core of the value formation. For instance, if people attach a negative feeling to an attribute (e.g., windcatcher), they probably associate a negative value to it. Besides, some classes of values are keener to be more firmly attached

to certain emotions (e.g., aesthetical value with joy, and scientific value with trust).

4. Discussion and conclusion

Social media contributes to the act of remembering together, strengthening the sense of belonging and place attachment to the built heritage. Reaching and considering collective values and feelings about built heritage in an inclusive way contribute to the sense of identity and continuity, increasing the chances of a heritage attribute being conserved. Overall, the main contribution of this paper was to reveal the potential of applying social media analysis for participatory heritage management processes through the identification and interpretation of values and their association with sentiments and emotions.

Artificial intelligence methods were used to extract people's feelings and values assigned to windcatchers of Yazd from Instagram and Twitter over the last ten years. In contrast to some scholars' findings that people often use social media to be pessimistic about urban issues, posts rarely addressed negative sentiments over windcatchers in this research. Also, the association between values and the dominant emotions (namely joy, trust, and surprise) was analyzed, revealing some initial relations such as the relation between aesthetical values and joy, as well as, the scientific values and trust. Emotions might be related to the reasons why people convey value and how they interact with heritage and its attributes. Accordingly, this might affect how the public engages with heritage management. Still, this is just the start. Further research is needed to analyze the importance of emotions and how the relationship between emotions and value formation can be an asset for more inclusive heritage management.

The results of the data analysis provided a better understanding of the public's feelings and values assigned to windcatchers in Yazd, Iran. An innovative aspect of this research is the methodological process developed, which can be applied to other case studies with different scales.

Future studies are needed to advance social media data analytics, particularly concerning heritage management. First, social media's potential for crowdsourcing and real-time data analysis could drastically affect heritage management decision-making. The second issue is how to utilize the collective values and emotions expressed by online communities in heritage management to align with the sense of continuity and strengthen the collective memory and conservation of built heritage. Through these actions, social media and AI methods have the potential to contribute to more inclusive heritage management, bringing together a diversity of public voices in all its spectrum of positive and negative emotions and values. When better aware of the relation between values and sentiments, policymakers can better define their strategies, triggering them to rather invest in trust when motivating residents to keep their houses' windcatchers and use them as natural ventilation systems (conveying ecological and economic values), or in joy, when motivating residents to keep windcatchers based on beauty and scenery (aesthetical values). A small but crucial difference that can ensure the success of strategic planning in heritage management.

Second Part

Some Theoretical Considerations in Order to Start a Dialogy between the Three Branches of the Langer's Tree

JOSEP MUNTAÑOLA

In the first part, this book describes theories and research examples to know the challenges that the digitalization of human cultures implant into the design education of today in all the systems included in the diagrams I and II. Also, the Langer's tree with its mysterious third branch advises humanity that the computer is not just a new technical tool, because it supposes a kind of knowledge different of the other two branches of the tree. As in the known case of the Deep Blue Chess Computer, the opinion of the chess champion Magnus Carlsen is significant. He says that the computer always wins in a competition with him, the best player on the earth today, but as he himself pointed out, he learns almost nothing playing with the computer, because he always loses. To learn, he needs a real intersubjective confrontation with real good players of chess, and since the intersubjective confrontation is far away of the knowledge of the machine, because it cannot know in real subjective space and time the feelings of the two players, he stopped to play with it. Moreover, in order the computer to know that real chess confrontations should be substitute by a virtual platform of playing chess, or in other words, by playing chess virtual games among avatars or robots, that already exist. Then, chess

will survive only in virtual environments, but not in real socio-physical real confrontations. And this can be applied to architecture and planning too.

Since we want in this second part of this book to focus our attention into education. Let's show in a very abstract way how the architectural cognition develops in the ontogenetic branch of the Langer's Tree, with specific and important ontogenetic "transitions".

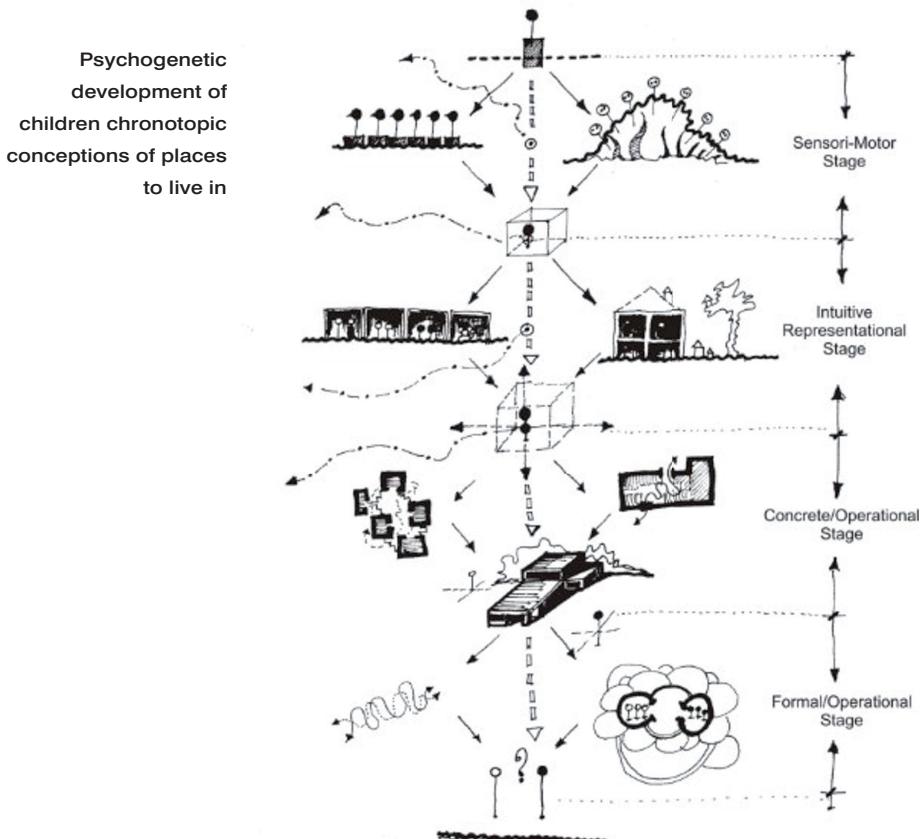


Diagram III. The Psychogenetic Development of Architectural Knowledge.

Children Model Of Cities: Monologic And Dialogic Structures

Diagram IV. *Models of Cities Built by children.*



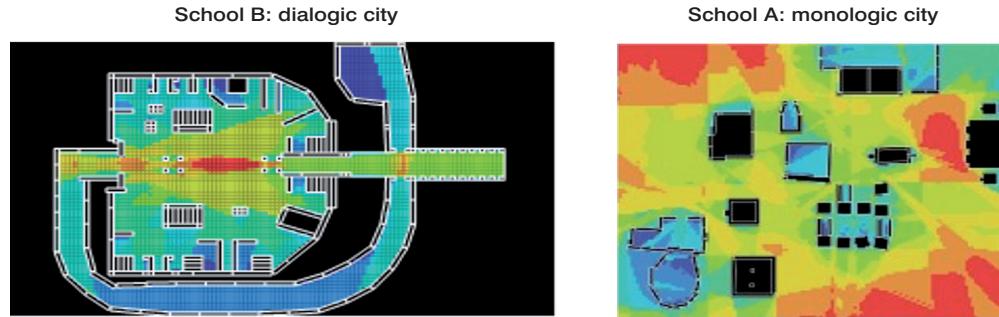


Diagram V. The Dialogical and Monological Socio-Fisical Differences Analysed by The Space Syntax Algorithm.

Children Model of Cities: Monologic and Dialogic Structures

Dialogic cities		Monologic cities	
Subjects	Objects	Subjects	Objects
S1	01	S1	01
S2	02	S2	02
S3	03	S3	03
<i>Points of view and "voices" interrelated.</i>	Physical and social space and time are interrelated chronotopically.	<i>Points of view and "voices" are independent of each other.</i>	Physical space & time, and "social" space & time, only relate at the individual level. The objects' relations and the subjects' relations do not correlate.
There is a configuration between subjects and objects.	Norms for objects are interdependent of the subjects' norms.	There is no configuration between subjects and objects.	Norms for objects are independent from norms for subjects.
	Objects and subjects configure a context.		Objects and Subjects are context free.

Diagram VI. The Social-Physical Interaction According to the Dialogical Education of the Schools.



ET - L - 40 - 1



JOE L - 4 - 10 - 1



ART 49 - 2



JOE D - 4 - 10 - 1

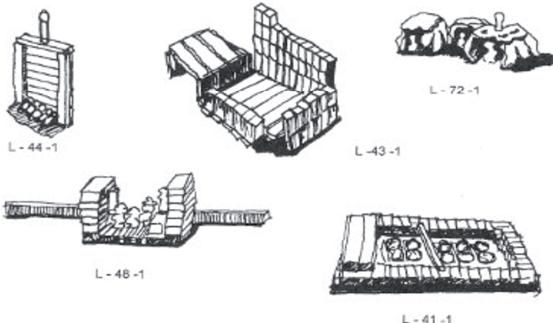
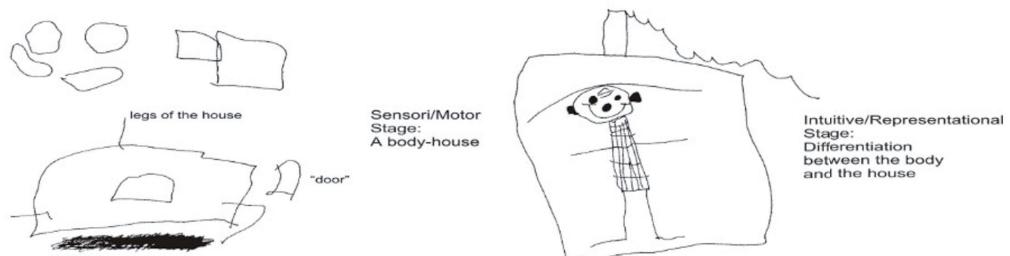


Diagram VII. The Beginning of the Space and Time Knowledge in Empty Places.

Everybody is sleeping Representing the Human Void.



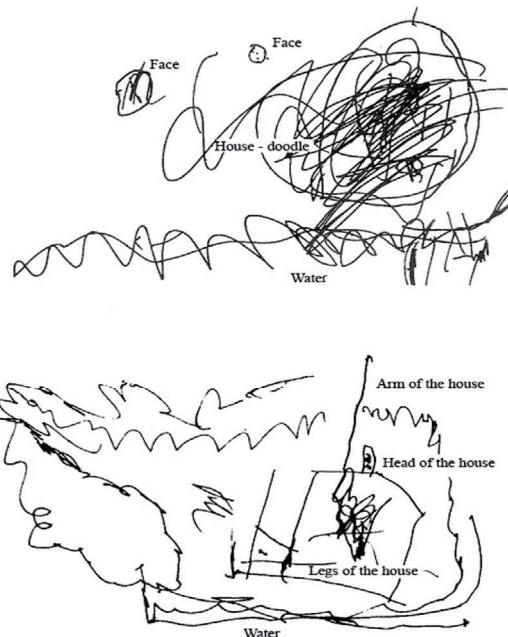


Diagram VIII. The first Architectural Transition from Body- Places to Houses.

This ontogenetic model of architecture and of design in general is the output of thousands of experiences in different countries with children from two years of age until teenagers of 15 years. The diagram III is the general psychogenetic development of children architectural cognition from 2 to 15 years of age. There are a lot of previous works on this development included into the final bibliography, for our aim here we just analyze the main consequences of this psychogenetic development in our design education today. (Muntañola J.1973,1980,2012,2021)

The two fundamental changes of the space and time ability of children take place approximately at the 3 years and at the 7 years of age. The first change supposes the uncovering of a first degree of time order, so the body is not identified with the design house, tree, etc. (Diagram

VIII) and it can be inside or outside of the design. The designs obtained a permanence outside body direct life and a first degree of abstraction arises in the brains of children. Observe that this transition demands everybody "to sleep", (Diagram VII) that is to be without active senses, either touch, seeing or smell altogether. This is the price you need to pay in order to understand what an abstract empty space is, and at the same time, the gain is a life independent of a direct control by the environment. To claim that this new situation is a loss of human naturality it is a wrong position, as we argue later. This first change allows children to speak.

The second big transition is around 7 years when the time takes a new power of a general time order for all and the correlation of different viewpoints is fully understood and the second topological space order, to be inside in other inside, can be represented. Here the key is not to sleep, on the contrary is the identification of each person a different active human being, my mother in the kitchen, my father in the television, that is crucial, and a new intersubjective social interaction enters in the real life. This is also a somewhat sleeping process since nobody can be in the same place at the same time, and this allows a higher level of abstraction and free knowledge that has been defined in the tradition as the "age of reason" or as a change from childhood to "adult children".

The second change allows the understanding of geometrical usual projective relationships as the right line, the curve, and the basic Euclidean forms. However the full Euclidean abstracts geometric and mathematic Euclidean relations take more years to be understood.

In Diagrams IV you have a synthesis of hundreds of experiments with six children, three boys and three girls, making a model for the best city together. (Muntañola et alt 2012)

For our objective here it is fundamental to know that the genetic development of the spatial mental capabilities takes an ontogenetic order in total opposite direction of the historical cultural development of mathematics. The mathematical foundations of the projective geometry, coming from the mathematics at the time of Euclides, takes several centuries to develop, and also take several centuries more in order to develop the topological mathematical structures today in our computer. Children on the contrary, manage first the topological orders, after the projective geometric systems, and finally the Euclidean three-dimensional forms, of course in an intuitive form, not in a "formal mathematic" way. So, the physical development needs first topology, after projective order and finally the Euclidian physical control or the physical equivalent in other geometries. But social geometrical scientific development needs other order, since the topological physical mathematical orders need, to be understood, complex mathematical systems that needed centuries to evolve.

This basic involution between the ontogenetic and phylogenetic cognitive development explains why the design education need to start from intuitive syntactic bases to keep scientific and artistic human conditions in a simultaneous growing process. Human bodies are not machines, so the abstraction emerges from a crossing point between two different epigenetic human processes, one coming from the environment to the brain (Bottom up) and another going from the brain to the environment in form of actions, reactions, and perception after the interpretation of the whole situation (Top. Bottom) (See diagram IX) (Friston K. and others eds. 2000).

Neurological Fundamental Feedback between Senses and Simulation

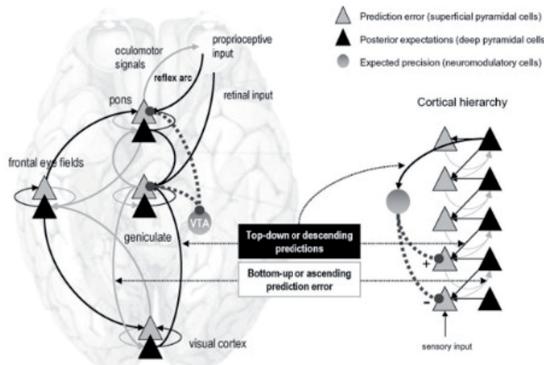


Fig. 2. This figure summarizes the neuronal message passing that underlies predictive coding. The basic idea is that neuronal activity encodes *expectations* about the causes of sensory input, where these expectations minimize *prediction error*. Prediction error is the difference between (ascending) sensory input and (descending) predictions of that input. This minimization rests upon recurrent neuronal interactions between different levels of cortical hierarchies. Anatomical and physiological evidence suggests that superficial pyramidal cells (grey triangles) compare the representations (at each level) with top-down predictions from deep pyramidal cells (black triangles) of higher levels. **Right panel:** this schematic shows a simple cortical hierarchy with ascending prediction errors and descending predictions. This graphic includes neuromodulatory gating or gain control (dotted lines) of superficial pyramidal cells that determines their relative influence on deep pyramidal cells encoding expectations (in the same level and the level above). Note that the implicit descending gain control rests on predictions of the precision of prediction errors at lower levels – and can be thought as mediating top-down attentional gain. **Left panel:** this provides a schematic example in the visual system: it shows the putative cells of origin of ascending or forward connections that convey prediction errors (grey arrows) and descending or backward connections that construct predictions (black arrows). The prediction errors are weighted by their expected precision, associated with projections from ventral tegmental area (VTA) and substantia nigra (SN). In this example, the frontal eye fields send predictions to primary visual cortex, which sends predictions to the lateral geniculate body. However, the frontal eye fields also send proprioceptive predictions to pontine nuclei, which are passed to the oculomotor system to cause movement through classical reflexes. Note that every top-down prediction is reciprocated with a bottom-up prediction error to ensure predictions are constrained by sensory information.

Diagram IX. *The Fundamental Crossing Point Between the Bottom Up and the Top Bottom fundamental neurological processes between the body and his environment.*

This is because the progressive detachment from the organism of the environment is not a mistake that destroy the natural quality of the organism. Children in the wild without education are not at all the utopian good, nice, and clever beings that some wrong theories describe. On the contrary they are stupid, violent, and dangerous beings, and they are sometimes very easy to control by the dictatorship of fathers, politicians, and religious “gurus”. This dialogical development between children and their socio-physical cultural environments is the unique way for the epistemological human children development. Total wild freedom and total social control arrive to the same deadly end. The diagram X shows how these pathologies between children development and social environment are closely related to

the death of Langer's tree, when one branch died it prevents the two other branches to grow altogether, and the whole tree dies.

Pathologies of wild children FUNDAMENTAL PHYSICO - PSYCHO -SOCIAL DIALOGICAL INTERACTIONS (ACTIONS AND FORMS) NO MENTAL development	Pathologies of children with excess virtualization and mental development OR EXCESS OF CONFINEMENT and weakness in physical and social	Architectural aspects HETEROCHRONIC STRUCTURES FOR A NEW EQUILIBRIUM AGAINST THE SOCIAL DICTATORSHIP OR FASCISM
Disorderly movements, walking like a wolf, etc.. strange postures Degeneration of Points of View PHYSICAL NO PSYCHOSOCIAL	Accidents due to lack of experience in the physical world. Accidents. MENTAL NO SOCIO -PHYSICAL	Correct human movements (psycho -social) THE SOCIAL RITUAL; CHURCH OR RESTAURANTS SOCIAL NO PSYCHO PHYSICAL IN CASE OF FASCISM
They do not recognize their own image in a mirror DEGENERATION OF VOICES	Confusion between the virtual and the real world: symbols do not work in the real world	Proper image recognition and identity in the built environment. MONUMENTS AND SYMBOLIC REFERENCES SYMBOLIC MEANINGS OF FORMS
Absence of sexual identity and normal sexual behavior DEGENERATION OF FUNDAMENTAL PHYSICAL CREATIVITY	Intersubjective relations in relation to difficult or nonexistent sex (Japan)	Active and healthy sexual intersubjectivity INTERGENRE AND INTERGENERATION AND INTERCULTURAL SOCIAL INTERACTION IN PUBLIC SPACES.
They do not speak or draw, or do mime, etc.. Correctly DIALOGICAL SOCIAL BASIC DEGENERATION	Artistic patterns in the virtual world but NOT intersubjective socialization outside "internet"	Geometrical, musical and linguistic communication ARTISTIC COMMUNICATION IN ARCHITECTURE MEANS ACTIONS AND FORMS AESTHETIC CORRELATIONS THE ROLE OF HISTORY
Rhythms of night and day like other nonhuman species. Lack of emotional control MENTAL BASIC DEGENERATION WITHOUT PSYCHO -SOCIAL INTEGRATION	Stress, lack of control due to emotional does not follow the real world, the virtual world rules. Sleep disturbance. MENTAL WITHOUT SOCIO -PHYSICAL INTEGRATION	Emotional Rhythm (night and day), dreams HUMAN RHYTHMS SILENCE INTERLOCATIVE SOCIAL DIALOGICAL INTERACTIONS. SLEEP AND TOPOLOGICAL DIMENSIONS OF SPACE IN CHILDREN WITHOUT PSYCHO -PHYSICAL INTEGRATION
PHYSICAL	MENTAL	SOCIAL

Diagram X. *Developmental Children's Pathologies.*

So, education, in the best way of modern pedagogy, with Montessori, Piaget or Vigostky , it should be based on a dialogical paradigm where democracy and humanism can survive. Then the computer can help or to destroy this possibility. However, the three branches of the Langer's tree should work together (Muntañola J2003,2009, 2022) In diagram XI the ontogenetic, the

phylogenetic and the topogenetic architectural branch of Langer's three are represented by three triangles, one inside the other, linked by the three axes of the hermeneutic model by Paul Ricoeur prefiguration, configuration and refiguration. It is a metaphorical simplification of the human development; however, it helps to understand our human spatial behavior.

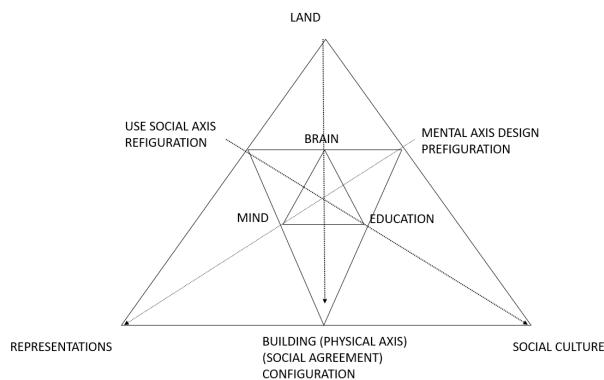


Diagram XI. *The Synthesis Between hermeneutics, phenomenology and Dialogics*

Then the main question for the designers in general is what the best connections between the anthropological history of space and the ontogenetic model are presented above. One answer was written in the foreword of the Spanish edition of the last book by Giedion as a first step on this phenomenological social direction (Muntañola j.1975) But, a lot of work and clarification is needed. Paul Ricoeur has done part of this work as the Diagram XII shows, where space and time intersubjective and socio-physical social relations, both interlocutive and interlocative, already existing millions of years ago, develops in parallel, where the architects and designers use virtual time to prove the real use of the physical object and the writer use the virtual space to prove the real meaning of his works on literature, legal

texts of science fiction. (Ricoeur P. 1998, 2000, 2002, 2004)

The Ricoeur Dialogical Space and Time Where Arque and Telos Are Confronted (Interlocation-Interlocation)

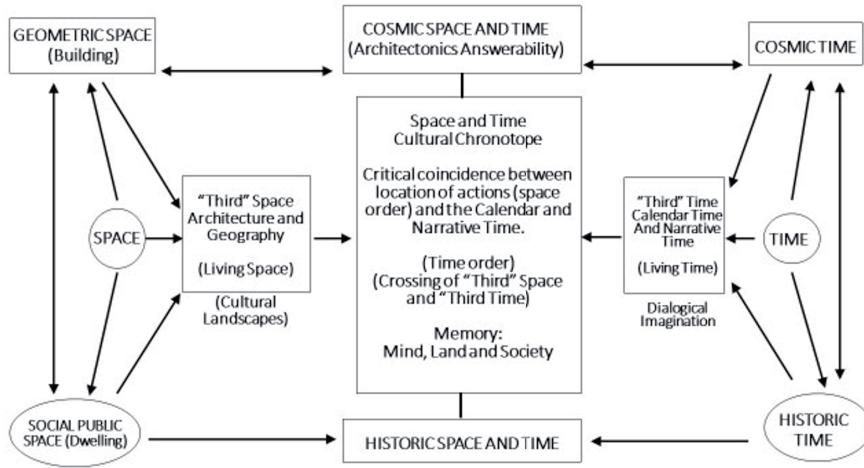


Diagram XII. the Hermeneutic Relation Between Interlocution and Interlocation

One way of looking to the links between the inside and the outside worlds that Giedion point out as the most important objective of each human generation, that is the equilibrium between feeling and thinking, is just what we are looking for in the intercrossing between ontogenesis and social cultural history, thanks to the topo-genetic branch of the Langer tree (Muntañola J2003, 2009, 2016)

The result is a surprise in relation to the realm of design in the humanity, that perhaps Lewis Mumford was the unique to forecast. Of course, the climate change and the care for the natural world is essential in architectural design, since he has been always socio-physical, never only social or physical, then the equilibrium between the feeling and the thinking gives to architecture and design

in general a strong developmental cognitive responsibility, expanded to all the disciplines and arts involved and represented today by the artificial intelligence uprising.

The posthumous last book by Ricoeur "The Course of Recognition" (Ricoeur 2004) is a precise philosophical guide to the designer in general, since describe for the first time in human history the meaning of the social recognition on the intersubjective social interactions, a key concept from the origin of the European humanism, but never analyzed in a systematic modern way until Ricoeur's book.

Then if this definition of the design practices and theories is correct, the role of the design is just the role that Giedion called "equilibrium", both, in between feeling and the freudian dimensions of it, and the exterior social and historical relationships today organized by different laws, rules and ideologies in permanent explosion. This equilibrium develops upon the large work by Jean Piaget, neighbor of Giedion in the same street in Zurich, and it can be ignored by the destruction of the natural environments or by the social wars between religions or social political interests etc. And the designers should know if they support life or death as we have described in the foreword of this book. The diagram X above about the development of human pathologies in children confirms these anthropological ideas by Mumford, Bakhtin and Ricoeur. Pathologies can have an origin in the physical human dimensions when social interaction disappears, as happens in the wild child abandoned in wilderness , or in physical disorders in children living inside a virtual world disconnected from the real social environment, or finally on the mental disorders produced by social environments converted into a fascist deadlock pushing to suicide, as the concentration camps by Hitler But there are a lot of other deadly environments as the ones described by Mumford in the Myths of The

Machine books. The third branch of the Langer's tree focused upon the epistemological power of the computer as a bridge between ontogenesis and human history has been analyzed by the four books of Topogenesis written by professor Muntañola between 1980 and 2009, since architecture and urban planning are a very important aspect of this third branch were design takes an enormous protagonist

Going back towards our objective about the artificial intelligence for architects and designers, we could think that the previous theoretical ideas under evaluate the cognitive role of the artificial intelligence and the computer in architectural design and in design in general. Not at all, the new developmental stage of cognition of the third computer branch of the Langer Tree is essential today for the humanity survival. Think about the vaccines of covid 19 and the role of artificial intelligence on it. Of course, this bears an ethical component about the right or not of the transitions between nature and culture, and between artificial biology and natural original biology, but this was present in one way or other since the beginning of the humanity as we have seen, and it is a natural component of the intersubjective concept. In other words, the more the third branch of the Langer Tree grows the more the other two needs to grow too, and the human ethics, politics, arts, and sciences will change with it.

In recent books and works, the algorithms, basic tools in the artificial intelligence aims, are analyzed as a danger for survival, in others as a key for survival. From the Langer Tree viewpoints they are, neither dangers nor keys for survival, they are simply mathematic structures developed today with the computer by huge and complex interdisciplinary and international networks, or of intersubjective relationships as we just described before. An algorism can today be crucial for a specific human problem as millions of years ago a new way to cut

the bones of animals could have been a key for a whole civilization to survive. But we need to evaluate them and not think that some men invented because they were unique genius. The new way of cutting the bone or the google algorithms are not isolated invention of geniuses. The mathematic knowledge in the Langer's Tree develops through the trunk among the branches, of course the ontogenetic branch is always unique and never the same in two subjects but is the intercourse between the other two branches that makes the miracle of the human culture and knowledge, not the isolated genius. We need to think dialogically from now on, if we want to understand what is happening today. (Bakhtin M. 1975, 1985)

From an intersubjective and inter-artistic point of view the intercultural phenomena, and the growing emigration processes, get new meanings and should be analyzed considering the whole Langer Tree and the intercultural structures on each person and each social emigration group. Designers and architects, as the last book by Richard Sennett insisted upon, should take the responsibility for the ethical dimensions of the use the objects they design. The intersubjective neutrality of the designer does not exist neither in architecture nor in design in general. (Sennett r, 2019)

To propose a methodology on design education considering the digital world we need to define the cognitive basic structures of design as chronotopes, that is, as socio-temporal socio-physical structures defined by Mikhail Bakhtin in his extended philosophical work on social dialogics. In the diagram XIII we see a general definition of human chronotopes in architecture and planning. They are in permanent revision, since chronotopes change with the development of Langer's Tree.

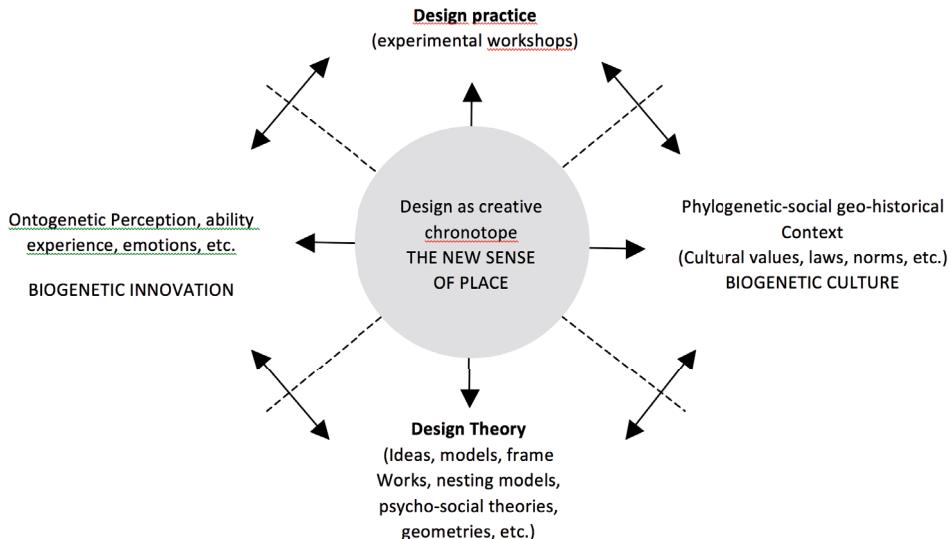


Diagram XIII. the Basic Structure of the Bakhtinian Chronotopes

When the designer, student, architect or professor, in order to understand what is doing needs to externalize it throughout a design, drawing, city or building, in fact, they are creating a chronotope. In spite he can be a powerful ontogenetic subject, to create this chronotope, he needs to accept intersubjective relations in some social, educative, or cultural and historical environment. The excellent work by professor A. Salama in England about architectural and spatial design education represent this, when relates the ontogenetic structure of the brain of the students with a conception of design education based upon the dialogical relations among the student of each specific design studio. The intersubjective relationships among the students themselves build the social context needed by each unique student to be able to create a new design. This is the kernel of the proposal by Bakhtin and Ricoeur (Salama A 2017)

If now we consider the diagrams XIV, XV and XVI about the chronotope cognitive emergence in the human mind according to the basic constructivist regulations in

the body, we can immediately see the mistakes of mixing arts, scenes, and social networks without be aware the way we are mixing dialogical and metaphorical human dimensions, without considering the three branches of the Langer's Tree.



Diagram XIV. Relationships between verbal and design intersubjective social interactions.

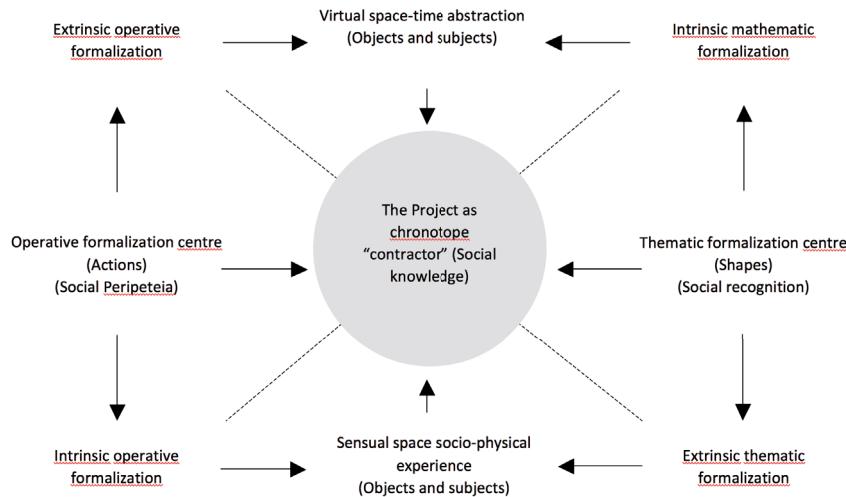


Diagram XV. The Act of design and their chronotopical emergence

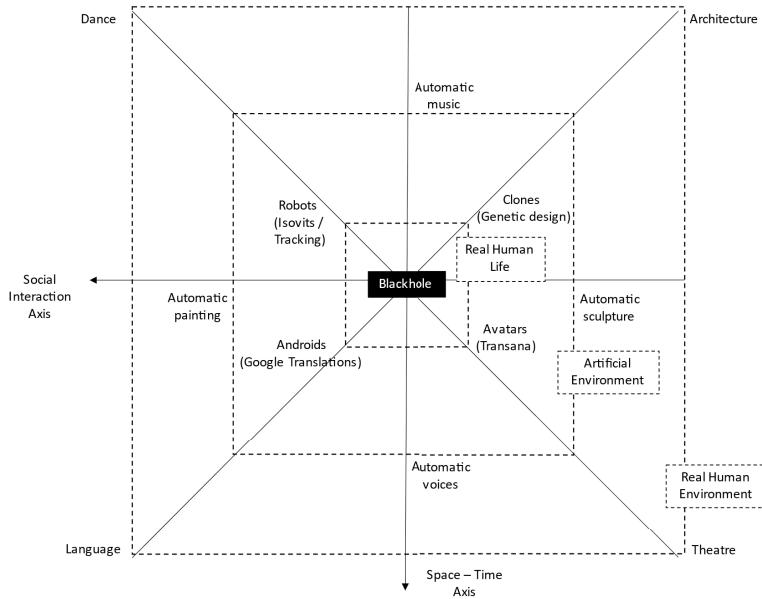


Diagram XVI. *The Socio-Physical classification of the Arts and the impact of the Artificial intelligence.*

Designs as chronotopes are links between cultural representations and real facts in some way of other, and in philosophical terms they are “traces”, a specific kind of human signs where the form is produced by the cause of the form of the sign, as a trace of an animal in the sand. We will develop the next years a more complete analyses of the classification of the designs as traces, but by now we can only insist upon the need for a serious design education cognitive framework. (Ricoeur P. 2000)

The algorithms are black holes in the middle of the diagram XVI, and it is a fundamental concept for the understanding of the whole cognitive framework. For instance, from a huge list of possibilities in relation to

statistic events in the design of an automatic translation of verbal languages, one of the main objectives of artificial intelligence, the blockhole is the chronotopic structure that can make obsolete the natural translation by natural brains. That, is an algorithmic universal machine of translation, that can be useful in the sense of the Deep Blue Chess Computer Machine, in terms of basic learning, competitions, or in simultaneous translations in technological or legal specific audiences, etc. However, the poets will learn nothing from this machine, since the poets' brains are not selecting the words in between millions of possibilities, but thanks to intuitive chronotopic intersubjective dialogues with the expecting reader qualities. The google machine has automatic artificial proposals not necessary the best ones, and to find these the poet will need to expend his whole life to find them in between millions of millions of possibilities as the Langer' tree proposes. The more the automatic translation is a success the more the poet is needed in translations between languages, perhaps will be the death of the bad poets but it can be the revival of the good poets educated in real poetic and dialogical contexts, that is, in the real design educative workshops defined by professor Salama in our case, and the chess competitions between the best players in the chess case we described above.

In design, and more specifically in architectural design, the three dimensions of the hermeneutic cycle. That is, the design, the construction and the utilities of the construction, should produce in their interaction, as in the Langer's Tree, good architectural and urban human places.

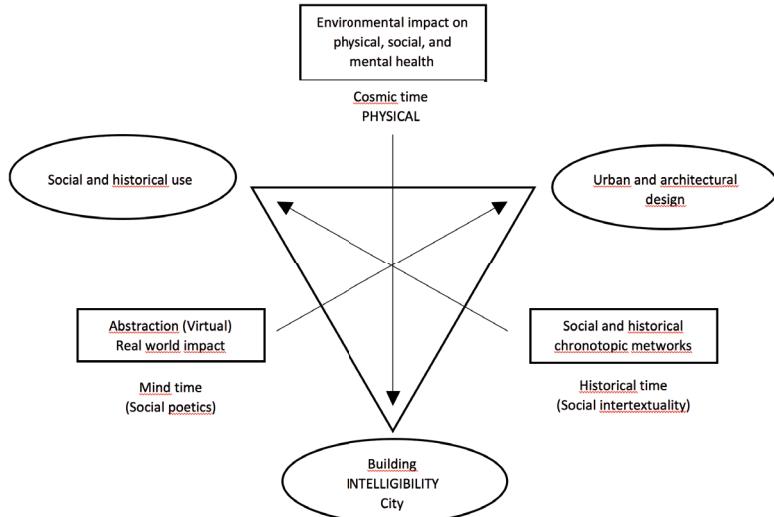


Diagram XVII. *The Fundamental Phenomenological Frame between Reality and Virtuality.*

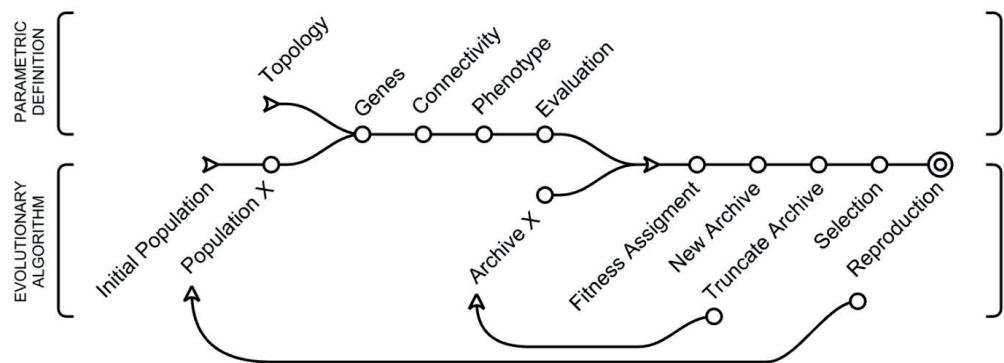


Diagram XVIII. *The Genetic Digital Design Processes (Navarro D. 2022)*

As we described before, the combination between the hermeneutic cycle and the dialogical scenario of a good design workshop, is the key concept of good design education in general, taking into account the situation of each design process in the general cognitive and

dialogical framework represented in diagram XVII on the one hand, and in the diagram XVIII, described by professor Diego Navarro in this same book, on another hand. Also the two epigenetic developments involved in the human mind, bottom up and top-bottom, (see diagram IX) supports that vital correlations between bodies and environments, that change according the interactions among the three branches of the Langer's tree. Then the methodological approaches to design education need to focus its attention on the links between the way the natural brains design and the way the computer works. As we have described before, this link is the crossing point between the two inverted epigenetic developments. (Friston K 2000, Ranier E Zimmermann 2015,2017, Dehaene S 2020, and Muntañola J. 2017,2019 ,2021)

Future looks both intriguing and difficult. There are some new ways and ideas towards an innovative architectural and urban design education. The texts on the first part of this book need to be analyzed with a clear mind and with enough time to consolidate the new ideas, as S. Dehaene stated recently and consequently the following theoretical directions are strongly needed:

- A) First of all, we need to take into consideration, the proposal by Rainer E Zimmermann about the coordination between the history of culture, architecture, and semiotics, in the sense that it could allow the cognitive construction of an evolutive general model of the spatial human systems based upon Bakhtin's chronotopes. A very similar proposal was stated some years ago by the prominent semiologue John Deely (Deely Jh 1990) when he said that semiology can be the key in order to organize human sciences around the central historical core of the humanity

The link between artificial intelligence and architectural design is then a rich topic to be explored, based

upon all the previous ideas about the impact of the computer into design education at the crossing point between the ontogenetic and the historical development. The work by Vincenzo Bagnato is a first step on the correct direction (Bagnato V. 2017)

- B) It is very important to analyze the interplay between the artificial intelligence and the real analyses of the socio phenomenological expectations and behaviors of subjects in empirical physical environments. This can be done in different ways, one is the comparative analyses at different scales in buildings and in cities, chronotopic rules at microscales and algorithmic results at the city macroscales. Another way is the real ethnomethodological study of micro situations with a macro analysis of big data at macrolevels.

This methodological hybrid methods needs a new theory about what a human place means today according to the works by Luis Umbelino, Paul Ricoeur and Josep Muntañola. (Muntañola J. ed.2021)

The definition by Koenig of a specific Cognitive Design Approach in the Ai in the sense that there is a dialogue between the natural mind and the computer is going in the same direction we propose here. (Koenig R.2020).

- C) It is fundamental explore changes in the intersubjective interaction and communication when codes and signs change from algorithms to chronotopes and patterns. Each traditional art was already a different way of human intercommunication, but now with the computer the complexity of the matter increases a lot and should be analyzed in detail.(Kirsh D.2020) The works in the first part in this book opens design to a new theoretical framework, and pushes together phenomenology, hermeneutics and structuralism in

order to obtain a coordinated new theory as Rainer E Zimmermann intends today.(Zimmermann R.E 2015,2017)

- D) The historical evolution of architectural design education between the Old Bauhaus in 1920 and the new Bauhaus today, should be carefully analyzed according to the double epigenetic development of meaning and the basic developmental inversion of the geometric competences in the ontogenetic development in relation to the history of mathematics The School of Architecture of the Open City in Chile in Valparaiso is a very important case study with several PhD Dissertations already published.
- E) Real design workshops linking chronotopes and algorithms in Salama's scenarios and Maria Gabriela Ribera Ríbero workshops in Tachira need specific analyses in each case. Two design education workshops following this dialogical socio-physical procedure can have a very different output and they can be analyzed with artificial intelligence tools.
- F) Biographic dissertations linking historical social environments with the design of prestigious architects who have worked on them are now fundamental. Such as the PhD recent dissertations of Julia Beltran and Sara Molarinho. They are an implementation of the diagram XII where hermeneutics and phenomenology are tied together in a topogenetic knot, that is, in a series of chronotopical formations.
- G) The new meaning of the "voids" in human places should be analyzed from innovative methodologies related with the "sleeping factor" of the ontogenetic process and with the artificial intelligence linguistic power. (Dehaene S 2020).

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**FIRST PART: PRACTICES AND IDEAS
EMERGING FROM THE IMPACT OF
ARTIFICIAL INTELLIGENCE ON THE
ARCHITECTURAL AND URBAN DESIGN
PRACTICES AND THEORIES OF TODAY**

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