THE IMPACT OF ARTIFICIAL INTELLIGENCE ON ARCHITECTURAL DESIGN AND HUMAN CONDITION

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The Pleasant Terror.

In front of the AI creations, I imagine that many of you feel a sense of amazement and miscarriage.
In a word, that sense that philosophers define as the Burke's *Sublime*: fear that fascinates, or in Kant's later reflections, the bewilderment someone feels when faced with phenomena that show the limits of our rational understanding.
I also imagine questions about *how* and, above all, *when* these avant-garde experiments will be actualized in the increasingly complex and difficult architectural profession.

Living with Algorithmic Machines and its Computational Intelligencies

Indeed, much is already present without us realizing it.
Living with our smartphones is the clearest example of the close relationship we have with computers, a machine that houses other invisible machines: algorithms, machines that process information rather than matter. A new inexhaustible matter of unlimited accumulation and transformation up to constituting itself in forms of intelligence.
We can call them *Computational intelligences* to which we rely more or less consciously, sometimes forcibly subjected, to guide and facilitate our lives. Inevitable acceptances to belong to social and professional coexistence.

Algorithms in Design and types of BIM

Sixty years after the primordial graffiti traced on a cathode ray tube monitor by Ivan Sutherland in the Bell Laboratories, the design profession has undergone a rapid transformation in a way each building phase is now processed by algorithms that go beyond simple representation. Surveys, measurements, conception, executive production, construction, process management, management and disposal of buildings increasingly depend on computational procedures.
The acronym BIM is the best-known point of convergence that the undersigned, taking up a division on Austin's language, divides into two different categories: *Informative BIM* and *Performative BIM*.
The first oriented towards the control of production and management processes that intersect robotics; the second to the generation of ideas which is the subject of designing.

Types of Algorithms for Design Creativity: form Parametricism to Generative Design.

In creative applications we can distinguish different types of algorithms.
The first ones of the parametric type that operate obscurely in our CADs but which, once revealed, have made it possible to generate drawings through coding in a way designing could derive from programming instructions rather than tracing geometric primitives.
This new approach was first reserved for few scripting initiates but some years later it spread to many thanks to the introduction of visual programming interfaces of which *Grasshopper* was the first to be released in 2007 under the name of *Explicit History* whose name defined the nature of this technology.

A second step occurred when parametric design abandoned the simple morphological generation for its own sake to merge with the *Performance Approach*: a way of conceiving design as a response to certain objectives that can be codified in performances. This new approach was born together to the first computers but it reached its full applicability only after computers were able to offer great computing powers at low costs. This new parametricism that Schumacher, overcoming the first formalist season of Zaha Hadid, welcomed and defined *Parametricism 2.0* is based on the optimization of the relationships between variables and parameters in view of objectives which, in the

majority of cases, responds to the approximation of the minimum in the *Pareto curve*, particular satisfactory function of economic disciplines.

For this search for the optimum, new so-called *evolutionary* algorithms were born employing different types of solvers depending on the problem to be treated.
Borrowing the paradigms of living systems, the best known are those of the *genetic* type and those of *swarms*: the former, in which the search for the solution proceeds by selecting the most suitable by emulating Darwinian selection processes; the latter in which the Pareto optimum is determined by taking as reference the logic of adaptive self-government of flocks and swarms.

This road led to *Generative Design*, the first forms of self-generation of the project where interrelated algorithms repeatedly and automatically modify the project parameters on the basis of the results of the checks carried out to produce different solutions that approximate the optimization sought.

Differences between Manual and Computational Heuristic Searches.
Generative Design is nothing more than the reproduction of traditional heuristic processes where, by groping and for continuous feedback, the designer gradually proceeds to refine the solution.
The big difference lies in the fact that while human practice proceeds within the enclosure of experience, of things already seen, or of the rules of the art, these algorithms are capable of processing hundreds of solutions at great speed with a certain degree of randomness and therefore able to go beyond the fences of intentionality and to open up to innovation.
Given the processing complexity, this optimization can, today, address a limited number of objectives typically restricted to structural and energy engineering that have also promoted its first applications. Certainly, a chimera for the entire architectural project where the variables are innumerable and impossible to define with precision.

Reversing the Approach: Deep Learning and Machine Learning.
Given these limitations, a new approach is rapidly gaining the scene: it is the *Deep Learning* and the *Machine Learning*, specific sectors of Artificial Intelligence.
Now, without the time to go into the functioning mechanisms of these new machines, allow me to briefly explain what the difference is compared to previous forms of artificial intelligence.
Forgive me for simplification, but we can say that while in the previous cases and in the first forms of Artificial Intelligence (the so called *Good Old-Fashioned Artificial Intelligence*) it was intended to deduce the solution starting from an arsenal of formulas and theories, in this case, given the impossibility of mastering the infinity of variables, they have chosen to reverse the problem: i.e. to scan or, if you prefer, demine information from thousands, millions and billions of existing facts, better if successful, in order to induce a resource of relationships from which we can then extract and generate answers to our questions .

Digital Neo Empirism and its Creative Results
It will not escape you that this modality can be assimilated to a form of empiricism where and as the English fathers of this philosophy preached, everything that presents itself in front of us is *real* and everything that is confirmed in its recurrences is *true* with all the limits that the subsequent philosophical thought has highlighted.

The training conducted in the research laboratories has made it possible to produce incredible results (more or less necessary) in different application sectors, but also creative ones including:
-articles published in authoritative newspapers;
-works of art (remembering that already in 2008 the first work was auctioned for 432,500 dollars);
-up to the extravagant challenge launched by a team of robots to the world champion soccer team for 2050.

We have recently been able to converse with bot friends capable of giving answers on the basis (right now) of 175 billion parameters built by looting books, newspapers, Wikipedia, scientific publications... basically everything that could be scanned in digital format and then refined with continuous self-learning processes.
But also to generate images by simply typing text prompts, also denying Sei Watanabe, one of the most visionary architects who has been working with artificial intelligences since 1994. According to him, these technologies could never have dreamed of. In reality they do, indeed they go further, to the point of giving birth to dystopian nightmares.

AI in Architecture.
In architecture, with the use of different types of neural networks (and specifically the *Contradictory Adversarial* ones) it is possible, according to a start-up, to generate furnishing solutions for given spaces in different styles, from classic to cyberpunk.
Or, as the founders of the start-up *Higharc* declaimed this new technology "give you the house you want without hiring an architect!" Through algorithms informed by GIS data, building codes, calculation handbooks, local price lists, customer requests, their Intelligent Home Building Platform can churn out different alternatives and proceed in continuity with the processing of the necessary technical, authorization and construction site documents.

The Uncertain Death of the Architect and Resilient Architecture.
Many will be seized again by that *Sublime* feeling of terror that the architect's death is really close.
To reassure you, today it seems difficult to predict times and ways of this event. Unfortunately we are also unable to imagine the entity and the effects induced by these technologies. As Elon Musk said, "we have summoned a demon whose capabilities are unknown".

Instead, in an optimistic forecast of happy coexistence, Nicolas Valencia foresees that the first sectors to be threatened will be those with high repetition and the most resistant ones will be activities with a high level of creativity and cultural profile which I would define as 'curatorial' when the project becomes an activity to choose between the alternatives generated by machines.

However, the effects and limitations of these technologies are already evident.
I would mention the legal disputes attributable to the computerized management of the project. Because, if it is true that BIM has made it possible to amend many of the errors deriving from its 'manual' management, it has also produced new types of errors and consequent unprecedented lawsuits as well.
The first and best known was that which occurred in 2006 during the construction of the gigantic Airbus A380 where some incompatibilities in the various versions of the *Catia* software, used by sub-contractors and contractors, produced multi-billion dollar damages and delays with interminable legal disputes.

For the limits, we point out the objective difficulties in learning and three-dimensional generation or, more generally, in the complexity of demining data which in architecture take on very diversified forms.
Above all, because the building asset does not result from an exclusively symbolic process as it is in mathematics or in the game of chess. The building process is deeply rooted in reality where we can encounter different representative and constructive codes that differ over time and in cultural contexts. Just think, how the formalization of designs has changed over the decades.
This means that the total automation of the project promised by *Xkool*, the Chinese cloud computing platform based on Artificial Intelligence, although probably soon feasible after six years of development, will not then be exportable to other contexts precisely because data, and regulations are totally different in different contexts requiring first to be demined and known individually.

The Problem Areas.

To get to the conclusion and for reasons of time, I would avoid listing the advantages, as I said, difficult to predict. Instead, I would like to summarize some more general questions which also include those of design as an activity responsible for the transformations of the world

1. The first problem area is related to digital language, its nature and its limits.
Borrowing the hypothesis of a universal language in the form of mathematics which was advanced by many thinkers starting from the 1600s (among which the most important was Leibnitz) up to Badiou, I like to define this language *Digital Mathema*.
A neo-language formulated by calculation and formalized by the mathematics of algorithms, which forces us to codify the world in a numerical-quantitative way, determining forms of exclusion for everything that is impossible to de-mine and then treat digitally.
Therefore, limited as well as discriminating that razes man, as Marcuse wrote, "in a single dimension".

2. The second question concerns the fate of creativity subjected to the logic of Operationism and Neo-Behaviorism. Those logics in which the generation and validation of results reside in the rational coherence of the process, utilitarian effectiveness and statistical recurrences of what already exists and can be digitized.
If his products can be considered as effective as they are innovative (beyond authorial prejudices), we cannot help asking ourselves how in this Neo-Empiricist World another Dick Fosbury could ever be reborn as an unexpected example of divergent thinking.

3. The third problem area concerns the possession of the demined data and what are the purposes of use.
So more than Ed Finn's concern to understand *What algorithms want* (title of a book wrote by him) the question, instead, concerns what who own them want. For these answers, I invite you to read a 2019 best seller: *Surveillance Capitalism*, a disturbing investigation by professor Zuboff on the future of humanity in the age of digital powers.

It is the old question of the spaces of freedom and democracy offered by technology of which the Blockchain is the latest example that will reveal again how the greatest potential will always translate into greater power of control of those few who financially can centralize its possession and govern it access.

4- Transparency and the ability to control is another rather disturbing problem area to a completely unprecedented extent in the history of technical progress. To explain this aspect I will use an example from the design industry. Several years ago, in a research of relevant national interest on the reliability of design, I conducted a survey on the reliability of structural calculation software to find out how in different software some default parameters were different and, even, how the operators neglected the setting. It could be concluded that these machines, becoming increasingly complex artifacts, precluded full understanding by the average end-user.
The question is even more relevant today since the growing complexity has been accompanied by the simplification of the interfaces to facilitate their use but - in fact - exaggerating the problem.
A sort of *gamification* where the *knowledge* is replaced by the *how to do* or, if you prefer, how to do often with the Unbearable Lightness of Tinkering.

The loss of control is amplified with cloud computing where increased computing needs require to delegate tasks to ubiquitous data centers. The result is the loss of control as well as ownership of the software, now offered no longer as a product but "as a service".
But opacity is a much deeper problem that lies in the very nature of algorithms. Machines that allow reality to be simulated through numerical modeling (the famous Digital Twin), therefore symbolic representations that require simplifications and, last but not least, tricks or patches (the philosopher Vaihinger would define them as fictions), to make theoretical formulations operable which are intractable from the point of view computationally.
Faced with increasing complexities, the validation of these algorithms and therefore their reliability are delegated to other algorithms, further precluding direct control by humans.

The matter is becoming even more serious with the spread of algorithms which not only design and then manufacture microprocessors, but which manufacture other algorithms with intrigues which the programmers themselves admit they are unable to unravel by placing serious limits on their technical certifiability.
An analogous situation is occurring in the so called *Unsupervised Learning* where learning processes take place in spite of any human possibility of control. With risks that convinced the head of Google research department, Amit Singhal, to resign in 2015.

In all these cases, the only acceptance criterion still remains the Operationalist one, which is to ascertain that they are computable, that they function effectively and therefore admissible as real.

I would therefore close with some of the corollaries, a few words on the most obvious risks.
The first concerns the abdication of our decision-making and critical skills in favor of algorithmic outputs in which humanity seems to revert to a kind of magical fideism or at least, in the words of Bogost in his book *The Cathedral of Computation*, of theocratic obedience.
As Joseph Weizenbaum noted, we progress in our ability to calculate and simultaneously regress in our ability to recognize what is worth counting.
The second is the effect produced by the diffusion of the Digital Mathema which, where we can recognize the Heideggarian *Gestell*: the scaffolding/imposition on the world to decipher and transform it, and even more worryingly, the inevitable cause of modification of our behaviors and our ways of think: in short, the influence on the goals we set for our actions.

In the face of an evolution of these machines towards forms of natural communication, in fact, a growing mutation of humanity towards the logics that supervise their functioning acts as a counterbalance. We speak and reason more and more by hastag, by data-entry and according to the ordering logic of databases; by hypertexts, in an ever more accelerated movement responsible for disrupted superficial and compulsive stimulations that eliminate any possibility of reflection. Even worse, these machines are flattening language to the mere words of measurement, calculation and performativity, excluding other plausible intellectual possibilities.

5- Finally and consequently I would mention the expropriation of the life of the human being up to the depths of his intimacy.
The consumer profiling practices that are carried out (as we all experience by now) through a savage behaviorist and emotional demining is just one of the most evident examples of how humanity has become, in Heidegger's sense, a *fund* that disposes itself to the technique: humanity is changing in a resource to be extracted and exploited for the production of a profit.
In this process we witness a redefinition of being which is *being employed*, material cause rather than efficient cause of changes. In this sense, humanity not only submits itself to the incontrovertible, however obscure, results of rational processes but, as a resource, it is also deprived of independence and intentionality.
In this prospective it seems that we are loosing, according to Heisenberg, the fact that phenomena could be influenced by the observer and even more, in Reichenbach's words, by the tools used for observation: it seems that phenomena, tools and instruments are increasingly defining us as observers.

In the face of this relativism (to the limits of skepticism) I, therefore, feel inclined towards the conclusions of the last Lyotard in which human action is related, not so much to pragmatic rationality, to the purposes of the useful, the true of the science or the right of justice, but to an ineffable aesthetic motivation, which rises as an *a priori* determining the human being.

Taking up from the beginning, I would, therefore, like to close on a positive note by reassuring you that certain feelings of amazement and miscarriage represent an entirely human ability, which should not lead us to fear but to a certain optimism since these are abilities that represent a bulwark that will prevent any Artificial Intelligence from successfully pass (at least for now) that famous Turing Test according to which an automaton is indistinguishable from a human: it cannot yet experience this sublime emotion.