

# *Adauctus Architectus Novus* on the Definition of a New Professional Figure



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**Abstract** This contribution proposes a reflection on the evolution of the professional figure of the architect thanks to the implementation of technologies brought by the fourth industrial revolution. Technology has continually transformed the architect, expanding his skills and potential through digital fabrication tools: these allow the figure of the architect to be elevated from a simple designer to a complete realizer of the work. The contribution is divided into three parts: the first investigates, in a critical key, how technology has been a constant that has assisted human evolution in its various phases, modifying, changing, evolving and, perhaps in some ways, dis-evolving man; the second part proposes to present the definition of the new professional figure of the architect, fruit of the progress brought about by technological evolution through the application of digital fabrication tools in the management of the architectural process; furthermore, among the new tools that enhance the figure of the architect, we can now register the impact of artificial intelligence. This can represent a new starting point in the reflection of the design process, making an essential contribution to what comes before the project itself, that is, the creative phase.

**Keywords** Technological innovation · Digital Fabrication · Artificial Intelligence · Human–machine interaction · Generative design

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# 1 Introduction

We are experiencing a new evolutionary phase, perhaps revolutionary, among the many that have characterised the evolution of humanity: it is a process that stems from the fourth industrial revolution, and it's leading to fully automated and interconnected industrial production, in which products and means of production become networked and can "communicate," enabling new methods of production, value creation, and real-time optimization. The interaction between man and machine, which is diminished in the more authentic concept of augmented reality and into the transition from "digital" to "real" through additive manufacturing, 3D printing, robotics, communications, and machine-to-machine interactions, is certainly one of the directions of development on which Industry 4.0 products are having a profound impact. The link between humans and machines is marked by intricate reciprocal impacts. Following classical cause-and-effect reasoning, technology cannot be considered only a product of man. It feeds back on the man in an advanced form of circular causality. A circular interaction between man and technology requires one to look for the evolution of man in the complex interactions between biological evolution (Darwinian), socio-cultural evolution (Lamarckian), and development or technological evolution. For this reason, we can speak of human-machine co-evolution, identifying biological, socio-cultural and technological evolutions as interacting factors.

Technology has become an environment to live in, an extension of the human mind, a world that is intertwined with the real world, impacting and being influenced by how we design and build spaces. The introduction of digital technologies and media into architecture has sparked a design revolution that has resulted in substantial advancements in the discipline. Particularly, digital fabrication has enabled architects to overcome the gap between representation and construction, allowing for a seamless connection between design and production. The introduction of new technologies has forced a redefinition of the architect's professional identity. As a result, it is essential to evaluate the role of technology innovation in architectural design and implementation, as well as how it impacts how architects approach their profession.

The employment of digital fabrication and material techniques to achieve a balance between virtual models and actual artefacts is a topic of critical importance and urgency in this setting. As discussed by Robin Evans in "Translations from Drawing to Building" [1], the gap between drawing, the standard design medium, and building, the result of an architect's work, is the void in which significant innovation occurs. In architecture, digital approaches such as digital fabrication and generative processes can facilitate a seamless connection between design and manufacturing, allowing for better efficiency and innovation.

Against this backdrop, the reflection proposed in this paper is strongly related to the scope of this book, which seeks to systematize and analyze the greatest contributions and experiences in the professional, academic, and research sectors of architecture and design based on this new design paradigm. It has already been proven that the tools that have come with technological progress have changed the profession

and made it necessary to work under a new definition of the professional figure, related to the potential and difficulties of the post-digital era.

## **2 From *Homo Sapiens* to *Homo Technologicus*. Reflections on the Cognitive, Emotional, and Social Consequences of the Pervasiveness of Technology.**

“It’s a turp of decadence!” [...] “Who cares about the Greeks and the Latins, good at most to furnish some roots to the words of modern science!”—exclaimed the old professor Richelot, teacher of classical languages, the protagonist of a posthumous narrative composition by J. Verne “Paris in the twentieth century”. Written in 1863 and set in 1960, the novel describes the French capital as a hyper-technological metropolis where the invasion of machines has reduced human capital and the triumph of capitalism, of technical and utilitarian culture, has generated a grandiose, productive, and winning system, in which art, reduced to mere entertainment, no longer counts for anything, except as a ridiculous damsel in the service of science, with its lyrics to progress.

The paradox of the story lies in the fact that it is a futuristic fantasy that, with extraordinary foresight, in the mid-nineteenth century, predicts a future that is not the radiant one of the progresses promised by the sciences but is instead the gloomy one of the deaths of the humanistic dimension of human consciousness. Verne’s distrust of machines and technology, which transpires with prophetic lucidity in this sort of visionary novel, made reflect on what the logician and the philosopher of language, Ermanno Bencivenga, considers to be the threat that is most undermining our time: the ability to reason which risks to disappear. For Bencivenga, this ‘gentle catastrophe’, as silent as it is devastating, is gripping the new generations, especially those who are more exposed to the frenzied proliferation of technological tools, as well as of information and communication media, which have now become too fast and powerful compared to the time that logical thinking requires. The disturbing result is that young people get increasingly used to the idea that someone else, or something else, will reason for them.

During our evolution, we have learned to speak, read, and write. According to anthropologist Arnold Gehlen and many others, technology has always been the means man uses to make up for his physical and mental deficiencies and therefore it can be considered as the extension of our senses [2]. In other words, technology constitutes for man an extension of his body, of his physical and psychic abilities; it is a prosthesis that allows the creation of augmented reality. For example, the hammer extends our hand for strength; the car extends our foot for speed; the mobile phone extends our ears and mouth to increase our communication skills. *Homo technologicus* has therefore grown up using digital technologies since birth. Among the latter, the remote control, the mouse, and the mobile phone: these tools, in fact, lead

to different management of all information: today's children are skilled in controlling information flows, dealing with its over-availability, selecting it appropriately and according to their needs. Their non-linear behaviour, the control of information, the knowledge of how to navigate through information efficiently and effectively, how to communicate, and how to effectively build a network of peers lead to the development of crucial skills for a chaotic and creative society.

The paradigm of how technological science is changing us as people and how it is shaping our minds is represented by social media (Facebook, Pinterest, YouTube, Twitter, etc.): "social networks" that forge in their image and likeness an orthodox way of thinking and acting which, together with the automatic prompts of cell phone keypads, are drastically thinning our vocabulary [3]. Sigmund Freud argued that "it is impossible to know men without knowing the power of words" and "if words become thinner", as the psychiatrist Paolo Crepet points out, "they simplify, become ugly and horrible neologisms; if our emotions become small icons coloured on a mobile phone screen, even the bricks of our unconscious will inevitably become sand" [4].

*Homo sapiens*, with its rationality, which has always been its pride, has therefore transformed itself, since its appearance on planet Earth, into *Homo technologicus*, given the close, almost symbiotic relationship that has linked it to the various technologies from he discovered and built, and with which it can be said that he co-evolved.

However, it is necessary to "start thinking again" because we are all participating in the definition of a new evolutionary matrix that deprives the new generations of what they need more than anything else: the ability to think.

Nevertheless, what is meant by thinking? It derives from the Latin verb "*pēndere*", which means: to weigh, to estimate; alluding to the act of evaluating things with the intellect; thinking is reasoning, it is arguing, or "giving an account of what one is saying". To think, after all, is to preserve one's dignity as a human being because, without thought, there is no conscience.

In today's digital, globalized and connected world, we must preserve this ability in order not to become software, we must regain the ability to process thought, open up to the slow spirit of our brain and induce the new generations by educating them to focus attention on something other than a display in order to avoid—as caustically noted by the anthropologist Niola—inadvertently making them pass from the age of the "*Cogito ergo sum*" to the age of the "*Digito ergo sum*".

### **3 *Novus Architectus Aducto* and "Adjacent Possible" of New Stone Architecture.**

In the age of digital transformation that is characterizing these decades, changing entire industries and classes of professionals, the figure of the architect is the one who, thanks to the digital revolution, has undergone and will continue to undergo significant transformations.

It is now unthinkable to design structures without the help of computers. They are used throughout the whole of the architectural process, from conceptual design to actual building. The digital processes used by architects and building consultants include three-dimensional modelling and visualisation, generative form discovery, programmed modulation systems, structural and thermal evaluations, project management and coordination, and file-to-factory manufacturing. Digital Fabrication deals not only with additive technologies, which are only one of many pieces that make up a much more complex picture. In particular, it includes all those technologies that allow moving from a simple idea to its realization. These also include subtractive technologies—milling machines, numerical control machines, mechanical cutting and laser cutting—and all the technical knowledge related to the digital world necessary to juggle such machinery properly.

The combination of past and current technologies knowledge directs architecture towards an informed approach to ensure maximum performance, whether energetic or structural, but also aesthetic and cultural, prefiguring new paradigms for buildings, especially those in stone. The stone, compared to the modern materials, is considered difficult to submit both for the product design and for contemporary architecture. In addition, it is considered to represent an old material, or rather strongly connected to the forms of the past and tradition. On the contrary, it is known that, for a designer, there are no ancient or modern materials, but it is the way the material is transformed, worked, and shaped that makes it new and innovative rather than old and decrepit.

Certainly, the renaissance of the using stone nowadays is related to the evolution of digital fabrication in the dual aspect of both technological evolution of the parametric and generative three-dimensional modelling software and thanks to the robotics and numerical control machine tools applied to stone manufacturing. In the project-product process, a new and unprecedented direct relationship between designers and final product is established thanks to robotic production of stone components. The contemporary designer is a “*Novus architect adaucto*” or an “expanded designer” in the sense that he possesses new robotic arms which allow him to cut and shape the stone according to his direct requirements without any external mediation. In this perspective, the famous “dress architect” (the role of the architecte—*habit de l’architecte*) changes both because of the new tools at its disposal and of the new forms that he can produce.

In this new perspective, the role of the “fabricator”, the person who creates the work, disappears. His role interposes between the author and the final work, but the designer becomes the maker of his work thanks to his new robotic arms that allows him to cut and shape the stone and to mount and assembly the masterpiece. The direct control of the making of the work by the author is the first step to redefine a new profession, paradoxically similar to the architect—master of the past.

Although there is great excitement, shown by the growing interest on the part of professionals in understanding how it is possible to integrate these technologies within their cultural background, the limits due to the construction process have not yet been completely overcome.

In this new scenario, the new architect of the future is the author and creator of his own work or at least the one who ensures the final work the most suitable correspondence with the original idea of project without mediation and/or constructive interpretations by others. The new designer takes on new critical skills, goes back to the real construction and assumes new ethical and civil responsibilities of his job. Thanks to the development and dissemination of digital knowledge related to manufacturing (FabLab—Fabrication Laboratory), this process of redefining the role of the designer could occur at any scale, from architecture to design product, and at any level of business activity, from big industries to the small workshop of the province.

Now, it is an incessant cultural process, not only within the stone world, which is based exclusively on a new culture of doing and of the strong contact with the materials, of learning and supporting the process concerning the incubation and birth of ideas. The latter is the most delicate and important aspect which is a key point for the reformulation of university programs and teaching methods.

The lithic prototypes come to life under the influence of research and innovation aimed to expand the “adjacent possible” of stone, according to what Steven Johnson argues in “Where Good Ideas Come From: The Natural History of Innovation”. The adjacent possible, according to the author’s statements, is a “kind of shadow future, hovering on the edges of the present state of things, a map of all the ways in which the present can reinvent itself”. That is identify for us new possibilities and potentiality of stone even with the risk to exceed in the morphological/structural boldness, absorbing the lessons of constructive-technological areas, including external contributions not strictly related to the logic of stone. As Steven notes, the adjacent possible “captures both the limits and the creative potential of change and innovation.”

Johnson identifies seven creativity “models”, through which it is possible to search for innovation. Some of them can be identified within the designer intellectual work:

**Slow intuition**, which is preserved and stored in mind for a long time before it is shaped by the lightning of the immediate intuition.

**Serendipity**, which is a neologism indicating the feeling you get when you discover something unsought and unexpected while you are looking for another.

Serendipity is not only a feeling, but it also indicates the typical element of scientific research when important discoveries have been made while looking for something else. The term **exaptation** was coined in 1971 by the evolutionary biologists Stephen Jay Gould and Elizabeth S. Vrba: an organism develops a trait optimized for a specific use, but then that trait is redirected to a completely different function. A classic example are the feathers of birds, which initially appeared in dinosaurs to regulate body temperature and later evolved into flying instruments: a tool created by the evolutionary needs for a given purpose reveals unexpected utility for another purpose. A pen or feather adapted to warm up is “exaptated” for the flight.

According to Johnson, intuitions arise slowly over the time, but they materialize rapidly thanks to the composition of the last tile to finish the mosaic, giving the complete vision of the scene. The last tile comes like a thunderbolt! The innovative environments are those that encourage their residents to explore the adjacent possible, making available a wider and more versatile sample of spare parts—mechanical or

conceptual—and promoting new ways to recombine them. There are many novel solutions and brilliant ideas, at your fingertips. The matter is to use the available resources in a different manner, in order to create new combinations. Most of the times innovative ideas do not arise from the strokes of genius, but from a good *bricolage*.

This adjacent possible concept is interesting and very useful in developing innovative routes. Although we are accustomed to think about innovation as a leap ahead in time and space or sudden swerving due to the genius of the inventor, we must agree that the history of cultural, artistic, and scientific progress is comparable to the “story of a door leading to another door, exploring the palace one room at a time”. Researching, designing, making, building you may encounter errors or serendipity phenomena, which are both fundamental for scientific research: from mistakes and “casual discoveries” are born the best innovative ideas of our society (see Fig. 1).

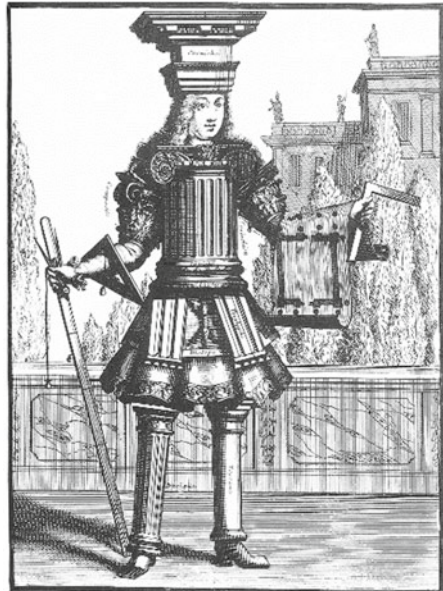
#### **4 Architect with “*Extended Mind*”: What Happens When Artificial Intelligence and Human Creativity Meet?**

Just as digital manufacturing technologies have made it possible to enhance the figure of the architect, metaphorically equipping him with robotic arms that exponentially elevate his architectural abilities, a further upgrade can be accomplished at an intellectual level by implementing artificial intelligence within the design process. Artificial intelligence (AI) has permeated every aspect of contemporary life. It is used in everything from online recommendation systems to pricing algorithms, from providing personalized news and ads to suggesting the perfect ending to a sentence written by you.

In the beginning, it was science fiction that introduced us to the concept of artificial intelligence and the so-called “technological singularity”. The term “singularity” was introduced by the science fiction writer Vernor Vinge in 1983, and it was brought into wider circulation by Vinge’s influential 1993 article “The Coming Technological Singularity” [5]: it refers to the point in time when the advancement of technology will accelerate beyond the capacity of human beings to comprehend or predict it. Artificial beings, created by humans who share with them the ability to process complex thoughts, come into conflict with their creators. On the other hand, this event has already taken place in Mary Shelley’s *Frankenstein*, published for the first time in 1818, and considered to be one of the most important literary forerunners of science fiction. But it was in Samuel Butler’s dystopian book “*Erewhon*”, published in 1872, where intelligent robots were first mentioned, perhaps forecasting our own technological culture. “Compared to the machines of the future, those of today are like the first dinosaurs to man. The largest, in all probability, will shrink a lot” wrote Butler a century and a half ago. Since then, science fiction books and movies have looked at the topic from many different perspectives, including philosophical and ethical ones. In an effort to both amuse and raise issues about the future, film and

**Fig. 1 a, b** G. Fallacara 2016, *Adauctus architectus novus*, Interpretation from *Habit de l'Architecte*, engraving attributed to Nicolas II Larmessin, probably made in the seventeenth century.

**(a)**



*Habit d'Architecte.*  
Le second à Paris. Chez M. de Lamoignon, Rue d'Angouleme devant l'Hotel de Pignerol, à la Cour de l'Oratoire, et chez Pélissier au Bois.

**(b)**



*Habit d'Architecte.*  
Le second à Paris. Chez M. de Lamoignon, Rue d'Angouleme devant l'Hotel de Pignerol, à la Cour de l'Oratoire, et chez Pélissier au Bois.



literature have given us many complicated concepts in recent years. This translates into what is still the current debate between “technophobia” and “technofilia”, where the optimistic hopes of “futurologists” clash with the visions of the most pessimistic “techno sceptics” who see artificial intelligence as the invention that would lead to the end of humanity.

Among the various sectors that have been permeated by artificial intelligence-based solutions, there are also the art and architectural ones. Art has always had a complex and evolving relationship with science and technology. Recent developments in machine learning have led to an acceleration in the exploration and discovery of the potential possibilities of AI applied to art through the adoption of technologies such as neural networks and deep learning. In recent decades, and with particular acceleration in the last five years, rendering algorithms designed to modify images in several ways have been developed. Furthermore, in recent months, social network boards have been flooded with images generated by artificial intelligence systems: algorithms capable of generating spectacular photorealistic images from text input.

The use of artificial intelligence in architecture design is not new. Attempts to replicate an architect’s design abilities using a computer date back to the late 1960s [6]. However, AI research has gone through several phases of rapid decline, but it is currently on its way to a successful future [7]. As a result, particularly because to modern computers’ enhanced capabilities [8], AI will soon massively empower architects in their day-to-day practice [9]. In any case, the employment of AI in the architectural profession will not be universally welcomed. Some may dismiss it, just as some did when computers first entered the mainstream architectural culture around thirty years ago [10].

In architecture, a typical project goes through conceptual or pre-design to the operations in order to manage the building itself [11]. Architectural design is a complex process that requires imagination and skills to generate new ideas [12]. Since the design criteria are not yet fully defined at the conceptual stage, the application of artificial intelligence to this process should not be directed toward finding a solution in a specified search area; this method should instead be seen as a study of the requirements and potential solutions to achieve those criteria during the conceptual design phase [13].

Today the designer has new tools at his disposal to create, and an “inspiring muse” who offers new opportunities to investigate his own emotions, and new languages capable of mixing reality with the product of the reinterpretations of neural networks. Artificial intelligence and machine learning play a fundamental role in today’s lives, thanks to the development of increasingly advanced systems inspired by the human way of thinking, acting, solving, and creating. To talk about artificial intelligence means talking about what it means to be human in the age of AI. If there is one characteristic that belongs to humanity, it is creativity. Creativity is not limited to art, and creativity is very human. There is no precise definition of creativity, but one of them is that creativity could be defined as the production of new effective knowledge from existing knowledge, which is achieved through problem-solving [14]. Creativity is also a form of care and recognition of the different ways of being. Precisely for this reason, it is natural to ask ourselves whether it is legitimate to approach a term

so strongly connoted by our sensitivity as living beings to something artificial such as a machine or software.

Creativity is one of the most mysterious and, simultaneously, most noteworthy qualities of all human existence. We can define it as the ability to create something that is innovative and recognized as such by the community. Indeed, human creativity is also the result of the stratification of acquired data because every artist draws, even unconsciously, from the fabulous creations of the past. Therefore, no work of human ingenuity is entirely self-sufficient and purely original. However, the human artist has free will. He chooses which field of art to dedicate himself to and the purpose of his work. On the contrary, an artificial intelligence system follows an algorithmic procedure that tells it where, how, and what to look for.

AI is about origination and novelty, doing things that nobody anticipated and that we did not expect. It has an emergent intelligence. We cannot predict quite the outcome that it is going to offer us. It is based on everything it was fed, but it not only giving back exactly what has been given. It is recombining it and giving back to us a in a new outcome. From this, it can be stated that there is something about a sort of autonomous creativity.

Nevertheless, what happens when machines, algorithms and artificial intelligence come into play? There is the need to imagine a new type of creator, a new breed of artisans who are at ease with these evolved instruments. Artificial neural networks are more than a tool; it has an intelligence of its own, and we must understand that when working with it. It can be seen as a medium, as something we work within. Indeed, there is a need to understand its properties. When a sculptor works with a piece of marble, he or she must understand the marble's feel. With AI, we must understand the way it sees the world and the way it thinks. It's something to work alongside.

It is essential to consider that an AI system is not self-sufficient in deciding what to do: at the base of its creation, there is information that man enters. Therefore, it is possible to believe that creativity can be improved by the collaboration and interrelation between man and machine.

AI can be seen as a kind of "extended mind": a prosthetic device that can enhance the natural intelligence of the human being [15]. It's another form of intelligence to work with. In this way, for the designer comes the possibility to work not only with his own mind, but with this broader sea of possibilities which can take him to a new place.

## 5 Conclusions

The impact of digital design and fabrication techniques on architecture is already far-reaching. The integration of digitally generated data to produce precise and complex geometry, to direct making and assembly process, and exploit material performance is returning architects to a position that had disappeared with the master-builders of medieval times. The tools provided by digital technological progress have allowed the

designer to take control of and retool the entire design, fabrication, and manufacturing process, leading to the generation of the architect of the future: a professional figure based on a combination of the skills of the architect, augmented by computers and computer-driven machines. With these new powers, architects are now able to craft the digital tools and processes required to make architecture for the post-digital age.

The language of architecture, the figure of the architect as a professional, and the method of design have evolved, in tandem with the changing purposes that different societies have had for this profession and art, which is destined to undergo radical transformations in the coming decades. It is hoped that this contribution will not only spark the curiosity of readers, but also motivate them to engage in further research and participate in lively debates on the subjects at hand.

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