# What About Humans? Artificial Intelligence in Architecture


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**Abstract** Artificial intelligence is about to reshape the architectural discipline. After discussing the relations between artificial intelligence and the broader question of automation in architecture, this article focuses on the future of the interaction between humans and intelligent machines. The way machines will understand architecture may be very different from the reading of humans. Since the Renaissance, the architectural discipline has defined itself as a conversation between different stakeholders, the designer, but also the clients and the artisans in charge of the realization of projects. How can this conversation be adapted to the rise of intelligent machines? Such a question is not only a matter of design effectiveness. It is inseparable from expressive and artistic issues. Just like the fascination of modernist architecture for industrialization was intimately linked to the quest for a new poetics of the discipline, our contemporary interest for artificial intelligence has to do with questions regarding the creative core of the architectural discipline.

**Keywords** Automation · Artificial intelligence in architecture · Human–machine interaction

Envisaged from a humanist perspective on architecture, the main problem raised by the introduction of artificial intelligence in the design process has to do with the roles that the humans will play in a few decades from now in this process. What if artificial intelligence was soon to become a pervasive reality in architecture? What type of agency would humans retain once computers have taken over many tasks that they still carry out today?

Before addressing this question, let me begin by an apparently naïve question. Why is it that we want so much to automate not only fabrication but also large

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parts of the design process itself? Why is it that we are gradually passing from a discourse on robots to a discourse on artificial intelligence in architecture? After all, one could wonder whether automation will truly happen in our field. Human labor comes still cheap compared to the machinery needed if we want to automate significantly the building industry. This is even truer of the design process. Young architects are not that expensive compared to the sophisticated machines that would be needed to replace them. Starting from this question will allow me to unpack a number of dimensions not currently discussed in the field of digital architecture.

## 1 Automation, from Myth to Reality

The truth is that automation is not an entirely rational enterprise. It is all the more unavoidable that it is rooted in something that extends deeper than rational calculation, something that has to do with the recognition that there are forces in the world that go far beyond the usual factors that shape our ordinary actions and productions. How to be plugged into these forces was a question that the Surrealists had tried to raise through their practice of "écriture automatique," automatic writing.

The reason I am mentioning the Surrealists is not only because of their use of the notion of automatic writing and more generally automatic creation as a way to go beyond ordinary artistic production in order to tap into more fundamental forces such as those that move the unconscious. Among their disciples was a young intellectual who was later to become one of the major Post-War French sociologists, Pierre Naville. Naville worked on automation in the industry. But while doing empirical work on what was happening on workshops floors, he remained sensitive to the lesson that the Surrealists had taught him.

He famously declared in an influential essay entitled Vers l'Automatisme Social, Towards Social Automatism, published in the early 1960s: "I am not far to believe, despite the violent rejections that it often provokes, that automatism represents an archetype as ancient and radical as our sense of symmetry or cycle, that it touches something intimate in us, a vibrant chord of our creative power, that it has to do with enchantment, with our will to power, and many other impulses that moves us, starting from our unconscious" [1].

For Naville, automation was ultimately about this general pursuit of automatism as an archetype. It had to do with the quest for a spontaneity usually reserved to natural phenomena and beings. It was an attempt to make nature do, by itself, through machines harnessing its power, what humans wanted it to do. It appeared as a Promethean quest that could never be fully satisfied by our technology, as sophisticated as it could be, for it possessed a foundational and even mythical character.

Envisaged from this point of view, automation corresponds to something far more fundamental than the ambition to improve efficiency. It has to do with the desire to create something that can rival nature, living beings in particular. Another way to put it is to say that automation has to do with the desire to animate matter, to surround

**Fig. 1** William Blake, Elohim Creating Adam, circa 1805

oneself with artificial creatures that seem endowed with something akin with life. There are multiple legends and works of fiction that illustrate the enduring character of this theme, think of Pygmalion, the Golem, or Frankenstein (Fig. 1).

From the start, robots were inheritors of this tradition. Like their mythical predecessors, they were situated on the fringe where the distinction between the natural and the artificial becomes blurred. Published in the 1880s novel by the Symbolist French writer Auguste Villiers de l'Isle Adam, L'Ève Future, The Future Eve, is characteristic of this blurring. The artificial woman featured in the novel gradually awakes to a life very similar to the human one. Similarly, in Fritz Lang's Metropolis the robot seems endowed with a vibrant life that allows her to impersonate a human. The question of the relation between robots and life has of course known a new development with artificial intelligence and deep learning, but our fears of an artificial form of life challenging our alleged superiority as "real" human beings has remained unchanged. In many fictions, beginning with Metropolis, robots seem endowed with almost diabolical powers.

The potentially diabolical dimension of robots offers a convenient transition toward a fundamental aspect of animation: its ambiguous, transgressive, and finally potentially sinful character. For, at least in the Western tradition, it is only God or the gods who can animate. This is what God does when he creates man and woman

**Fig. 2** Animated Modernism: The La Tourette priory by Le Corbusier completed in 1961

in the Genesis. For humans to animate appears as a transgression that can easily lead to catastrophe. Think of the series of unfortunate events that follow the animation of the Golem or Frankenstein.

Let me now turn to architecture. The discipline has a both intimate and complex relation to the question of animation. On the one hand, it tries to animate matter so that it can address humans, as if it was about to speak. This expressive power was traditionally entrusted to ornament. But ornament was not alone to fulfill this function. Composition played also a role in the capacity of architecture to address humans, to enter in relation with them akin to a sort of dialog. On the other hand, animation has to be incomplete; otherwise, it appeared as transgressive (Fig. 2).[1]

For a very long time, architecture had to do with animation, but its animation left almost entirely aside the question of automatism and automation. The discipline was in quest of an immobile animation. It was very different in that respect from other domains, from technology in particular with its multiple machines in motion.

Now, it is striking to observe how what has happened in the past decade or two can be characterized as a dramatic shift in the relations in between architecture and animation. With the rise of digital culture and the extended use of computers and robots in architecture, animation has become inseparable from the question of automation. Following what I said earlier, such a transformation can be interpreted not only as a technological revolution but also as a reactivation of powerful mythical

[1] On animation in architecture, see Spyros Papapetros, On the Animation of the Inorganic: Art, Architecture, and the Extension of Life (Chicago: The University of Chicago Press, 2012), Antoine Picon, La Matérialité de l'Architecture (Marseilles: Parenthèses, 2018).

**Fig. 3** Fabio Gramazio and Matthias Kohler, robotic arm in operation, 2008

forces. This mythical character explains probably why the relation between automation and architecture is complex and even contradictory. Part of the power of myths lies in their capacity to host contradictory dimensions, just like dreams (Fig. 3).

Automation in architecture is an unfolding process. So far, the most salient phenomenon has been the development of digital fabrication with laser cutters, milling machines, 3-D printers, and, of course, robots. With their multiplication, one has observed the rise of interrogations regarding the possibility to automate entirely the construction process, just like what has happened in the automobile industry.

At this stage, it is possible to go even further and imagine that we could very well be on the eve on a new wave of automation, the automation of design tasks proper with the rise of artificial intelligence. This is what I will mostly discuss in the rest of this article.

## 2 Big Data, Machine Learning, and Architectural Conversation

Under what condition is the development and use of artificial intelligence possible in architecture, in the design process in particular? Let me begin by evoking some of the basic conditions that will need to be fulfilled in order to have truly intelligent machines.

The first condition is to have gathered sufficiently large quantity of data enabling machines to learn from precedents in architecture, landscape architecture, urban design, and urban planning. A number of designers are currently exploring what this perspective may entail concretely. At Harvard Graduate School of Design, Andrew Witt is among them. His researches on the possible use of big data are emblematic of the issues raised by the development of big data related to buildings, landscapes, and cities.[2]

In architecture, if machines ingest large enough databases of types, tectonic details, and ornaments, one may reasonably suppose that they will be able to produce designs of their own. What will these design look like? They may combine elements that we don't usually associate, such as Baroque compositions and modernist details, for instance.

Should this scenario become true, two questions would immediately arise. First, will we be able to understand how machines reason? It is not only a matter of being able to picture how algorithms actually function. The elements on which the machine base itself may differ profoundly from ours. Where we see floors, walls, ceilings, and roofs, the machine may choose a different way to organize its reading of buildings. Among humans, there are already differences between the way buildings are understood because of linguistic nuances and technological variations. The French word "poutre" corresponds, for instance, both to the English terms beam and truss, which means that entities that are of the same nature for French builders belong to distinct categories for their English-speaking counterparts. Think of how disconcerting the elements of construction produced by machine deep learning could be from what humans ordinarily recognized as the fundamental components of the building industry. We are already observing significant differences between the way they tend to see cities from a radical perspective than ours. They tend to observe, for instance, clouds of data or rather traces of geolocated events that have become big data after being recorded (Fig. 4).

Surely, the distance between our intuitive grasp of objects and phenomena and methods following entirely different premisses predates the invention of the computer. The diffusion of calculus during the eighteenth century was accompanied by a very similar interrogation on the relevance of the new mathematics pioneered by Newton and Leibniz since they were so far away from the geometric reasoning that had dominated since ancient times. What took place upon the course of a few decades was a dramatic realignment of human intuition, which enabled scientists and engineers to build coherent and above all operative mental images of how calculus did actually operate.

Will humans be able to produce similar mental images enabling a better understanding of machine procedures of deep learning? Theorist and historian Mario Carpo doubt it [2]. Contrary to him, I personally believe that this be the case for specialized professionals of code, the contemporary equivalent of early-19th scientists and engineers confronted with the Intricacies of Calculus, who will be able to imagine how computers operate. But since design and coding are very probably going to remain

[2]See the project showcased on his website, "Certain Measures," https://certainmeasures.com/.

**Fig. 4** "Conversation" between a Buddhist monk and a robot at Longquan Temple, near Beijing

separate activities, except in some specific cases, a new question arises. Should we force machines to work with the same type of elements than those we manipulate day after day in design? Should machines be obliged to combine floors, walls, and ceilings, instead of the elements that deep learning might have led them to identify? This would make machines easier to understand, but it might be the same token deprive them of any genuine creative power. With computers following our ways to understand buildings, we will soon have machines which will be able to produce tolerably good Baroque churches of modernist villas instead of producing hard to imagine combinations of elements of an unknown nature. But is it what we really want? The building industry may not have the same hesitation. After all, it has been feeding for centuries on libraries of established types and patterns. However, this might not be the optimal way to mobilize computation in design. Kostas Terzidis has, for instance, advocated to respect the fundamental "otherness" of computers in order to fully take advantage of their creative potential [3].

Now, the previous discussion revolves around a central issue, that is, the way we will communicate in the future with machines or, to put it in a slightly different light, how to have a true architectural conversation with it. It is worth remembering at this stage that the architectural discipline is actually based on a series of conversations between architects and clients, architects and entrepreneurs, and entrepreneurs and labor, to name only a few. For the funding fathers of Italian Renaissance architecture like Leon Battista Alberti or Daniele Barbaro, this conversational character was the most fundamental aspect of the discipline [4]. From such a perspective, the main challenge raised by artificial intelligence in architecture lies in the difficulty to reach a sufficient level of understanding of machines to be able to associate them in productive manner to the conversation. This will prove extremely difficult if machines are too different from us, but forcing them to mimic us may lead to the symmetric pitfall of making them not interesting enough to deserve consideration.

## 3 The Automation of Design and Fabrication

At this stage, it seems plausible to assume that machines will soon be able to do more and more. It seems also plausible to assume than in most case we will force machines to consider elements and to follow rules that are somewhat similar or at least compatible with those that we have adopted in architecture and the building industry. Theorists like Karl Chu may dream of a completely alternative mode of design, but the industry will probably not be as open to this possibility.[3]

Until recently, one assumed that automation would impact only poorly qualified jobs. This might not be the case. Architecture will be probably among the most severely hit disciplines. The reason for this high degree of vulnerability is that architecture is among the formalized of all the arts. The mechanical part is stronger than in other domains, and hence the traditional position of the discipline on the threshold between art and technology. The very use of orders and proportions by the Vitruvian tradition seems already to be calling for automation, as Mario Carpo has convincingly argued in his essay *The Alphabet and the Algorithm* [5].

The early-19th project of Durand to codify design procedures could constitute an even clearer forerunner of the reflections on the possibility to use intelligent machines to design. British Architect Cedric Price's approach to projects like Generator seems also to announce an era of active machine involvement in design. One might be thus tempted to establish a genealogy leading from Durand to Price and from Price to contemporary machine learning.

It is almost certain that we are heading to an era of active machine involvement in design. This era had been announced by many proponents of early computer-in-architecture culture. It was, for instance, a key belief of the researchers led by Nicholas Negroponte in the Massachusetts Institute of Technology Architecture Machine Group, the ancestor of the Media Lab [6].

Retrospectively, the period during which computers and robots were mere tools will appear as a parenthesis in a long march toward a true cooperation between man and machine. Again, it is not sure that intelligent design machines will reason like humans. This means that as important as their intrinsic power to produce design solutions will be, their capacity to have a conversation with us will prove crucial. Negroponte's Architecture Machine Group had a clear vision of the necessity to be able to truly enter into a dialog with the computer. This is the reason why it gradually turned to questions of interface, thus giving birth to the Media Lab.

Intelligence will not be limited only to design proper. Construction will also be impacted. So far, robots are no more than mechanical slaves. One may imagine that they will acquire some autonomy. We might then see the emergence of disagreements between these various forms of artificial intelligence. Design could very well remain a conversation. But between whom remains undecided. Besides humans and computers, robots might have a role to play in such a conversation, especially if we

[3]See, for instance, Chu, Karl, "Metaphysics of genetic architecture and computation," in Constructing a New Agenda: Architectural Theory 1993–2009 (New York: Princeton Architectural Press, 2010), 427: 431.

try to follow John Ruskin advocacy of the rights of labor to be associated to the creation of any form of collective work. Aren't they about to become the new labor force of our digital age?[4]

Before dealing with what could still remain the human responsibility in this transformation, let me say a word about some professional changes that this evolution will accelerate. Some of these changes have already intervened with the diffusion of digital tools. While thousands of books and articles have been devoted to the development of digital architecture, it is surprising to observe how little is currently written on that matter.[5]

The first striking feature of what has happened in the design profession is the consolidation of practices. Giant firms are no longer the exception. The rise of artificial intelligence in architecture may increase further this phenomenon. Indeed, it requires substantial investment in hardware and software that may not be accessible to small- and middle-sized structures.

In these extended practices, there is a risk of rapid obsolescence for designers because of the rapid evolution of a more and more demanding technological environment. Will the future of the profession concern mostly designers in their 20s and 30s, like what has happened in many sport disciplines?

Finally, one observes a profound redefinition of authorship with the rise of more collaborative and networked forms of authorships.[6] This tendency will be accentuated by the cooperation with machines. What will mean being an author in dense networks comprising not only humans, but also computers and robots? Bruno Latour's Actor-Network Theory offers only very partial answers to this interrogation [7]. It leads to the more general question of what could remain specifically human in the future of design that I have sketched. It is not an easy question to answer. One may of course play the humanist and invoke the monopoly of humans on genuine creation. But is this attitude sustainable? We are already seeing texts written by computers, paintings produced by them. These creations are not yet brilliant, but nothing indicates that there are asymptotic limits to what machines can achieve (Fig. 5).

## 4 What About Humans?

What will remain specifically human in a design process suffused with artificial intelligence? The question is complicated by the fact that since we invent machines, there is something partly mechanical in the way we think. This mechanical dimension of human thought obsessed French eighteenth-century philosopher Denis Diderot, the Chief Editor of the *Encyclopédie*. It was the source of his interest for the mechanical

[4] See on this theme Antoine Picon, "Free the Robots!", Log, n° 36, Winter 2016, 146: 151.

[5] We have tried to address the subject in Wendy Fok, Antoine Picon, eds, Architectural Design, "Digital Property: Open Source Architecture," vol. 86, n° 5, 2016.

[6] For an example of a more collaborative form of authorship, see Philip F. Yuan, Collaborative Laboratory/Works of Archi-Union and Fab-Union (Hong Kong: Oscar Riera Publishers, 2018).

**Fig. 5** Iris van Herpen with Jolan van der Wiel and Marjan Colletti, Quaquaversal centrepiece, Musée d'Histoire de la Médecine, Paris, 2015. A spectacular example of distributed authorship

arts to which he devoted a large part of the *Encyclopédie*. For Diderot, to describe a machine as he did with a knitting machine was synonymous with trying to address the question of what is mechanical in the human mind. Indeed, he assumed that we can design machines only insofar that we think like them [8] (Fig. 6).

If we are partly resembling machines, what is unique to what we bring to the design process? An immediate answer lies in the fact that we are still endowed with a much more generalist form of intelligence than machine. The path leading to computers able to successfully compete with the all-purpose brain that we possess is still ahead of us. But let us assume for the sake of the argument that we will be confronted to much more powerful and general forms of artificial intelligence in the near future: what could remain then the exclusive competence of humans?

Two factors must be taken into account at this stage. First, we have an embodied intelligence. Our conceptions and experiences of the body have proved eminently variable from one period and a civilization to another, but to be human is to have a body through which our brain and the awareness of who we are structure themselves. The findings of contemporary neurobiologists like Antonio Damasio tend to support this hypothesis [9]. The lack of embodiment, in the intimate sense I just referred to, represents a real limitation of robots and artificial intelligence.

Second, because we have a body, we have emotions that mix the purely physical and the mental. Memory and most of our cognitive functions blend in a very similar way the physical and the mental. Such an interaction is what produces the human relevance of objects and actions as well as this series of echoes in each other minds that we call meaning. It is telling that for a very long time, architecture was interpreted as what happened to buildings when they were able to connect with us through some

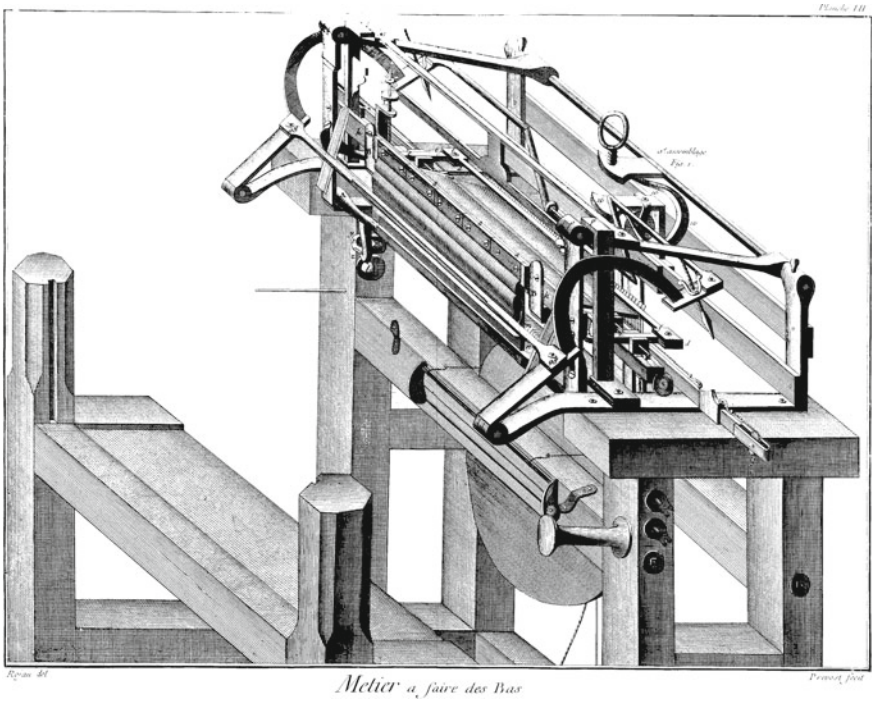


**Fig. 6** Knitting machine described by Denis Diderot in the Encyclopédie

affinity with our body. The five orders of the Vitruvian tradition found, for instance, their legitimacy in the analogy between their proportions and those of the human body. More generally, the symbolic is very often connected to our body.

I would personally assign to the humans the task to decide what truly matters, to choose among a range of possible solutions produced by the machine what seems the most relevant to humans. In other words, this entails a shift from tactics to strategy, from the how to the why. This shift has already begun to happen with the diffusion of digital tools, with the rise of parametric design, in particular, that may produce and infinity of solutions. In that latter case, the real decision-making has to do with selecting what are the right questions. Again, the why seem to become more important than the how.

From this perspective, architecture becomes a question of choice, something akin to a form of action. Machines produce while humans perform, while they make choices that have to do with how the physical and the symbolic are actually co-emergent.

The interaction between the physical and the symbolic is what makes possible dwelling, or inhabiting, in the sense popularized by Martin Heidegger in his seminal text "Building Dwelling Thinking" [10]. Machines can occupy a space, but humans have the relatively unique capacity to inhabit it. Making choices about inhabiting

could very well become a unique prerogative of humans surrounded by artificial intelligence in the future.

I am advocating here a kind of return to the phenomenological frame, with a major caveat; however, the fact that this return should not be accompanied with the hypothesis of a completely static conception of what constitutes the human. One should not assign a fixed essence to mankind. Even embodiment could characterize one day highly advanced machines.

Meanwhile, pressing issues are on the table. What will be, for instance, the future of labor in a highly robotized design world? There again, there is nothing dictated by a fixed nature, but constructs in continuous evolution. This means that the distribution of the tasks between humans and machines is to a large extent a construct, a political construct. To be human is to be political, as Aristotle famously remarked [11]. We need urgently to redefine the politics of design envisaged as the relations between the various actors, human and non-human, that are involved in it.

## 5 Updating the Myth: The Need for a New Poetics

In architecture, myth and poetics have particularly strong connection. Technology in architecture has no relevance if it does appeal to these closely related dimensions. This was the case with industrialization at the apex of modernism. Industrialization was never about rationalization only. It was about connecting to a broader dynamism and about poetics.

It is probably too early to say how this poetic dimension will play out in the development of artificial intelligence in architecture. But let me note one thing: usually architectural poetics plays on the fringes of the dominant productive system. It appeals to nostalgia as well as to various themes that appear as counterpoints to the prevalent rationalization schemes. The dream of a reinvented craftsmanship haunted modernity and industrialization, for instance. The contribution of Jean Prouvé cannot be understood out of this frame. But this is also true of a radical advocate of industrialization like Buckminster Fuller. What moves us with the Dymaxion car is precisely its bricolage dimension quite different from mainstream industrialization (Fig. 7).

What will be the fringes of an artificial-intelligence-driven world? A possible direction that deserves exploration could be to introduce glitches, to perturbate the perfection of machine design. This imperfection has again to do with the couple body/meaning. It was present in Ruskin reflections on ornament, or later in Le Corbusier's fascination with the imperfections of concrete that made manifest the presence of man. What could imperfection mean in a new machine age?

We could also invert the roles and have the machine produce disconcerting glitches and objects. Of course, all this might require a negotiation with machines. And here we are back to question of conversation. Speaking of conversation, why not imagine that buildings themselves could have eventually something to say? Why not envisage forms of artificial intelligence the body of which could be buildings,

**Fig. 7** Construction of a Buckminster Fuller's Dymaxion Car prototype in the early 1930s

homes, in particular? Cedric Price's Generator project suggests something like this. This would constitute the ultimate form of architectural animation (Figs. 8 and 9).

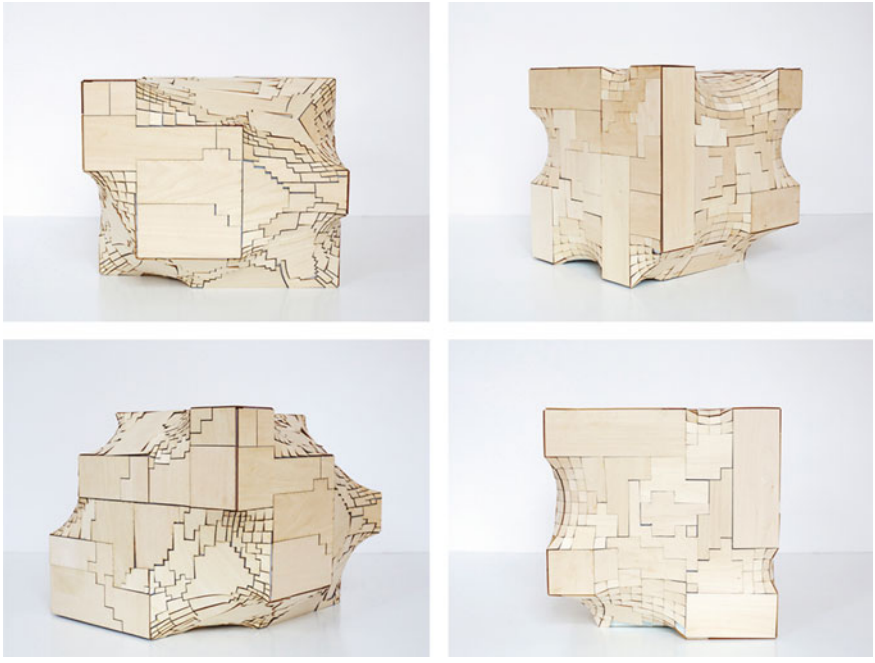

**Fig. 8** "Mine the Scrap" project by Tobias Nolte, Andrew Witt, and al., Certain Measures, 2015–2016

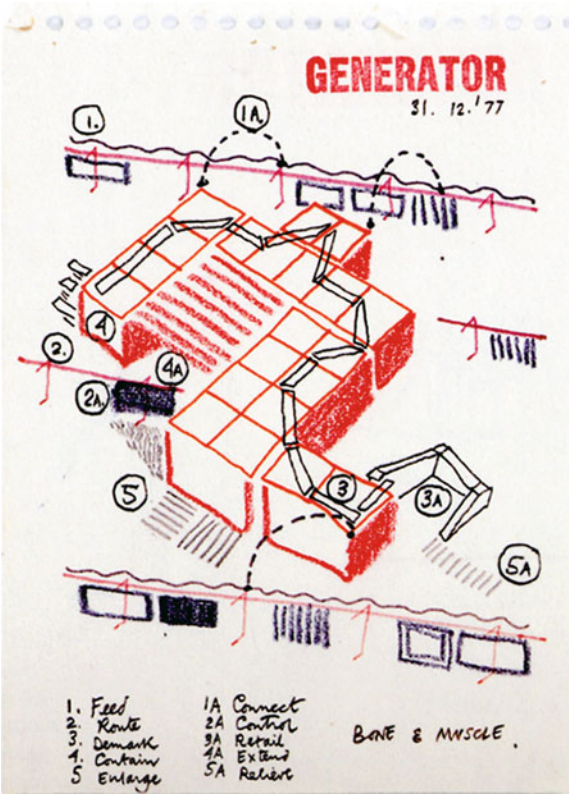


**Fig. 9** Cedric Price, schema of the Generator project, early 1970s

Ultimately, we might want to question also what will be probably at the core of the role played by humans in an artificial-intelligence-driven design world: inhabiting. Are we going to keep forever the monopoly of this key dimension of architectural experience? Questioning the fringes of established practices and beliefs, reinventing the mythical might involve a critique of inhabiting as we have known it so far. A world in which we are no longer the only one to inhabit could become possible in the future. After all we have never designed only for humans. For instance, we have often drawn and built for horses as well as humans. A seventeenth-century Parisian hotel was meant to accommodate both. At the turn of the nineteenth and twentieth centuries, large cities were inhabited by tenth of thousands of horses, which an American urban historian has interestingly characterized as "living machines" [12] (Fig. 10).

Science fiction novels and movies are already presenting us with multiple images of life with artificial companions with whom we inhabit. Take the movie Ex Machina, for instance. Design is among the key dimensions that makes us humans. It will probably remain so in this new machine age that I have evoked. To be human might have to do with the fact that we are never sure of what it means exactly. Design crystallizes this incertitude.

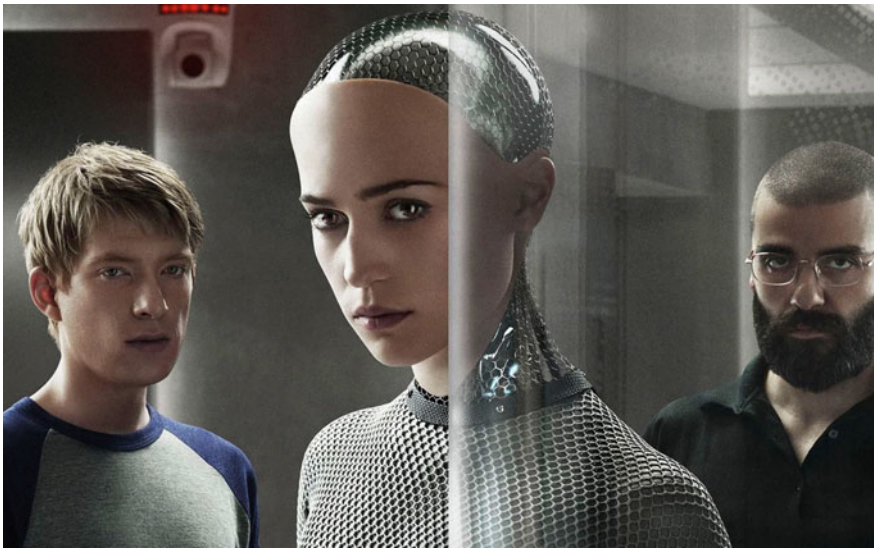

**Fig. 10** Still from the 2014 British science fiction movie Ex Machina

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