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Designing Technical Systems in The Anthropocene: Manifesto for a New Paradigm

Jean-Philippe PIERRE[1]* and Guillaume PERROCHEAU[2]

[1]Geography-Geopolitics, ISEN Mediterranean, RASSCAS Laboratory, Toulon

[2]Management Sciences, ISEN Mediterranean, RASSCAS Laboratory, Toulon

ABSTRACT

The RASSCAS Laboratory (Applied Research in Social Sciences to Design a Sustainable Anthropocene) is a human sciences laboratory based in a digital engineering school. The idea of this laboratory is to guide engineering students towards models of design and innovation that respond both to the ethical desires of this young generation and to the need for responsible innovation imposed by the context of access to development that is fair for mankind and sustainable for life and the planet.

This article is first and foremost a profession of faith, that of researchers who have decided to commit themselves to the path of development that respects life. It is also a call to become aware of the need to modify traditional design models. It's a call for a paradigm shift from anthropocentric models to one that gives equal place to human and non-human living beings.

***Corresponding author**

Jean-Philippe PIERRE, Geography-Geopolitics, ISEN Mediterranean, RASSCAS Laboratory, Toulon.

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Intent

This article, presented in the form of a manifesto, is a call to change the way technical systems are designed. Based on a multi-disciplinary approach, which acknowledges the physical reality of the world (as described in climatology or geology, for example), it encourages everyone involved in the thinking process as well as the making of technical systems to a paradigm shift. Furthermore, this document is an invitation to scientists, engineers, and decision-makers to recognize the extent of their influence and their responsibilities in shaping the technological systems that surround us. Finally, this text outlines a research and action program, that may inspire those seeking to develop technologies better-suited for the current era.

Let's Start from The Premise That the Anthropocene Calls into Question the Current Concept of Technological Progress

"*Ultimately, intelligence, seen in what appears to be its original approach, is the ability to make artificial objects, in particular tools for making tools, and to vary the way they are made indefinitely*" [1].

Throughout its history, Bergson's homo faber has inserted a multitude of objects, infrastructures, robots, networks, factories, and machines into the biological world - the world of the living, of genetics, of photosynthesis, of the great natural cycles of water and nutrients - enabling him to feed himself, travel, care for his beloved ones, communicate, entertain himself and understand his surroundings. This movement accelerated around the eighteenth century in Europe with the Industrial Revolution. A revolution marked by its banks, factories, techniques, and fossil fuels, combined with colonialism, and later globalization, rapidly expanded its influence across the entire surface of the globe.

At first, it might 'be conceivable that this wave of technology, automation and machines, which Bruno Latour calls *the modernization front*, is inexorable and that it will bring greater well-being, security, care, peace, and wisdom to as many people as possible [2].

Little by little, this idea of inevitable modernity, driven by perpetual innovation and beneficial to nature, reached its limits. This began to become apparent at the end of the Second World War when everyone realized that man had developed the technical means to destroy humanity in a matter of minutes with nuclear bombs. The idea became clearer in the early 2000s when the scientific consensus on the evidence of the Anthropocene took hold and we realized that man, with his socio-technical systems, was now jeopardizing the stability of living conditions on Earth as we have known them for 12,000 years.

"Because human activities have also grown to become significant geological forces, for instance through land use changes, deforestation, and fossil fuel burning, it is justified to assign the term "Anthropocene" to the current geological epoch" [3].

"Preliminary estimates suggest a Technosphere mass of approximately 30 trillion tonnes (Tt), which helps support a human

biomass that, despite recent growth, is 5 orders of magnitude smaller" [4].

Now, even if this fact is still hard to accept for large sections of the population (including economic and political decision-makers) it is well-established that **human activity, supported by its colossal technical infrastructure, is the main cause of the disruption of cycles that are essential for living beings, including humans: For some time now, this has been referred to as the human era, the Anthropocene** [5]. Today, it's faber versus sapiens: man is determined to do what he knows will harm us and future generations. It has to be said that the main belief of modern man is outdated. Today, the rise of science and technological innovation is not systematically synonymous with progress and well-being for mankind.

The classic dualistic ontology, called "naturalism by the anthropologist Philippe Descola, reifies the separation between man and nature, but this model does not correspond to the physicochemical reality of the world. Humans are living beings, whose survival depends entirely on the functioning of the rest of the living world [6]. **Man believes that he is interdependent with the rest of the biosphere**. In this context, the separation between man and nature does not correspond to known biological and physical reality.

Therefore, The Anthropocene Imposes a New Design Paradigm for Engineers

Among those who think, design, manufacture, maintain and modify this Technosphere, engineers and scientists occupy a prominent place. By definition, **engineering consists of designing technical solutions and systems using the knowledge available in the scientific state of the art**. As highlighted by the sociologist Richard Sennett, the work of an engineer is not fundamentally different from that of a craftsman [7]. Engineers design artefacts: they imagine them, and they follow a path - a process - making their ideas tangible, through plans, prototypes or objects (artefacts). During this process, the hand meets with the head. Homo Faber and Homo Sapiens are one. Humans think through their gestures and objects. Moreover, there is no order or hierarchy between the imaginary, the process of making and the artefact constructed. Sometimes it's the artefact itself that, seen from another angle, inspires a new idea, as when a prototype is made in a FabLab. Or it may be the process, the method, that suddenly gives birth to an unexpected artefact, even by mistake...

In the realm of engineering, there is a generative dance between imaginaries, processes and artefacts: At all three levels (imaginary, process, artefact), the current paradigm is still rooted in very strong implicit beliefs, which are being profoundly challenged by the Anthropocene. For each of these beliefs, RASSCAS proposes a way forward.

1. When it comes to the imaginary, our ability to envisage the future is constrained between disenchantment and disembodiment. The first step that can be taken is to break out of this confinement, **to create new imaginaries for the Anthropocene**.
2. In terms of technology design processes, designers alternate between user-driven and technology-influenced methods, both of which are fundamentally anthropocentric. The second approach **proposes the implementation of design methods centred on living beings**.
3. Finally, on the artefact side, the power of the new tools is both fascinating and frightening. Their trajectory seems to be moving inevitably towards complexity in High-Tech. The third suggestion is not to arbitrate between High and Low Tech, but rather **to prefer the Right Tech**, which is an invitation to reflect on the ethical use of technology.

In the remainder of this text, these three points will be developed, going back over the beliefs and detailing the proposed way of overcoming them

Path 1: The Need to Create New Imaginaries for The Anthropocene

How the future is imagined always influences how the devices of the present are designed in the past, philosophers, thinkers, and politicians contemplated the future, but now, it's the realm of business leaders and fiction writers [8]. On one hand, the major technology corporations present a technophilic future, where the world is saturated with networked infrastructures. They promise space tourism, drone deliveries, collaboration with artificial intelligence, and robots for medical care, suggesting that technology holds solutions to all problems, extending the 20th-century modernist paradigm. Unfortunately, this paradigm neglects the planet's physical limits and its resources, which are nonetheless necessary for the manufacture and maintenance of what Michel Serres calls "Object-worlds", whose voracious appetite for energy seems to have no limits [9]. **In this context, GAFAM's future is disembodied, because it is cut off from the physical realities and needs of life**.

On the other hand, the vision of the future is carried by artists and fiction writers. But this futuristic world is almost always a dystopia. From *MadMax to A Clockwork Orange*, from *Star Wars* to *Planet of the Apes*, from *Cyber* Punks to the dark cities of *Blade Runner*, the new world is often worse than the present, featuring violence, inter-stellar wars, humans enslaved by machines... **In this perspective, the future of fiction is disenchanted, depicting futures devoid of hope and illusion**.

For those of us who design objects and solutions for a sustainable and desirable world, there are reasons for anxiousness, because the solutions proposed are often caught between disembodied and disenchanted visions. It's time to get out of this dilemma.

The COVID-19 crisis shed new light on this question of the "future". In the years 2020 and 2021 philosophers, authors and thinkers have rekindled their interest in the future, which has been reinvented by the ill-defined concept of the "world after". In reality, there is no singular "world after" firstly, because there is not 'one' world but 'many' worlds (of education, finance, politics, childhood, health, Asia, Europe, social media, renewable energies, etc.). Secondly, because these worlds have no fixed before-and-after states. They are in a constant state of change, birth, interaction, demise and renewal. Gilles Deleuze and Félix Guattari described this reality as **a living ball of woven worlds, like a vast mass of rhizomes intertwined with each other** [10].

The Anthropocene is adding to this complexity by adding the disruption of life cycles (droughts, eutrophication of aquatic environments, cyclones, etc.) to the social rhizomes. And yet, in this world of fundamentally uncertain equilibrium, the need to build shared visions has never been more pressing. As sociologist Michel Grossetti has shown, uncertainty does not prevent analysis or action [11]. What may seem sudden and unforeseen to us is often simply a change in the scale of a phenomenon, a change that was already present, dormant in society, which from one step to the next, from rhizome to rhizome, suddenly becomes visible to the observer who until then had remained inattentive.

It is therefore proposed that anyone who designs technical objects and their applications should take back control of the construction of imaginary worlds. This involves the revitalization of visions crafted within reach: in collaboration with customers, suppliers, communities, immediate environments and stakeholders. The real impact of the Anthropocene on life on Earth remains unknown. The story has yet to be written, and it should be written by those intimately connected to the complexities at a grassroots level. **The visions that need to be constructed must propose scenarios in which humans, with their emotions, bodies and techniques, interact with non-humans in a more symbiotic way with non-humans**, for another geological era that the philosopher Glenn Albrecht calls the "symbiocene" [12].

Path 2: Refocusing Design Processes on The Needs of Living Organisms

- The design methods used in innovation, and taught in engineering schools, are in tension between two trends: **technology-centred methods and use-centred methods** the first case, the movement is from science to man: a new property, a new material, a new assembly or a new type of component is discovered, and designers then try to find applications, use cases, markets and customers for it.
- In the second case, the movement is from humans to technologies: the focus is on users, customers, citizens and patients and, based on an understanding of their needs, assemblies of technological elements are designed to satisfy them.

In these two often complementary approaches, what lies at the heart of the process is the response to human needs. For years, the methods used have been derived from the social economy. sciences and design, such as ethnography, design thinking, value proposition design, qualitative user studies, etc. In both cases, anthropocentric design methods are preferred, **which by construction are ill-suited to taking into account the complex needs of life, whether human or non-human**.

In the present day, as per the analysis of Bruno Latour, a philosopher and sociologist of science, a distinctive feature is the intertwining of the geological and biological history of the Earth with human history. For instance, a drought that devastates a crop is intricately linked to human-induced global warming [13]. Therefore, drought is not solely a "natural" occurrence nor exclusively a "human" one. It implicates humanity both in terms of its origins and consequences, as well as the broader spectrum of non-human life. This forces the designer to reassess his interactions with his environment, which is not just an 'environment' like a set, but a fully-fledged player in the sphere of human existence. It is proposed to broaden the scope of design so that it is aligned with wider human and non-human needs. The understanding that technological devices must serve this dual purpose - to meet human needs while preserving, and ideally regenerating, the conditions for the development of life - It is therefore proposed to change perspective... It is also conceivable that, in certain cases, the subtleties of life offer engineers efficient and economical models for design and organization. Ecosystems and taxa then become sources of inspiration for design activities. **In contrast to the prevailing paradigm of anthropocentric design (user-centred design), We therefore suggest adopting a life-centred design approach**.

From a methodological point of view, it is becoming imperative to learn how to integrate non-humans into the design and decision-making processes. Engineers must rediscover "a concern for nature", to quote the title of a major work on the subject [14]. To begin with, we need to rebuild the link between engineers and the living world, by helping them to re-experience nature. We also need to systematically reintroduce non-human actors into our design processes. We need to find spokespeople for ecosystems every time we want to manufacture, modify or design an element of the technosphere.

Path 3: Making Right Tech, Useful Artefacts to Maintain and Regenerate a Safe and Just Space for Humanity

In the 1960s, the engineer Gordon Moore predicted that the number of transistors and microprocessors on an integrated circuit surface would double every two years at the same manufacturing cost [15]. For more than 50 years, this prediction proved to be accurate, creating an endless stream of technological innovations based on ever faster, more powerful, higher-performance "High Tech". They have given us the illusion that **high-tech, backed by science and its discoveries, would give humans the Promethean power to solve any kind of problem through technology**, and this logic can of course be applied to global warming itself. This vision is pejoratively described as technosolutionist, although it still seems to be deeply entrenched in whole parts of industry as well as in certain universities and research institutions.

The problem is that these high technologies **also require ever-increasing amounts of energy and materials. Moreover, they fuel a logic of growth based on linearity**, from the extraction of a natural resource to the fabrication of manufactured products with an ever-shortening lifespan, which often ends in the creation of useless waste that is detrimental to living organisms. What the Anthropocene teaches us is that, for physical reasons of resource availability, the infinite growth of High Tech (and its negative externalities) is neither sustainable nor durable.

By antonymy, it has been described as "Low-Tech" the movement that, contrary to the mainstream, favours low-tech solutions. This movement holds out the promise of sobriety in the use of resources and energy, emphasizing user autonomy, the reuse of materials from the past, the reparability of solutions by design, and the circularity of technical trajectories (the tool does not generate waste, it is a resource for other cycles). For engineers who dare to think outside the box, such as Philippe Bihouix, low-tech could be the basis of a sustainable technical civilization [16].

In the Anthropocene paradigm, the aim of using these tools and techniques is to preserve, and if possible regenerate, stable living conditions in what the economist Kate Raworth has called a safe and just space for humanity [17]. "Safe' because the ceilings of planetary limits have not been exceeded, 'just' because the social floors of equity are maintained at levels that guarantee peace. However, this safe and just space, which offers the conditions for sustainable progress, will need a technical infrastructure so that human beings can continue to care for themselves, learn,

exchange ideas, enjoy themselves, etc. In some cases, it will be necessary to build new infrastructures. In some cases, you have to make trade-offs and accept, for example, that health-related uses can be equipped with the most advanced technologies, while others will rely on more sober devices. It is proposed not to put Low Tech against High Tech, but rather to speak of "Right Tech", the right technology is that which is not pejorative for the human ecological niche or its social organization. There are three points to bear in mind when defining Right Tech:

- Ecodesign (thinking about the life cycle of the device and aiming for the circularity of resources)

- Uses (using technologies to regenerate living organisms and promote social equity)
- Economic models (moving from linear models to economic models based on functionality and cooperation, and if possible, to regenerative models, as defined by Christophe Sempels, for example) [18].

Another Program to Design Technical Systems for A Sustainable Anthropocene

To summarize, we have concluded that the paradigm of technological progress, with its current economic models and social structures, is not sustainable. The disruptions we are generating or to which we are contributing (climate, pollution, etc.) and the unreasonable extraction of limited natural resources, are destroying the minimum conditions for the harmonious development of known living organisms and human societies.

We are proposing to everyone who designs technical systems and their applications,

- To reformulate the "Technological Why": Take control of shaping imaginative realms, redefine the purpose behind technology, and recreate visions—all within practical reach.
- To rethink the "Technological How": Broaden the focus of the design process to align with wider needs, encompassing both human and non-human entities. Learn to include non-humans in design and decision-making processes.
- To redefine the "Technological What": Assess the relevance of tools and techniques based on their contribution to preserving and, ideally, regenerating a safe and just space for humanity.

It is to be hoped that this manifesto will serve as a basis for a gradual re-evaluation of beliefs and values, habits concerning technological design. This invitation is extended to all designers: architects, designers, engineers, and project managers, engaged in shaping the technosphere. Importantly, this article is not a challenge to the utility of technical systems, or even to the idea of progress based on scientific knowledge. **On the contrary, it is a call for more scientific engagement, awareness, and knowledge in the design of technical systems**. Moving forward, we now need to draw on the life sciences, economics, geology and anthropology to envisage, design and produce technical systems.

The research and exploration program introduced here is **the essence of the laboratory** RASSCAS (Applied Research in Social Sciences to Design a Sustainable Anthropocene), created in 2022 by the authors of this text within the ISEN Mediterranean. It summarises the work ethic and framework of intervention of the RASSCAS laboratory. We sincerely hope that it will do more than just stimulate the entrepreneurial spirit. reflection and dialogue but also potentially spark controversy among those who, like us, acknowledge the lessons of the Anthropocene and are driven to deploy their knowledge and creativity in the service of designing technical systems for a future that is not just desirable and feasible but also sustainable for all life forms.

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