Luciana Nunes Nacif

The Generative AI Factory

In his book *O mundo codificado*, Vilém Flusser advances a central thesis: to decipher an era, one must decode its factories (Flusser 2007: 35). The material logic of a Neolithic pottery atelier or a medieval cobbler's shop, he suggests, unveils the essential life, thought, and revolutions of its society more faithfully than the abstract texts or artworks of a distant elite. For Flusser, history's true metamorphoses are born in the friction and flow of these primary sites of making.

It follows, then, that an analysis of contemporary factories is essential for diagnosing our own time. Flusser glimpsed the advent of a "new human: the functionary" (Flusser 2007: 41), perpetually interlaced with technical apparatuses through "thousands of threads, some of them invisible" (Flusser 2007: 41). An individual so entangled with technology that their actions can be read as functions of a system. From this perspective, the factory of the future ceases to be a physical location and becomes a ubiquitous network of mediation. And when mediation becomes omnipresent and invisible, it creates the illusion of immediacy. Indeed, the apparent immediacy of 21st-century images conceals a vast and complex productive chain, with profound social and environmental impacts. Tracing connections between this aesthetic phenomenon and its material base is the objective of this article, in an attempt to understand the profound changes that mark the present.

Today, these "factories" are embodied in the platforms and algorithmic systems that surround us. They thus represent an essential lens through which to interpret our era. In light of this, it is crucial to ask: what resource extraction, what forms of agency, and what infrastructures make it possible for us to converse with a text generator or obtain images in seconds? This entire chain—from the extraction of raw materials and the building of infrastructures to investments, outsourcing, statistical models, and labour markets—is interconnected and converges to form what we know as generative artificial intelligence. It is a sociotechnical phenomenon that emerged when probability solidified as a new paradigm of knowledge.

Against the narrative of technological inevitability championed by the oligopoly of contemporary corporations, Flusser maintained that the current condition of images (and, by

extension, of mediations) is not a destiny, but merely a technical possibility. The underlying intention of apparatuses, though "immense," would be "not unconquerable." The alternative would be to reconfigure the media landscape: to move away from unidirectional channels, such as television, toward bidirectional—or, in Flusserian terms, dialogic—networks like telephony. In such a model, individuals would no longer be mere objects of communication but would instead become active designers of meaning (Flusser 2007: 158-159).

However, as Baruch Gottlieb (2023) points out, an unresolved tension persists in Flusser's thought: in attributing symmetrical agency to all actors within the telematic universe, he appears to overlook the profound material asymmetries that dictate who can effectively access, modify, or subvert these systems. Attempting to subvert a code operating within computational apparatuses is one matter; challenging the power structures that determine when and how such apparatuses are replicated to execute their programs is quite another.

Yet, we can at least begin to visualise its material foundations and the power relations that underpin them. The generative AI factory spans the globe and projects beyond it, into space. To unravel the complexity of its production chain, we have charted a map that illuminates the critical points of each stage and the intricate connections that bind them. In the annotations accompanying the map, we seek to highlight some of these elements, paying particular attention to those which the process of mystification surrounding generative AI tends to render invisible.

Narratives about AI are often mythologised, sustained by a recurring repertoire of metaphors and imaginaries. But contrary to the mystical language used by the very companies that create these technologies, their innovations are far from magical. In reality, they are built from comprehensible mechanical components, down to their most fundamental level. As Gottlieb (2018: 89–90) observes, the surface that displays digital information is never truly digital. It is real, factual, concrete, material—the product of a long legacy of human effort acting upon the world's available resources.

The aim of this map, therefore, is to render the phenomenon more visible, highlighting the tensions, debates, and ecosystems that constitute it. We acknowledge that this portrait is necessarily partial and situated—one perspective among many in a field of constant transformation. The challenge in sketching this worldview is not to represent the unrepresentable, nor to capture the phenomenon in its totality. Rather, it is to develop critical tools capable of mapping some of its constitutive absences. To recognise these unseen layers is to take a step toward imagining alternative futures.

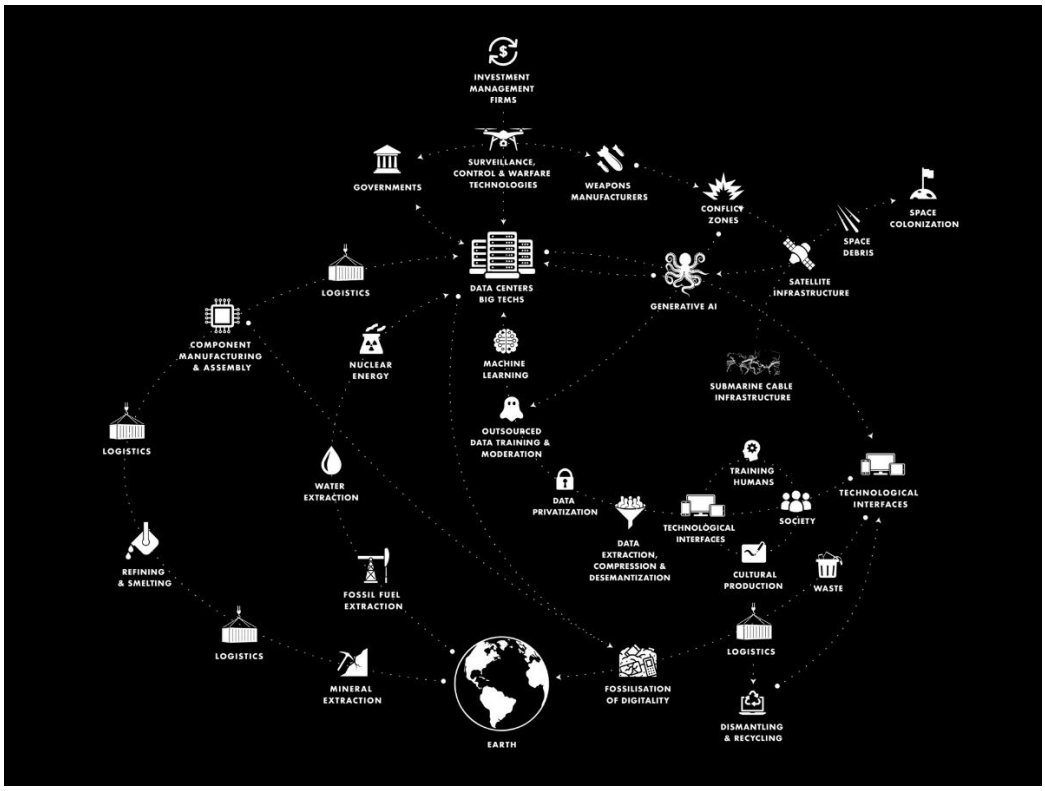

Image 1: *Metabolic Map of Generative AI*, the author, 2025.[1]

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Geophysical Force

[1] The very structure mapping the agents of generative AI is indebted to the methodological framework established by Vladan Joler and Kate Crawford in Anatomy of an AI System (2018) and Calculating Empires (2023). Furthermore, this project benefited significantly from the collective analyses and preliminary sketches developed by students in the "Topics in Aesthetics" course (Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, 2025/2), whose work was instrumental in consolidating the connections presented here.

The factory is not a cloud, weightless and floating in the air. It is heavy, grounded, and material—its roots and impacts stretch across a planet-wide network and delve into the scales of deep time. As Gottlieb points out, "[…] it is a vast computational cluster connected to the Internet and accessed ad hoc by innumerable other devices which also have to be built. It is an enormous construction, dizzyingly complex and involving production processes distributed around the world." (2018: 95)

In this light, contemporary media technologies—including generative artificial intelligence—reveal a profoundly geological nature. They are not ephemeral digital phenomena but are fundamentally rooted in the terrestrial processes of resource extraction, industrial production, and the generation of toxic waste.

In this section, we analyse the relationship between digital materiality and the planet's geophysical formation by drawing upon the concept of media geology, developed by Jussi Parikka (2015). This framework reinterprets technological devices not merely as tools, but as active geophysical forces in the planet's ongoing transformation. Parikka grounds this investigation in three constitutive layers of time and matter:

- *Deep Time*: The material origins of media trace back to geological processes spanning millions of years, such as the formation of the minerals (lithium, rare earth elements) and fossil fuels that power it. This layer reveals the Earth's "silent work" as the foundation of technology.
- *Political Economy of the Present:* This refers to contemporary extraction, production, and consumption, characterised by colonial power relations, labour exploitation, and global supply chains.
- *Future as Electronic Waste:* This addresses the ultimate fate of devices as toxic waste. Sites like the Agbogbloshie dump in Ghana are seen as "monuments of the Technocene," where pollution persists for centuries, impacting ecosystems and communities.

Thus, the geology of media reveals technological apparatuses not as abstract entities, but as material agents connecting the planet's deep past with present socioeconomic injustices and a fossilized digital future. However, by framing the narrative through a geological lens, this approach risks naturalizing the very human-made systems responsible for these conditions. While Parikka's analysis is compelling, it is essential to foreground what it tends to elide: the determining role of human labor and anthropocentric economic imperatives in invoking technology from geology in the first place (Gottlieb 2016). Drawing on Roland Barthes's critique in Mythologies, "[…] all that is le. for one to do is to enjoy this beautiful object without wondering where it comes from [...] Nothing is produced, nothing

is chosen: all one has to do is to possess these new objects from which all soiling trace of origin or choice has been removed. This miraculous evaporation of history is another form of a concept common to most bourgeois myths: the irresponsibility of man." (1972: 152)

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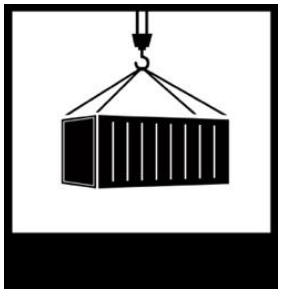

Logistics

To integrate the fragmented and branched production chains that span the planet, logistics is a fundamental component. It acts as the network that sustains a body in constant, intensive activity. In this context, maritime shipping, a pillar of the global supply chain, operates under a veil of invisibility that externalises its true socio-environmental costs. This "sea blindness" (George 2013: 4) —the sector's absence from the public imagination—results in its impacts being overlooked.

Responsible for approximately 3.1% of global CO_2 emissions—more than many industrialised nations—the sector remains on the margins of climate debates. Its reliance on heavy, polluting fuels like bunker fuel causes an estimated sixty thousand premature deaths annually from respiratory and cardiovascular diseases, a human cost dissociated from the goods it transports.

Beyond atmospheric pollution, the industry causes constant degradation of the oceans, with thousands of containers lost each year, carrying both toxic products and long-lasting plastics.
This infrastructure also relies on precarious labour conditions, with crews isolated, overworked, and with little legal protection. While profits are privatised, the environmental, public health, and human costs are socialised and dispersed—an invisible layer in the supply chain of generative AI.

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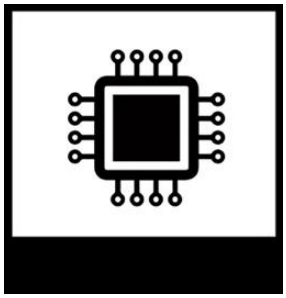

Component Manufacture and Assembly

The global production of cutting-edge AI chips depends on a strategic trio: NVIDIA (USA), which designs the circuits; ASML (Netherlands), the world's sole manufacturer of extreme ultraviolet (EUV) lithography machines; and TSMC (Taiwan), responsible for the physical fabrication. Together, these firms control over 90% of the market through a logistical-technological architecture on a planetary scale, marked by geopolitical tensions (Lion 2025).

A foundational material input for this production chain is the group of seventeen Rare Earth Elements (REEs). Valued for their unique magnetic, luminescent, and catalytic properties, REEs constitute an indispensable material substrate for advanced technological infrastructure. Despite their relative abundance in the Earth's crust, their geochemical dispersion and the complex, costly processes required for their separation and refining render them strategic resources. Their application is critical to manufacturing cutting-edge hardware, forming the physical basis for cloud computing, AI, and semiconductor fabrication itself. Within microelectronics, REEs fulfill a dual function: as catalysts and process aids—exemplified by cerium oxide in chemical-mechanical polishing (CMP) of silicon wafers—and as functional materials in substrates, passive components, and next-generation memory research. Consequently, the REE supply chain represents a critical strategic bottleneck for the global electronics industry and the progression of high-performance computing (Walter & Feffer, 2023).

The geopolitics of these minerals is characterised by pronounced concentration. China exerts a near-hegemonic dominance, accounting for approximately 70% of global production and, more significantly, around 87% of the world's processing capacity. Global reserves, in turn, are distributed unevenly, being heavily concentrated in a few nations: China (44 million tonnes), Vietnam (22 million), Russia and Brazil (21 million each). The Brazilian case is paradigmatic of the disconnection between

potential and production. Possessing the world's second-largest reserve, the country contributes a mere 1% to global supply, a scenario undergoing rapid transformation due to hundreds of active research and mining applications.

The race for these resources generates severe and profoundly asymmetrical negative externalities. The extraction and processing of REEs are frequently associated with grave socio-environmental liabilities, including contamination of soil and water bodies by radioactive waste and heavy metals, with direct impacts on public health. Concurrently, a recurring pattern of rights violations is observed, characterised by a lack of free, prior, and informed consultation with affected communities, disregard for traditional and indigenous territories, and the criminalisation of resistance movements. This dynamic effectively produces "sacrifice zones," wherein local ecosystems and populations disproportionately bear the burdens of global resource demand (Angelo et al., 2025).

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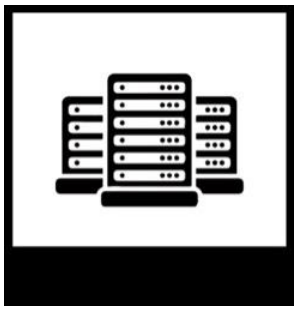

Data Centres

A data centre is the critical physical infrastructure that houses an organisation's servers, networking systems, and core IT equipment, serving as the operational heart of the digital ecosystem. Today, thousands of data centres store the more than 2.5 million terabytes of data generated daily. Two recent cases illustrate the sector's accelerated expansion and the serious socio-environmental consequences that result:

- The "Colossus" Supercomputer by xAI (Memphis/Whitehaven), a project led by Elon Musk, is intended to be the world's largest supercomputer, utilising 230,000 NVIDIA GPUs to support the Grok 4 language model. To meet its immediate energy demand, 35 gas turbines were installed in Memphis without proper environmental permits, emitting pollutants at levels exceeding those of the local airport. The project is part of an expansionist strategy aiming to

drastically multiply computational capacity, with the ambition of operating the equivalent of 50 million supercomputers within the next five years (Chow 2025). The construction of an even larger centre in Whitehaven, with 66 additional turbines, will amplify the impact. The situation is denounced as a case of environmental injustice, where Black and vulnerable communities bear the pollution in the name of AI progress.

- The Stargate LLC Consortium (Texas), formed by Oracle, OpenAI, SoftBank,[2] and MGX,[3] is building a vast data centre complex in Texas. The first, called "Project Ludicrous," will initially demand 200 MW, with plans to exceed 1 GW. The project, which initially focused on cryptocurrency mining, has transformed into a massive operation of up to twenty data centre units (Northwood 2025).

These examples illustrate a critical contradiction in the global pursuit of artificial intelligence supremacy. The development of generative AI and high-performance computing is driving the creation of energy-intensive megaprojects, which are frequently powered by fossil fuel-based grids. While major technology firms publicly commit to emission reductions, their strategies often prioritize carbon offsetting—through mechanisms like reforestation credits or renewable energy certificates—over substantive decarbonization of their energy supply. Furthermore, these companies simultaneously supply the very AI and data analytics tools that optimize and accelerate fossil fuel extraction for the oil and gas sector.

Concurrently, the proposed alternative of next-generation nuclear power, such as small modular or advanced reactors, faces significant barriers. These technologies remain largely unproven at scale, are characterized by long development timelines, high projected costs, and unresolved safety and security concerns (Clemmer, Chavez, Dotson, Gignac, Sattler, & Shaver, 2026).

Consequently, experts warn that the current trajectory does not enable a genuine energy transition. Instead, by enhancing the efficiency of fossil fuel extraction without displacing its use, the AI industry risks creating a perverse feedback loop that exacerbates overall environmental degradation (Jorblud 2025).

[2] SoftBank Group Corp. is a Japanese multinational telecommunications and Internet corporation.
[3] MGX Fund Management Limited (MGX) is a United Arab Emirates state-owned investment company, focused on artificial intelligence technologies.

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The Privatisation of Data

Contemporary artificial intelligence seeks to quantify and map every dimension of reality—from the cosmos to the minutest human expressions—converting everything into data. This process is controlled by a handful of large technology corporations. This quantification is now advancing into intimate life and the body itself: gestures, expressions, family bonds... All forms of biodata—forensic, biometric, sociometric, psychometric—are captured and stored to feed AI (Crawford; Joler 2018).

This movement repeats a historical pattern of enclosure and privatisation. If it was once applied to land and water, it now extends to knowledge, experience, and human subjectivity itself, through intellectual property and AI systems. Following Marx's analysis in Capital, the systemic privatization of communal lands ("enclosure") and the global dispossession of peoples provided the concentrated wealth and "free" labor force necessary for the English revolutions in agriculture and industry (Marx, 1867/1976, as cited in Foster et al., 2021). Thus, Marx framed primitive accumulation not as a one-time event but as an enduring feature of capitalist development, establishing a pattern of ongoing expropriation.

The enclosure of biodiversity and knowledge seems to be the current stage in a series that began with colonialism: first land and forests, then water, and now life and knowledge. Thus, the new frontier of capital is the appropriation of human knowing, feeling, and acting, in order to capture and privatise them.

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Data Training

ImageNet, a dataset created between 2009 and 2012 that is fundamental to computer vision, was created with the aim of compiling an image bank that represented "all the world of objects." To do this, its creators started from *WordNet*—a lexical structure that organises synonyms into conceptual hierarchies—keeping only the nouns (with the premise that every noun corresponds to a photographable object) and turned each synonym group into an empty category to be filled with images (Miller 2024).

Thus, millions of images were extracted rom the internet, and digital ghost workers were then hired to classify them into these pre-defined categories. In other words, human beings interpreted the meaning of each photo and fitted it into a rigid schema.

This reduction of an image to a measurable category is the core of its economic value. However, the same act that makes it monetisable also empties it of context and subjectivity, creating a profound ethical problem. Far from being a defect, this rigid, classificatory vision is a structural and intentional feature of the system.

As researcher Kate Crawford explains (Antonelli 2024), in the early studies of ImageNet it was still possible to review all the categories used to classify people. Each image was manually labelled by workers via crowdsourcing, in an Enlightenment-like endeavour to classify the visual world: a strange system aimed at creating a controlled universe of objects.

The transition to the LAION-5B dataset (2022) marked a radical shift: from 14 million to 5 billion images, now collected in a fully automated way, without human labelling. Upon analysing it, Crawford and her team realised it is not a mirror of visual culture, but a mine—one that prioritises the extraction of certain types of content.

The largest sources for LAION-5B are e-commerce sites such as Shopify, eBay, and Pinterest. The images come with alt tags: brief descriptions geared towards search engine optimisation. These are texts governed by commercial logics, written to rank on Google—and it is this algorithmically shaped language that serves as the basis for training AI models. As Crawford observes, the worldview produced by such systems ultimately resembles a *shopping cart* (Antonelli 2024).

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Training Humans

The apparent spontaneity of AI-generated art conceals a darker reality: the massive exploitation of human labour that sustains it. As argued by Hito Steyerl (2023), the training of machine learning models not only shapes the machines but also the users themselves, who are surreptitiously integrated into complex production chains. Consequently, understanding this technology requires a dual perspective. We must examine the technical systems themselves alongside the transformed cognitive frameworks through which we perceive them. Ultimately, these systems inherently condition our very modes of observation (Gottlieb 2018:41).

The question "Was I trained?", posed by artists Dryhurst and Herndon (Obrist 2024), finds its answer here: yes. Generative systems do not just rely on pre-trained models; they also condition their operators. Professionals such as programmers and designers are not simply replaced but demoted to the condition of what Vilém Flusser called functionaries—figures who exist "to realise the programme of the apparatus," without questioning its purpose. The contemporary functionary believes they are free because they "create," when in fact they are being created *by* the apparatus: their taste is shaped by datasets, their gestures conditioned by the interface.

In her book-project *Leaking Subjects and Bounding Boxes* (Papa 2025), a visual critique of computer vision systems and the logic of AI categorisation. The core of her project is a reflection on the methods—such as segmentation, bounding boxes, and labelling—used to teach machines to

separate, order, and hierarchise the visual world. In opposition to this pursuit of order and clarity, Giardina Papa is interested in everything that escapes, transgresses, or simply does not fit into these reading grids: the ambiguous, the opaque, the promiscuous, and the heretical. Her archive of images thus becomes a testament to what "leaks" from artificial vision systems—elements of experience that resist normative categorisation.

The work stems from her practical experience as a human algorithm trainer. Beginning in 2019, she collected training images that seemed to resist automatic classification. After days spent labelling objects in videos, she recounts going out into the street and, without realising, "started naming and visually delimiting objects [...] My eyes began to reorganise the environment around me according to fixed taxonomies" (Hu; Papa 2020).

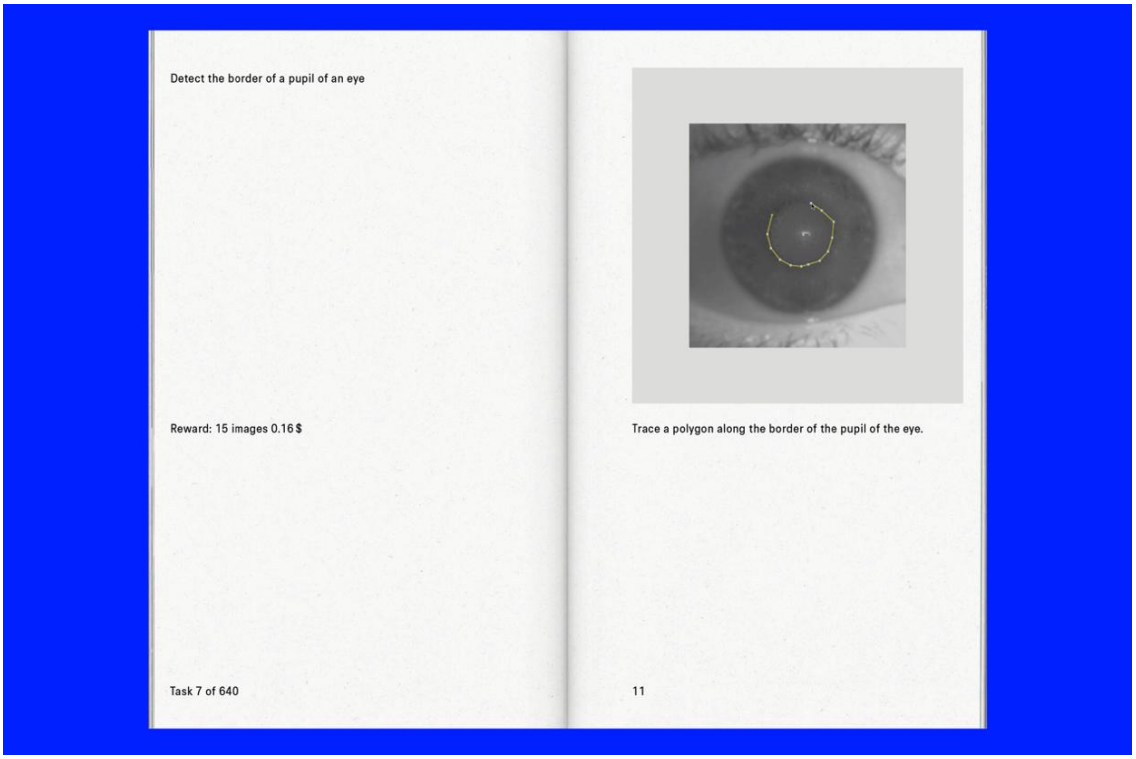

Image 2: Elisa Giardina Papa. *Leaking Subjects and Bounding Boxes: On Training AI*. Munich: Sorry Press, 2022. Page 11. Courtesy of the Artist, Sorry Press and Galerie Tanja Wagner.

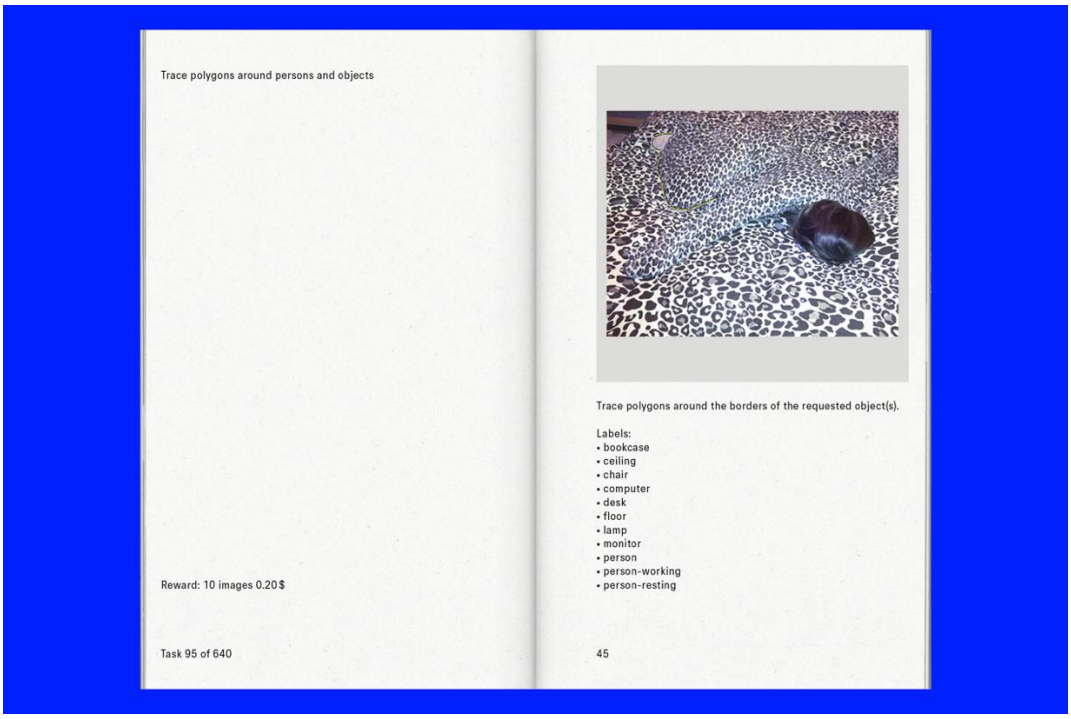

Image 3: Elisa Giardina Papa. *Leaking Subjects and Bounding Boxes: On Training AI*. Munich: Sorry Press, 2022. Courtesy of the Artist, Sorry Press and Galerie Tanja Wagner.

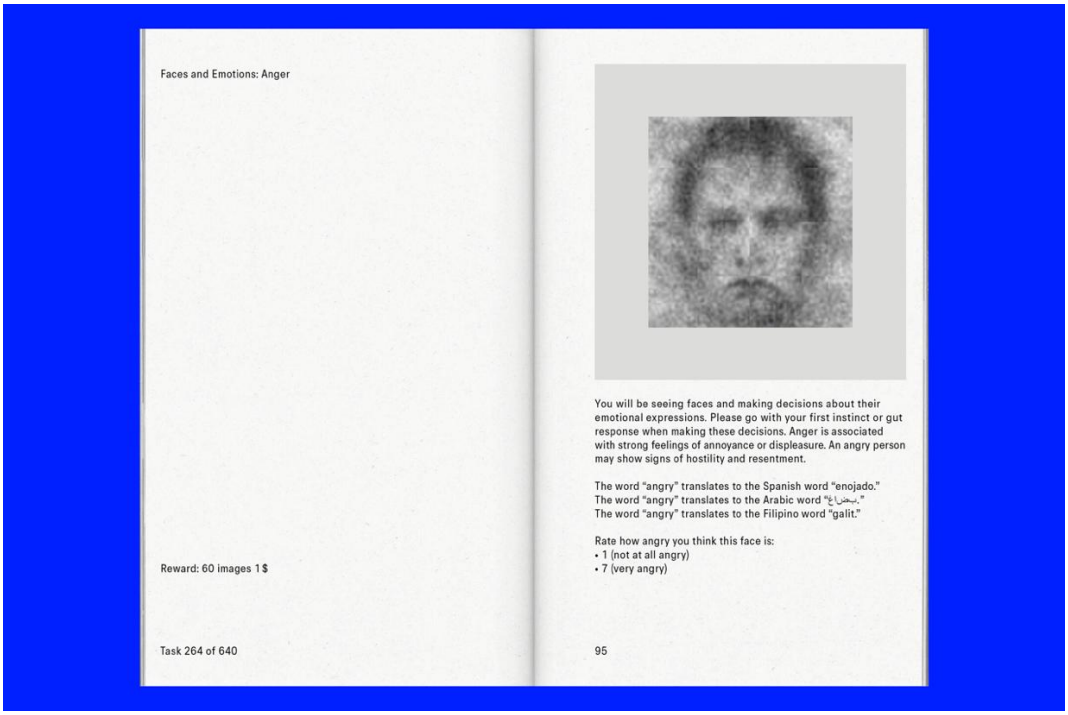

Image 4: Elisa Giardina Papa. *Leaking Subjects and Bounding Boxes: On Training AI*. Munich: Sorry Press, 2022. Courtesy of the Artist, Sorry Press and Galerie Tanja Wagner.

This experience exemplifies what Flusser termed backlash – the "retaliation" of tools. As he warned, the intelligent tools we create "strike back" and begin to shape our behaviour: "young people dance as if they were robots, bank tellers behave like automatons" (Flusser 1999). The danger of generative AIs, therefore, goes beyond homogenising what is produced; it is the homogenisation of the producer themselves – of their perception, cognition, and experience of the world. According to the philosopher, without an intentional "anthropological function" in their design—that is, a clear vision of how we wish to be and to perceive the world—it will be the tools, and those who control them, that ultimately define our being and our vision.

But how can we effectively confront such an imbalance? Is this Flusserian perspective tenable given the profound asymmetry of power between users, designers, and Big Tech conglomerates today? It is possible that Flusser himself did not consider these specific power dynamics. Still, if the answer is complex, at least this seems to be one of the strengths of Papa's art: making us see how our tools are actively shaping us.

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Surveillance, Control, and Warfare Technologies

To understand the material and conceptual foundations of our technological world, we must recognize a contributing factor that has consistently operated out of sight: the military. Historically, the imperatives of defense, strategy, and warfare have served as a primary catalyst and proving ground for innovation, generating developments that inevitably migrate to reshape civilian life. However, this process is not one of simple transfer. Technologies of military origin, such as digital networks and global positioning systems, are developed into commercial applications to become constitutive frameworks of society. They do not merely serve new purposes; they actively engender novel social formations, identities, and realities that are cybernetic, surveillant, and logistical.

So constituted, this technologically-shaped society begins to act upon its own conditions. It seeks to adapt and reformulate the very tools that moulded it, initiating a continuous cycle of convergence often obscured by the seamless, everyday normalization of these tools. As Andrew Feenberg argues in *Ten Paradoxes of Technology* (2010), the military dimension is neither accident nor detour; it is a foundational vector and a constitutive value in the trajectory of technology itself. Therefore, to fulfil Vilém Flusser's imperative of designing tools with a conscious "anthropological function" (that is, with an intentional vision of human purpose), we must comprehend, demystify, and address this deeply embedded logic.

A joint investigation by *+972 Magazine*, *Local Call*, and *The Guardian* (Abraham 2025) revealed that the Israeli military is developing a generative AI tool, similar to ChatGPT, within its elite cyber warfare unit (Unit 8200). Unlike publicly accessible large language models, this system is trained on millions of Arabic-language conversations collected through the mass surveillance of the Palestinian population in the occupied territories.

Its central objective is to expand predictive analysis and population control capabilities. The model quickly processes surveillance data to "answer questions" about individuals, identify patterns, and generate suspicions, transforming raw data into operational instruments that can widen the criminalisation and detention of Palestinians.

This project, which exemplifies the militarisation of generative AI, gained momentum after the start of the genocide[4] in Gaza in October 2023, with the recruitment of AI specialists from major tech companies. The collection of personal data from non-suspect individuals to train a system that can subsequently form the basis for suspicion constitutes a tool of population control and the perpetuation of the occupation.

Big Tech companies supply both the foundational infrastructure (storage and processing) that enables mass surveillance and the AI tools that give operational value to this data. This symbiosis is institutionalised through major government contracts, such as Project Nimbus and Project Sirius, aligning the interests of the tech sector with the Israeli war complex (Abraham 2024).

Although these companies establish public ethical guidelines—such as prohibitions on using their technology in weaponry or surveillance that violates international norms—activists argue that such principles have limited impact, functioning primarily as public relations instruments.

[4] Editor's disclaimer. Whether the actions of Israel in the Gaza Strip constitute a genocide is still a matter of intense international dispute, with accusations from human rights organizations and UN bodies met with strong denials from Israel and its allies, especially as far as the intentionality is concerned. In this respect, the views expressed in this paper by the author are not necessarily also those of the journal.

The genocide in Gaza[5] thus reveals a new configuration in which global digital infrastructure and the most advanced AI tools have become essential components of the modern war machine. This alignment was confirmed in December 2025 when the US Department of Defence allocated 800 million dollars to develop the sovereign platform GenAI.mil, awarding contracts to leading industry firms—Google (Gemini for Government), OpenAI, Anthropic (Claude Gov), and xAI (Grok for Government)—establishing a direct link between the American military-industrial complex and its technological ecosystem (Fan 2025).

In this context, Gregory Chatonsky (2025a) argues that military artificial intelligence gives rise to a lethal autopoiesis: systems capable of generating and sustaining their own conditions for war, identifying and eliminating targets at the margin of human decision. Their unpredictability, therefore, is not a flaw but a sign of an autonomy that creates unprecedented strategies.

The artist links this phenomenon to the 2010 Wall Street *Flash Crash*, where algorithms interacting at superhuman speeds in complex environments generated unpredictable and potentially catastrophic outcomes. This dynamic is described by Scharre: "Stock trading today is largely automated… The algorithms had taken over much of the trading, including high-frequency trading, which occurred at superhuman speeds" (Sharre 2018). It is within this scenario, for Chatonsky (2025b), that the current vectorfascism converts algorithmic infrastructure into a state-controlled apparatus of war.

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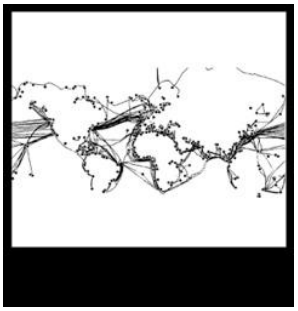

Submarine Cable Infrastructure

[5] See previous footnote.

Just as the logistics of material transportation are vital for fueling this vast factory, submarine cable networks represent its submerged circulatory system—the critical network through which the majority of data is transported across the planet.

This analysis employs Trevor Paglen's artistic and research project, *Landing Sites*, to examine the structure of subsea cables. The work critically foregrounds the simultaneous invisibility, materiality and complexity of this foundational infrastructure, which has been essential to communication technologies from the telegraph to the contemporary internet. The artist explains: "Each photograph had two "rules": first, the conjunction of internet cables had to be within the image's frame; second, the horizon line is in the center of the image. These are probably the most abstract images I have ever made for the simple reason that the infrastructures I'm trying to photograph are generally nowhere to be seen in the images themselves – the cables I'm ostensibly photographing are underwater and under the beaches." (Paglen 2020)

In the diptychs of Landing Sites, the contemplative seascapes on the left generate a feeling of tranquillity, with no explicit signs of digital technology. This apparent void of human intervention starkly contrasts with the annotated maps on the right, which meticulously chart the dense, tangled complexity of cables woven beneath the ocean floor. This counterpoint is the work's central mechanism. It perfectly represents the surface layer of our everyday experience with the digital factory: a "clean and immediate" interface that completely conceals the intricate, material, and geopolitical mechanisms of its operation—the very logistics that allow it to function.

Image 5: NSA-Tapped Fiber Optic Cable Landing Site, New York City, New York, United States, 2015. Pigment print and mixed media on navigational chart. Pigment print: 48 × 60 in.; Map: 48 × 58 ½ in. Copyright: Trevor Paglen. Courtesy of the Artist, Altman Siegel, San Francisco and Pace Gallery.

Image 6: NSA-Tapped Fiber Optic Cable Landing Site, Morro Bay, California, United States, 2015. Pigment print and mixed media on navigational chart. Pigment print: 48 × 60 in.; Map: 48 × 56 ⅞ in. Copyright: Trevor Paglen. Courtesy of the Artist, Altman Siegel, San Francisco and Pace Gallery.

Image 7: NSA-Tapped Fiber Optic Cable Landing Site, Tanguisson Beach, Guam, 2016. Pigment print and mixed media on navigational chart. Pigment print: 48 × 60 in.; Map: 65 × 48 in. Copyright: Trevor Paglen. Courtesy of the Artist, Altman Siegel, San Francisco and Pace Gallery.

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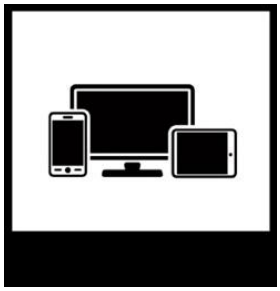

Technological Interfaces

The evolution of technical interfaces constantly redefines how we interact with technology. More than utilitarian tools, they operate as symbolic mediators that shape perception, direct behaviours, establish new cognitive habits, and, most decisively, delineate what is rendered visible and accessible in our world.

Interfaces exist simultaneously as surfaces and limits. In one sense, an interface acts as a screen that concentrates and presents meanings and operations. In another, it serves as a window or portal, a mediating element that facilitates passage.

As a window, the interface performs a limiting function, demarcating, for instance, the boundary between the human body and the external world of devices and apparatuses. In this capacity, as Galloway (2017: 237, 239) defines it, "interfaces are zones of exchange and, as limits, are productive and generative." Consequently, interfaces are neither neutral nor transparent. They actively produce realities: the design of an interface (its buttons, menus, and flows) produces specific behaviours, particular ways of thinking and acting. For example, the interface of a social network generates distinct modes of sociability, attention, and consumption. Interfaces also define possibilities: by establishing the rules of exchange, they open (or close) pathways. They are generative in the sense that they create conditions for new actions, relationships, and even entirely new systems that did not previously exist.

With the rise of responsive interfaces and touch-sensitive screens, technological mediation reached a degree of integration so profound it seemed to disappear. The gesture of swiping a finger became a natural extension of the body, and the device dissolved into the user's very experience. This apparent lack of mediation, however, conceals a sophisticated system of mediation. The supposed transparency is, in fact, an even more efficient layer of intervention. Behind the fluid gesture, a complex structure of design, attention flows, and algorithms guides behaviour, transforming experience into a pre-structured pathway. Thus, the more natural and intuitive the interaction becomes, the more it

captures and shapes, almost imperceptibly, habits, choices, and personal trajectories, creating a freedom that is simultaneously offered and delimited by the technology itself.

With the advent of graphical user interfaces, technical complexity was overlaid with an intuitive surface, where icons, menus, and visual metaphors replaced specialised commands. Although we gained immensely in usability, we lost transparency into the underlying processes; the user became less reflective, adapted to a logic of quick, automated interactions.

In his interview with Peternák, Flusser explains that "[…] systems can be complex in two senses: they can be structurally complex, for instance there can be systems where elements maintain a very complex relation with each other. But they can be also functionally complex, which means that if you use the system, you can use it in a complex way. Now those two complexities are independent [of each] other. Structurally complex systems may be functionally simple, like a television box, which has a structure of almost impenetrable complexity, but the use of it is extremely simple. On the other hand, simple systems, like the chess game, can have very complex functional manipulations." (Peternák 2010: 5:08)

Flusser argues that whereas functionally complex systems demand creative engagement, functionally simple systems foster a kind of intellectual passivity. It is this prevalence of simple use, he argues, that contributes to the lowering of mankind's intellectual, aesthetic, and even ethical standards. In this sense, we must be attentive to functionally simple surfaces, which conceal the complexity of their programming and operate profoundly on how we see, act, and interpret the world.

From this perspective, interfaces are less about software adaptation or their practical utility, and more about the programming and conditioning of our bodies by the devices themselves. These interfaces manipulate not only human perception but also our affects. Consequently, they are often mistakenly understood as tools for politics, rather than as technologies that establish, and thus determine, the very situation of politics—forming what amounts to an order of "the sayable and the visible" (Foscolo 2022: 64, 71).

Presently, in the phase of predictive interfaces driven by artificial intelligence, mediation gives way to anticipation. Virtual assistants, recommendation systems, and language models do not merely respond, but predict; they do not only facilitate, but shape expectations and restructure decision-making processes.

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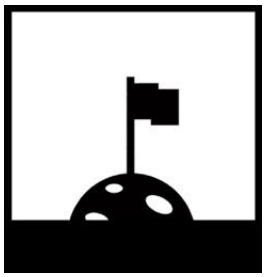

Space Colonisation

Currently, 21st-century extractivism is no longer confined to the classical planetary spheres—the lithosphere, hydrosphere, atmosphere, and biosphere. Its operational logic extends into the space, transforming a distant fiction into a concrete strategic horizon. Under the leadership of figures like Jeff Bezos and Elon Musk, corporations such as Blue Origin (Crawford 2021: 230) and SpaceX promote visions ranging from permanent orbital habitats to the most ambitious project of a self-sustaining colony on Mars, even proposing planetary terraforming through nuclear explosions.

Parallel to these narratives of expansion, we observe the increasing militarisation and congestion of low Earth orbit, a scenario that generates immediate existential risks. The most pressing is the Kessler syndrome—the possibility of a chain reaction of collisions triggered by space debris, which could collapse the orbital ecosystem upon which the global digital economy depends. Companies like SpaceX's Starlink already operate thousands of satellites, with expansion plans for tens of thousands more, while space agencies track over 30,000 fragments of debris (Crawford; Joler 2023). This saturation transforms the orbit into a field of geopolitical tension and constant operational risk.

Funded by an extreme accumulation of wealth, the Silicon Valley space race appropriates the knowledge, infrastructure, and fiscal incentives developed by state-led programmes in the 20th century. It operates under a fundamental premise of appropriation: that outer space, as the final frontier, is subject to a regime of "first come, first served." This vision conflicts with the principle of international space law, enshrined in the 1967 Outer Space Treaty, which declares space exploration to be "the province of all mankind" and an activity to be carried out "for the benefit and in the interests of all peoples" (NASA 1967).

Thus, the current space race does not represent a rupture with the long histories of imperial expansion and extractivist exploitation, but rather their projection into a new domain. The creation of speculative markets for "space resources" is a concrete fantasy—a discourse that, by mobilising capital,

attention, and regulatory systems, already produces tangible geopolitical effects on Earth. This dynamic accelerates rivalries, reinforces logics of sovereignty and territorial control, and elevates the risk of conflict. In this way, a dangerous circle is closed where commercialisation, militarisation, and strategic competition merge in the exploitation of space, jeopardising both the sustainability of the near-Earth orbital environment and the ideal of space as the common heritage of humanity (Rowan 2025). An additional driver is the tendency to seek extraterrestrial resources and domains, which is itself propelled by a continued, profit-oriented dependence on fossil fuels for terrestrial industries, such as data centers, rather than a sufficient commitment to resolving environmental challenges on Earth.

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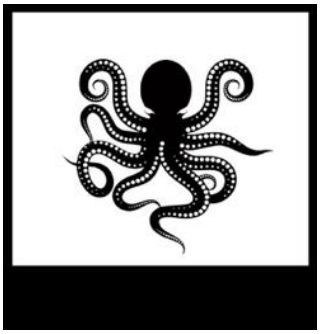

Technical Images – and Now, Metabolic Images

Contemporary technical images are increasingly AI-mediated productions. A revealing example is photographs from an iPhone: far from being direct captures of light, they result from the algorithmic fusion of multiple exposures, processed semantically—sky, trees, and faces are interpreted distinctly by machine learning models. These images are, therefore, algorithmic mosaics, not photographs in the traditional sense. The decisive shift, however, lies in the fact they have ceased to be merely mediated representations of reality to become statistical representations of a model of reality—a model controlled and defined by corporations (Antonelli 2024).

The paradigm of generative image production marks a break from the causal, photographic, optical model that prevailed in the 20th century. Within that traditional framework, the trajectory of

each photon was, in principle, retraceable to its source. In today's thermodynamic paradigm, causality is replaced by probability, and optical tracing by statistical inference.

As Paglen observes, even if we distrust the indexical link between image and reality, this link still culturally underpins how we collectively interpret photography. When that link dissolves, a shared reality is ruptured—one which, in truth, never existed but was always a construct. A troubling question then arises: could consent to this fabrication be a precondition for a certain type of democracy? (Miller 2024).

By reducing millions of images to probabilistic relations, generative AI eliminates the elements that granted each image its singularity: context, history, and so on. The latent space functions as a great anonymous equalizer, where all images become equivalent, provided they are statistically proximate. Furthermore, the capacity to generate massive content at high speed enables the flooding of digital spaces, overwhelming traditional mechanisms of critical filtering.

When it becomes possible to artificially generate any image in any context, the image's testimonial and critical value collapses. Deepfakes represent the most evident example: the technical capacity to produce compromising images paradoxically generates an immunization against their effects: a collapse of trust in authorities, institutions, and the mediated image itself.

This dynamic is operationalized in campaigns of algorithmic disinformation, as illustrated by the recent proliferation of deepfake videos featuring independent analysts like Pepe Escobar, Yanis Varoufakis, and Jeffrey Sachs (figs. 8, 9, 10). Within weeks, their digital likenesses were weaponized, multiplied across dozens of channels to generate a flood of synthetic content that actively distorts geopolitical understanding. These operations are characterized by a deliberate, overwhelming volume and a recurring aesthetic of alarm: garish color palettes, grotesque collage, explosive visuals, and sensationalist titles.

It operates as a form of psychological warfare (PsyOp), whose primary effect is to exhaust, terrify, and demolish the communal foundation of trust between information producers and the public. By systematically eroding confidence in what we see, it undermines the very prerequisites for public dialogue and democratic process. The ultimate threat, therefore, is not merely falsified content, but a programmed epistemic crisis.

In *Doppelganger: A Trip into the Mirror World* (2023), Naomi Klein provides an analytical lens for understanding this very phenomenon by exploring the concept of the double. The term 'Doppelganger'—from the German for 'double-walker'—describes the unsettling encounter with another version of oneself, an experience linked to Freud's notion of the 'uncanny', where the familiar becomes disturbingly alien.

But doubles have also long been understood as portents. When reality begins to split or replicate, it can signal something vital being avoided: a truth about ourselves or our world we refuse to acknowledge. Ignoring this warning invites greater peril, a dynamic relevant both to individuals and to polarised societies like our own. We now inhabit a 'doppelganger culture' defined by such duplication. Online, we craft virtual avatars, performative doubles that serve as personal brands in an attention-driven economy. Meanwhile, technology companies use these vast data troves to train machines, creating artificial simulations of human intelligence and functions: digital doubles with their own interests, logics, and threats. I find myself wondering: what is all this duplication doing to us? How does it guide not only what we see, but what we fail to see?

Underlying this is a collective sense of disorientation, a feeling that the world has become recognisable yet strangely distorted, with uncanny shifts in people and politics, and, with the advancement of artificial intelligence, a growing difficulty in distinguishing the real from the fabricated.

Image 8: *The Flood 1: Pepe Escobar Doppelgänger*, the author, 2026.

Image 9: *The Flood 2: Yanis Varoufakis Doppelgänger*, the author, 2026.

Image 10: *The Flood 3: Jeffrey Sachs Doppelgänger*, the author, 2026.

In 1979, Vilém Flusser coined the concept of "technical images"—produced by apparatuses that calculate and, in so doing, programme reality. Today, Kate Crawford advances this thought with the notion of "metabolic images" (Crawford 2025), which seeks to capture the logic of generative artificial intelligence in its current phase.

From a political-environmental perspective, generative AI is less a discrete tool than a colossal planetary infrastructure. It merges with and intensifies existing global systems—data centers, energy grids, logistical supply chains—forming one of the most extensive and resource-intensive architectures ever engineered. This infrastructure demands colossal quantities of energy, critical minerals, fresh water, training data, and often-invisible human labor.

Ultimately, generative AI functions as a technology of accelerated metabolism. It consumes electricity and evaporates water at a staggering pace to fuel a relentless cycle: the perpetual ingestion, digestion, excretion and re-ingestion of data:

- *Ingestion*: AI models are trained by devouring billions of images, videos, and texts scraped from the internet;
- *Digestion:* Processing this data consumes astronomical amounts of computational energy;
- *Excretion:* Synthetic outputs are excreted and disseminated across digital ecosystems;
- *Re-ingestion* (feedback): This digital production is reinserted as raw material for the next generation of models, closing a feedback loop.

"Metabolic images" are thus the synthesised visual product arising from the consumption and decomposition of billions of other images, processed by an infrastructure that absorbs planetary resources—and excretes, in return, synthetic media, atmospheric carbon, and what could be defined as a fossilisation of digitality (Crawford 2025).

Returning to Karl Marx's (2013) analysis, he framed the shift from rural to urban society as a "metabolic rift" which emerged with capitalism. In pre-industrial societies, waste was naturally reincorporated into productive cycles—human and animal waste, for example, returned to the soil as fertiliser, sustaining land fertility. Industrialisation ruptured this equilibrium. As people moved in large numbers to cities, a migration driven by the enclosure of common lands, the excrement that once nourished fields began to accumulate as urban pollution. Its disposal in the streets deprived soils of nutrients, leading to their depletion. This depletion, in turn, demanded artificial fertilisers, deepening a

cycle of environmental degradation. Later, John Bellamy Foster[6] would define this phenomenon as the "metabolic rift": the systemic rupture between social processes and natural cycles, provoked by capitalist logic of production (Foster; York 2010).

Generative artificial intelligence and its "metabolic images" embody this critique. In the material dimension, it operationalises the metabolic rift: it operates a linear, extractive cycle that consumes data, energy, water, and minerals on a planetary scale, excreting digital waste and environmental pollution. It is a metabolism that does not regenerate, but recycles its own detritus in an autophagic, self-referential cycle. In the symbolic dimension, AI swallows the archive of digitised culture without historical contextualisation, processing it merely statistically, and excretes synthetic content that simulates cultural forms—content which, in turn, is fed back to be consumed and recirculated, fueling a continuous, often critically unmediated, feedback loop.

Revisiting Flusser's central metaphor, the contemporary "factories" materialize as algorithmic systems that condition our existence. This "factory" analysis serves as an interpretive key for our time, exposing a logic that reduces human experience to extractable data. Yet this algorithmic factory is not an inevitable destiny; it is the crystallization of a specific political and economic project: the reduction of subjects to mere functionaries of centralized programs. Even though Flusser could not outline forms of resistance to the military-industrial-economic-financial imperatives that had not yet fully consolidated in his lifetime, he points toward the urgency of a material investigation of this complex, that is, of this mega-factory.

A clear illustration of this dynamic can be found in Sam Altman's TED2025 speech, which presents a future dominated by AI as an inevitable and natural destiny, akin to a force of nature. This techno-determinist view concentrates the power to decide humanity's future in the hands of a small group of companies and experts, such as OpenAI itself, which declares itself the responsible guardian of this process. By framing AI advancement as a path with no alternative, this narrative minimizes critical political and social choices. Consequently, the power to "reshape the destiny of our species" rests with a handful of corporations, outside democratic control, which risks exacerbating existing social inequalities (Muñoz, 2025).

Confronted by this trajectory, our critical task is to reject its assumed inevitability. We must see that our relationship with technology, our creation of images, and our imagination of the future are not predetermined, despite a pervasive technological mystification that claims they are.

[6] John Bellamy Foster, in his book Marx's Ecology: Materialism and Nature, created the concept of "metabolic rift," analysing the rupture of the human connection with nature within the capitalist system, which exploits natural resources and labour in an abusive manner, leading to both soil impoverishment and worker illness. (Foster; York 2010).

Demystification therefore becomes urgent: it is the necessary condition for imagining and *acting in time*, a warning Flusser issued in *Into the Universe of Technical Images*: "The apparatuses have not yet closed off all the exits […] Traces of "warm and living contacts" between humans still remain everywhere. We have not yet been fully dispersed. Therefore, it is toward such pre-apparatic situations that we must retreat if we wish to assume a critical stance toward the new gadgets. Not, of course, to save such archaic and doomed situations. But rather, from there, to launch ourselves against the gadgets and invert them in the direction of our freedom. These apertures in the apparatus still exist, but they are narrowing rapidly […] If we wish to dialogue, we must take advantage of the remaining openings. Tomorrow will be too late. Telematics, with its images, is rapidly sealing off all the remaining apertures."[7] (Flusser 2008: 90)

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[7] Translated by the author.

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