

Software as Frozen Action Toward an Ontological Critique of Digital Sovereignty

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Abstract

Current European digital sovereignty policy — exemplified by the 2026 Technological Sovereignty Package — rests on a category error: it conflates ownership of code with functional autonomy over technology. This paper argues that software is not a bearer of potentiality but its third-order crystallization: the formalization of already-understood human action. Potentiality resides in the human agent and the community of practice, not in the artifact. Drawing on Aristotle's distinction between *dunamis* and *energeia*, Hui's cosmotechnics, and Simondon's theory of technical individuation, we demonstrate that open-source policy alone is insufficient for sovereignty because it addresses the most derivative layer of the technological stack while leaving its cosmotechnical and architectural foundations intact. We further argue that architectural choice — specifically the continued dominance of von Neumann discrete-logic systems — constrains which classes of human potentiality can be computationally actualized, and that this constitutes the authentic locus of the sovereignty question. Finally, we apply subsidiarity as an ontological rather than merely administrative principle to show that supranational technology governance systematically mislocates the problem. Genuine digital sovereignty requires what we term *functional sovereignty*: sovereignty over potentiality generation, cosmotechnical grounding, architectural adequacy, and governance coherence — not code ownership.

Keywords: digital sovereignty, cosmotechnics, software ontology, von Neumann architecture, subsidiarity, potentiality, Yuk Hui, technical individuation

1. Introduction: The Sovereignty Discourse and Its Missing Layer

On 3 June 2026, the European Commission presented the European Technological Sovereignty Package, a set of legislative measures targeting Europe's structural dependency on non-European suppliers for semiconductors, artificial intelligence infrastructure, and cloud computing. The package is substantial: the Chips Act 2.0 addresses semiconductor supply chains; the Cloud and AI Development Act proposes tripling European data center capacity; the Strategic Roadmap addresses AI in energy infrastructure. Commission President von der Leyen framed the initiative as civilizational self-determination — the capacity to develop, deploy, and secure the technologies Europeans rely on.

Among the four pillars, the Open Source Strategy stands out for its rhetorical ambition. Europe, the Commission notes, is home to over three million open-source contributors. The strategy proposes to leverage this asset to "develop and provide more sovereign solutions," scaling open-source alternatives in cloud, AI, internet technologies, cybersecurity, and semiconductors.

We acknowledge that the Commission's overall discourse is not reducible to code ownership. The package addresses skills development, research capacity, semiconductor production, cloud infrastructure, and strategic autonomy across multiple dimensions. Our critique is not that EU

policy ignores these layers. It is that the package lacks an ontological layer entirely: an analysis of *where potentiality resides* in technological systems and what this implies for where sovereignty must be secured. Without this layer, the other interventions risk being well-resourced responses to the wrong question.

This paper identifies and develops that missing ontological layer. It proposes that open-source policy alone is insufficient for sovereignty because it addresses the most derivative element of the technological stack: the code artifact. Potentiality — the capacity to act, to adapt, to regenerate — resides upstream: in human skill and judgment, in communities of practice, in the cosmotechnical order that determines what kinds of technological futures are imaginable, and ultimately in the physical architecture that determines which classes of human potentiality can be computationally realized at all.

To establish this argument, we introduce an analytical framework of four sovereignty conditions — *potentiality sovereignty*, *cosmotechnical sovereignty*, *architectural sovereignty*, and *governance subsidiarity* — and demonstrate that current EU policy, despite its ambition and scope, addresses none of these four conditions adequately. The argument proceeds as follows. Section 2 establishes the ontological status of software through Aristotle's potentiality-actuality framework. Section 3 develops the cosmotechnical critique via Hui. Section 4 deepens the analysis through Simondon's theory of technical individuation. Section 5 examines how computational architecture constrains actualizable potentiality. Section 6 applies ontological subsidiarity to the governance question. Section 7 concludes by specifying what functional sovereignty would require.

2. Software as Third-Order Crystallization: The Aristotelian Framework

Aristotle's distinction between *dunamis* (potentiality, capacity, power) and *energeia* (actuality, activity, being-at-work) provides the most precise available vocabulary for the question at hand. In *Metaphysics* Theta, Aristotle argues for the priority of actuality over potentiality in account, in time, and in substance. We must understand what actual seeing is before we can understand potential sight. Potentiality is always potentiality *for* something already actual — an eye has the capacity to see because seeing is already a coherent activity in a world of light, objects, and organisms with purposes. Remove the actuality, and the potentiality becomes unintelligible (1050a9–17).

Applied to technology: a tool has potentiality insofar as it is oriented toward an already-understood human activity. The hammer's potentiality to drive nails is not a property of the hammer alone but of the hammer in relation to the carpenter's skill, the wood's material properties, and the project of building. Aristotle is explicit that potentiality cannot be separated from its *telos*, the activity toward which it is directed.

What, then, is software? Software is a formal specification of a sequence of operations that a computing machine can execute. These operations correspond to — and were originally derived from — human activities that were already understood before they were formalized. This derivation is not accidental. It reflects a necessary epistemic order. Before a payroll system can be written, payroll calculation must already be understood as a human practice with definite rules, edge cases, and institutional context. Before a navigation algorithm can be coded, route-finding must already be comprehended as a spatial, temporal, and intentional process. The code does not create the understanding; it presupposes and formalizes it.

We propose the term *third-order crystallization* to capture this structure:

- **First order:** The human activity itself — skilled, embodied, context-dependent, intentional.
- **Second order:** The explicit understanding of that activity — rules, procedures, exceptions, articulated knowledge.
- **Third order:** The formal specification of that understanding in executable code.

Each step is a reduction. First-order activity is irreducibly rich: it involves judgment, perception, bodily skill, responsiveness to context. Second-order understanding captures the rule-governed skeleton but loses the tacit dimension. Third-order code captures the mechanically reproducible residue of the second order but loses everything that required judgment to articulate.

The consequence for sovereignty discourse is direct: owning the third-order artifact — the code — is often insufficient to confer ownership of the first-order activity or the second-order understanding. We acknowledge that open-source communities sometimes do transfer knowledge, training, documentation, and maintenance practices alongside code, and that in such cases open source can be a genuine vehicle of capacity building. But this capacity building is not a property of the code itself; it is a property of the community of practice organized around the code. The code is a condition for, not a cause of, that community's capacity. Where the community of practice is absent or underdeveloped, open-source code alone cannot substitute for it.

This asymmetry is the core of our first sovereignty condition. *Potentiality sovereignty* requires that European communities maintain and develop the first-order practices and second-order understandings that constitute their technological life — not merely legal ownership of third-order artifacts. A municipality that obtains open-source administrative software but lacks the engineering capacity to modify, maintain, and reimagine it has not gained sovereignty; it has gained a different form of dependency.

3. Cosmotechnics and the Order of Technological Embedding

Yuk Hui's concept of cosmotechnics, developed across *The Question Concerning Technology in China* (2016), *Recursivity and Contingency* (2019), and *Machine and Sovereignty* (2024), provides a complementary critique at a higher level of abstraction. Where the Aristotelian analysis targets the ontological structure of individual software artifacts, cosmotechnics targets the cultural and cosmological order within which any technological system is embedded.

Hui's central claim is that technology is never simply a universal instrument. It is always the unification of a cosmic order and a moral order through technical activities. In classical Chinese thought — across Daoism, Confucianism, and Mohism — technique was never separated from the natural and moral cosmos within which human action takes place. By contrast, Western modernity progressively severed this connection, reducing technique to instrumental rationality: the optimal application of means to given ends, with the ends themselves removed from philosophical scrutiny.

The consequence, Hui argues, is that global capitalism has become a cosmotechnical order — not merely an economic system but a unified arrangement of technical, moral, and cosmic imperatives that determines what kinds of technological futures are thinkable. "Capitalism is the contemporary cosmotechnics that dominates the planet" (*Machine and Sovereignty*, 2024). It colonizes not only what technologies are built but what technologies can be imagined.

Applied to the EU sovereignty discourse: the Open Source Strategy does not challenge the dominant cosmotechnical order. It proposes European ownership of artifacts produced within the same cosmotechnical framework — the same assumptions about computation as discrete symbolic manipulation, about data as extractable resource, about intelligence as statistical pattern-matching, and about governance as optimization. Making Linux or a large language model open-source does

not alter the fact that these systems embody a particular cosmotechnical understanding of what computation is for and what counts as a solution to a human problem.

This is not merely a philosophical observation. It has immediate policy implications. If the dominant cosmotechnical order is itself a constraint on what technological futures are imaginable — if European communities cannot develop genuinely different technological approaches as long as they think within the framework of Silicon Valley epistemology — then acquiring code ownership within that order cannot address the underlying dependency. It changes legal title on the artifact without touching the cosmotechnical conditions of production.

Hui introduces *noodiversity* — the diversity of epistemological systems and forms of knowledge organization — as the positive alternative. Genuine sovereignty requires not just different code but different ways of understanding what technology is for, different architectures expressing different cosmological commitments, different governance structures emerging from different communities of practice. This is what we mean by our second sovereignty condition: *cosmotechnical sovereignty* — the capacity to imagine and build technological systems grounded in epistemological frameworks that are not simply reproductions of the dominant cosmotechnical order.

We note that this is a demanding condition, and that Hui himself is cautious about what it requires in practice. Cosmotechnical plurality is not a return to pre-modern traditions. It is the cultivation of diverse technological imaginations capable of producing genuine alternatives — alternatives that would differ not only in their legal ownership but in their underlying assumptions about human life, community, and the purpose of computation.

4. Technical Individuation: Simondon and the Associated Milieu

Gilbert Simondon's philosophy of individuation offers a third perspective that deepens and specifies the Aristotelian and cosmotechnical arguments. Simondon argues that technical objects are not fixed artifacts but ongoing processes of *individuation*: they take on their specific form through engagement with technical milieus and human practices, and they retain a margin of indeterminacy — a preindividual charge — that exceeds their current form.

Simondon's key concept of *concretization* describes how technical objects develop over time toward greater internal coherence. An early technical object is abstract: its components serve single functions and often conflict with one another. Through use, modification, and integration with surrounding practices, a technical object gradually becomes concrete: its elements begin to serve multiple functions simultaneously, and the object achieves a kind of organic unity with its milieu. The steam engine, over its history, does not simply become more efficient; its components progressively achieve what Simondon calls a "convergent functioning," where each element participates in the overall operation in multiple ways (*On the Mode of Existence of Technical Objects*, 1958).

Crucially, this concretization is not a property of the object in isolation. It depends on what Simondon calls the *associated milieu* — the ensemble of technical, natural, and social conditions that the object co-constitutes with its environment. A technical object that is severed from its associated milieu — transplanted into a different context without the surrounding practices, knowledge traditions, and social structures that it presupposes — does not simply function less well. It reverts toward abstraction: its components no longer achieve convergent functioning because the milieu that enabled that convergence is absent.

This analysis directly illuminates what happens when open-source software is transferred without the associated milieu. The code may be formally identical, but the individuation process — the ongoing concretization that makes the object genuinely functional in context — cannot continue without the milieu. Open-source deployment in a context that lacks the associated milieu does not produce sovereignty; it produces a technical object frozen at an earlier stage of individuation, dependent on the originating milieu for any further development.

Simondon also introduces the concept of *technical lineage*: the genealogical chain through which technical objects evolve, each generation building on and transforming the previous one. Genuine technical capacity requires participation in a lineage — not just possession of the current generation's artifact. A community that receives a technical object without participation in its lineage cannot contribute to its evolution; it can only consume it. Sovereignty requires participation in the lineage, not just access to its current output.

These Simondonian concepts map directly onto our first sovereignty condition and enrich it. Potentiality sovereignty is not only about first-order practice and second-order understanding. It requires active participation in the ongoing concretization of technical objects within an associated milieu, and continuity with a technical lineage that makes contribution to evolution possible.

5. Architectural Adequacy: The Constraint of Von Neumann Computation

The preceding three sections have established that potentiality is mislocated in sovereignty discourse at the level of code artifacts. But there is a deeper mislocalization that the discourse has not yet reached: the physical architecture of computation itself.

If sovereignty concerns the location of potentiality, then one must ask whether computational architectures themselves constrain which potentialities can be realized. This question has been largely invisible in sovereignty discourse — not because it is unimportant but because the dominant architectural paradigm has been so thoroughly normalized that it appears not as a choice but as computation as such.

The von Neumann architecture — sequential processing of discrete symbolic operations over addressable memory, with strict separation of processor and memory — has been the foundation of digital computing since the 1940s. Current AI systems, cloud platforms, and semiconductor designs are all implementations, at varying levels of abstraction, of this paradigm. When the EU proposes to triple data center capacity and develop sovereign AI, it proposes more von Neumann infrastructure. The architecture itself is not questioned.

But architectural choice is not neutral. It determines, at the physical level, which classes of information-processing are tractable and which are not. Von Neumann architecture excels at exact symbolic manipulation, sequential logic, and discrete state transitions. It is structurally less suited to processes that are fundamentally oscillatory, field-coherent, and non-separable in character — processes that cannot be efficiently decomposed into discrete sequential steps without losing essential properties.

There are emerging theoretical and empirical indications that some central human cognitive processes — including aspects of perception, memory consolidation, and practical judgment — involve dynamics of phase-locking, oscillatory synchronization, and field coherence that are not naturally expressed in von Neumann terms. The relationship between neural oscillation and

cognitive function is an active research area (Buzsáki, 2006; Engel and Singer, 2001; Tononi, 2004), and while consensus on the computational implications remains incomplete, the question of architectural adequacy is increasingly recognized as substantive. One plausible interpretation of this literature is that computational systems intended to support human cognitive and social processes would benefit from architectural substrates whose operating principles are closer to those of the processes they serve.

This matters for sovereignty in the following sense: if European communities wish to build technological systems that genuinely support rather than distort the human activities they are meant to serve, they need the capacity to evaluate and develop architectural alternatives — not merely to own more instances of the current dominant architecture. *Architectural sovereignty* is therefore our third condition: the capacity to assess, develop, and deploy computational substrates whose physical operating principles are adequate to the actual character of the human processes they are meant to support.

We do not advocate here for any specific alternative architecture. The point is the principle: architectural choice is a genuine choice, not a natural fact, and sovereignty discourse that does not reach this level is operating above the most fundamental constraint on what European technological development can produce.

Post-von Neumann research directions — neuromorphic computing, photonic computation, oscillatory processing paradigms — represent early explorations of this space. They remain immature, and their eventual role in computational infrastructure is genuinely uncertain. But the question of whether European sovereignty requires investment in architectural diversity, rather than simply more capacity within the current paradigm, is a legitimate and urgent policy question that the current package does not address.

6. Subsidiarity as Ontological Principle

The preceding analysis has a governance dimension. If potentiality resides in human agents and communities of practice, then the governance of technology must be organized according to the principle of subsidiarity — understood here in a stronger, ontological sense than its usual administrative formulation.

In EU jurisprudence, subsidiarity is an administrative principle: decisions should be made at the lowest level of governance capable of addressing them effectively. This is a procedural criterion, leaving open the question of what "effective" means and who determines it.

We propose a stronger, *ontological subsidiarity*: governance should be located at the level where the relevant coherence is intact. "Coherence" here refers to the coupling between intentionality, practice, milieu, and artifact that we have identified as the condition of genuine potentiality. A community of practice — a municipality, a professional guild, a regional economy — maintains coherence when its members share the first-order practices, second-order understandings, and third-order artifacts that constitute their technological life, and when the artifact's individuation process is continuous with the community's own development.

Governance at a level above this coherence — governance that produces rules for practices it does not participate in, artifacts it does not use, problems it does not share — risks disrupting the coupling without which potentiality cannot actualize. This disruption is not hypothetical. The history of large-scale technology policy is substantially a history of interventions that addressed surface indicators (number of systems deployed, percentage of open-source usage, data center

capacity) while the underlying coherence conditions — skills, practices, institutional knowledge, technical lineages — were allowed to atrophy or were never developed.

This is not an argument against European-level coordination as such. There are genuinely supranational technological problems — electromagnetic spectrum governance, trans-border data flows, catastrophic risks from uncontrolled AI development, semiconductor supply chain fragility — that require coordination at scale. Hui's concept of *epistemological diplomacy* applies here: thin coordination protocols for problems that are genuinely planetary in scope, without imposing a unified epistemological or architectural framework.

But the question of which problems genuinely require supranational governance and which have been forced to that scale by historical economic concentration is itself a political question that sovereignty discourse should raise. Semiconductor concentration, cloud concentration, and AI concentration are not natural phenomena; they are outcomes of specific historical, economic, and regulatory choices. Treating their current scale as given and responding with supranational governance may reinforce the megamachine structure — what Mumford (1970) called the integration of technical systems into autonomous complexes that escape human control — rather than challenging it.

Ontological subsidiarity therefore implies: identify the coherence level at which each technological practice actually lives; restore the conditions of potentiality at that level; and limit supranational coordination to the residual set of problems that genuinely cannot be addressed otherwise. This is our fourth condition: *governance subsidiarity* — not as a procedural principle but as a positive requirement that governance be located where coherence can be maintained and potentiality can be generated.

7. Conclusion: Four Conditions for Functional Sovereignty

We have argued that the EU Technological Sovereignty Package, while addressing real and important dependencies, lacks an ontological layer: an analysis of where potentiality resides in technological systems and what this implies for where sovereignty must be secured. This absence is consequential. Without it, policy interventions risk being well-resourced responses to the wrong level of the problem.

The argument has established four sovereignty conditions, each corresponding to a level at which potentiality is generated or constrained:

- 1. Potentiality sovereignty:** European communities maintaining and developing the first-order practices and second-order understandings that constitute their technological life — not merely owning third-order artifacts. Concretely: investment in communities of engineering practice, maintenance capacity, and technical education that goes beyond training users of existing systems.
- 2. Cosmotechanical sovereignty:** The capacity to imagine and build technological systems grounded in epistemological frameworks that are not simply reproductions of the dominant cosmotechanical order. Concretely: support for research traditions, design philosophies, and governance approaches that start from different assumptions about what computation is for and what it means for technology to serve human flourishing.
- 3. Architectural sovereignty:** The capacity to assess, develop, and deploy computational substrates whose physical operating principles are adequate to the actual character of the human processes

they serve. Concretely: investment in post-von Neumann architectural research as a long-term sovereignty question, not only as an efficiency question.

4. Governance subsidiarity: Technology governance located at the coherence level where the relevant practices, understandings, and artifacts are actually coupled — with supranational coordination limited to problems that genuinely cannot be addressed at lower levels. Concretely: governance structures that restore and protect the conditions under which communities of practice can generate, maintain, and evolve their own technological capacities.

Together, these four conditions define *functional sovereignty*: sovereignty over what technology actually does, not merely over who legally owns it. They are demanding conditions. They require investment not only in infrastructure and intellectual property but in communities of practice, in architectural diversity, in epistemological plurality, and in governance structures adequate to the coherence level where potentiality actually lives.

The EU Technological Sovereignty Package is a significant policy initiative that addresses real vulnerabilities. Its Chips Act 2.0, Cloud and AI Development Act, and Open Source Strategy collectively represent a substantial reorientation of European technology policy. Our critique is not that this reorientation is misdirected, but that it is incomplete in a specific and consequential way: it addresses the artifact layer of technological systems without adequately addressing the four conditions under which the artifacts can generate genuine functional autonomy.

A sovereignty built on code ownership without potentiality development, without cosmotechnical diversity, without architectural adequacy, and without governance subsidiarity remains sovereignty at the level of legal title rather than functional capacity. The open-source myth — the assumption that transparency and ownership of code confer technological autonomy — is the most visible expression of this incompleteness. Correcting it requires not the rejection of open source, which remains a valuable instrument, but its recontextualization within a fuller account of where technological potentiality resides.

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