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DISCUSSION NOTE

On Technological and Innovation Sovereignty: A Response to Carl Mitcham's Call for a Political Theory of Technology

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Abstract The concepts of technological and innovation sovereignty open a pathway to address existing gaps in the governance of technology and innovation. Technological sovereignty aims to embed socio-political objectives within the development of technology and innovation, affecting economic governance and providing directionality of technological capacities. In this article, the concepts of technological and innovation sovereignty will be elaborated against the background of the paradigms of nation-state governance of technology, modern market-innovation and responsible innovation.

Keywords Technological sovereignty · Innovation sovereignty · Responsible innovation · Governance of technology · Geopolitics

Carl Mitcham's interest in developing a political theory of technology arises from his recognition that the achievements of technology and engineering ethics, to which he has made significant contributions, are insufficient given the scale of technological innovation and its social and ecological impact we are experiencing today. It can be seen as an extension of his earlier scholarship, much of which was captured in his *Steps Toward a Philosophy of Engineering: Historico-Philosophical and Critical Essays* [1], which impressively documents multiple relevant concepts for a philosophy— including ethics—of engineering.

Mitcham advocates for the development of a political theory of technology to address the evident shortcomings of research toward an ethics of technology, which does not adequately cope with the dynamics of global markets, and thus unable to guide technological developments within the political frameworks of nation-states. Take, for example, the notions of political and technological sovereignty, as far as I know always investigated separately. Mitcham, inspired by the work of Leo Strauss, argues:

> My hypothesis is that the emergence of political sovereignty has gone hand-in-hand with an emergence of technological sovereignty, that the two forms of sovereignty have been mutually reinforcing, and that the political philosophy of Strauss can help us appreciate this happening ([2], p. 332)

Historically, the development of both forms of sovereignty has been accompanied by an "ethics of moral constraint" that emerged alongside the nationalization of engineering practices (technological sovereignty) since the early eighteenth century. In a letter to the Portuguese King John V in 1701, the monk Bartolomeu informed the king about his invention of a "machine for sailing through the air," emphasizing

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its potential benefits for the Portuguese nation[1]. Impressed by early demonstrations of this engineering at court, the king appointed him to a lifetime position at the University of Coimbra, tasked with developing the technology in secrecy. Anyone who dared to replicate the monk's work faced the death penalty.

This historical example illustrates that the "responsible" use and control of engineering practices are often restricted to those deemed capable of acting responsibly— in this case, the sovereign. In modern nation-states, specific engineering practices continue to be regulated in terms of "who is in control" and "who can make use of them". To prevent misuse, technologies are placed under the control of the nation-state, and "responsible use" is that which benefits the nation-state. The politics of nuclear non-proliferation reflect this tradition: only a select few "responsible" governments are entrusted with the production of these weapons, and the development of space technology is still largely framed by the pursuit of "international leadership." All governments which employ these technologies are expected to exercise moral constraint in their application and to trust the "responsible" authorities governing this technology.

Coexisting to varying degrees with the "responsible state/sovereign" paradigm, capitalist societies have simultaneously let themselves be directed by market-based innovation. The political governance of national or international markets does not provide a specific forum or policy for legislation on individual technologies. Instead, we rely on the three market hurdles of, respectively, formal safety, quality, and efficacy assessment procedures that evaluate the properties of products produced by these technologies. Consequently, the benefits of products derived from technologies—without evaluating the technologies themselves—are demonstrated through market success, while potential negative consequences are assessed under formal risk assessment schemes. This creates a peculiar division of responsibilities: the state is accountable for defining product risks under authorization procedures and product liability laws, ensuring compliance among market operators. However, there is no evaluatory framework to determine what constitutes a positive impact of technology.

The underlying assumption is that "benefits" of a technology are not experienced universally. Through market pluralism, consumers are presented with a variety of choices, aiming to satisfy the diverse preferences especially found in liberal nation-states, where conceptions of the good are expected to vary. Competitors are driven to improve their products through innovation spurred by market demand. Consequently, the normative dimension of what counts as "improvement" is determined by market mechanisms. Modern technological innovation thus takes shape through technology that has been privatized in its production and democratized in its use. Market competition and individual choice promises to ensure product improvement for the collective benefit, rather than depending on the governance of a single actor (be it the king or the state) and its assertion of superiority.

In stark contrast to the governance of state-controlled technology, which aims to promote specific technologies and engineering practices, the vision of market governance and innovation sketched above adheres to the principle of *technology neutrality*. This principle posits that regulation should neither favor nor discriminate against any particular technology, allowing the market to determine which technology emerges as the "winner." Thus, market innovation lacks a control agent for technologies.

Under these conditions, global markets dictate what constitute "successful" products. Consistent with Mitcham's intentions, we need not only a political theory of technology but also a theory that addresses the more complex innovation processes driven by technologies that remain largely untouched by legislation within nation-states [3]. This highlights a significant shortcoming of an ethics of technology. In Europe, the AI Act[2]is

[1] The quotes come from the original letter Bartolomeo wrote to King John V. It is displayed at the exhibition "*Lux in Arcana. The Vatican secret archives reveal itself "(*Capitoline Museum, Rome, March 2012-September 2012). The Museum display gives the following further information: Gusmão presented a demonstration of his inventions, but we do not know for sure if the passarola itself was used, or simply a hot-air balloon. Neither do we know how big the prototype was: it seemed to be triggered by a strange combination of sails, wings and electromagnetism.

[2] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (Text with EEA relevance). http://data.europa.eu/eli/reg/2024/1689/oj

hailed as a pioneering piece of legislation addressing the risks associated with innovative outcomes of AI technologies (technology neutrality!). Yet it fails to account for the risk of becoming dependent on AI systems whose operational mechanics remain opaque (often protected under the property rights of private owners). While the Act ensures compliance with ethical standards—such as respecting individual autonomy—it falls short of defining socially desirable outcomes. Here the ambition of Responsible Innovation (RI) transcends that of ethics. RI calls for a socio-political ambition not just to respect human agency but to enhance it through public investments in AI systems.

Whereas the state-controlled paradigm of technological development and engineering practices was accompanied by an ethics of moral constraint, market-based innovations are accompanied by an evaluative form of ethics focused on constraint: an ethics of "what we should not do" (for instance, prohibiting human cloning, banning the marketing of human organs, and regulating product risks), rather than an ethics of what is desirable (e.g. "what we should do").

So, while Mitcham's thesis that technological sovereignty co-emerged with nation-states is accurate concerning the development of nation-state-controlled technology, it needs to be said that this technological sovereignty has been significantly undermined by global markets, which regulate the outcomes of technologies while leaving the technological capacities that shape these products largely untouched.

Recently, technological sovereignty has emerged as a critical issue on the political agenda in both the USA and the EU. In the wake of the COVID-19 crisis, cybersecurity challenges, and global competition, multiple undesirable dependencies have become apparent. For instance, the EU lacks the capacity to produce essential medicines within its borders, making it more reliant on specific market operators than on nation-states. In light of cybersecurity risks, the complex issues of digital sovereignty and data sovereignty have become pressing policy matters. It is unsurprising that "technological sovereignty" remains undefined at the European level; it exists as now as political aspiration, resulting in a blend of partly inconsistent ideas aimed at achieving an ill-defined objective.

The EU Chips Act [4] exemplifies this situation. While there is recognition that semiconductors are a strategic asset for Europe and provide geopolitical leverage, the EU has not effectively integrated geopolitical objectives with economic security goals. Instead, it merely states the policy objective for the EU to supply 20% of global chip production capacity. This aim is to be achieved through traditional innovation strategies, such as fostering a climate conducive to start-ups and ensuring access to capital. Commentators have quickly pointed out that while these measures may strengthen the semiconductor sector, they do not lead to true technological sovereignty [5].

The crux of the issue is that any move toward technological sovereignty necessitates a departure from an open economy and a relatively open innovation ecosystem. Technological sovereignty implies that a nation-state must have access to the technological capabilities required to produce products domestically, rather than relying on global markets. This inevitably suggests a level of "closeness". Pursuing technological development with political objectives and nationalistic implications is challenging to acknowledge within the European governance system, which has long relied on neoliberal theories of trade and innovation.

Nevertheless, the former EU Internal Market Commissioner, Thierry Breton, stated:

> Europe cannot make its digital and green transition happen without establishing technological sovereignty. We need to work together at the European level in areas of strategic importance such as defense, space, and key technologies like 5G and quantum. In doing so, we must focus on bridging the digital gap and involving all of Europe's regions [6].

This connects technological sovereignty with the concept of responsible innovation [7]. Responsible innovation aims to address market shortcomings by steering innovation towards socially desirable goals, such as those outlined in the European Green Deal.[3] For some time, there was hope that strengthening the market for green technologies could help achieve the Green Deal's objectives. However, as markets

[3] The European Commission has adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels: see https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

consistently fall short of delivering an environmentally responsible economic transition, the question arises: what mechanisms will promote innovation towards socially beneficial outcomes while ensuring some level of technological sovereignty?

Technological sovereignty is likely to be conceptualized minimally, avoiding nationalistic implications. For instance, this approach may seek to reduce unilateral dependencies or extend sovereignty to a network of reliable partners rather than centering it on a single nation-state or region. Sovereignty might be limited to a few critical technological capacities. Yet this is a delicate balance: economic security issues are increasingly tied to various technological domains, from ICT and microelectronics to AI, while the pool of reliable partners may also shrink. The challenge will be to integrate a relatively self-contained system of technological development and engineering within an economic framework that remains as open as possible. An alternative would be to invest in international governance and collaboration, co-developing technological capacities with partners, and establish mechanisms to ensure equitable access to resources and capacities. However, since this option is currently politically challenging, we may need to consider whether, should minimal technological sovereignty prove inadequate, it will be necessary to "re-nationalize" certain industries to guarantee the production of essential goods, such as medicines. This approach resembles China's, which has a more centralized technological governance model, enabling it to produce high-quality batteries within a closed innovation system. Obviously, the nationalization of critical industries or services is perfectly possible in democratic states: the democratic decision-making process may only require longer timeframes for their implementation.

However, in line with the two innovation paradigms I previously discussed, the alternative governance model should focus not just on technological sovereignty but also on "innovation sovereignty." There are concerns not only regarding technological capacities but also about the impacts of innovations developed in Europe or the USA—often with government subsidies—that subsequently have successfully relocated to Asian markets. For instance, the German photovoltaic industry, once the global leader in 2011, collapsed and relocated to China after the government eliminated subsidies and the policy of compensating solar panel owners for contributing energy to the grid. This shift resulted in the loss of ten thousands of jobs in the solar sector, including in research and development[4].

Innovation sovereignty requires a particular level of closeness of the economy. The USA's "Chips for America" initiative illustrates this trend: chip manufacturers receiving government funding are prohibited from expanding their production in China [8]. In 2012, it would have been inconceivable for Germany to implement similar measures to retain photovoltaic research and development at home. The political climate has changed.

The two prevailing paradigms of state-controlled technological development versus market-driven innovation highlight the governance challenges that lie ahead. We face a choice between the governance challenge of "responsible (territorially restricted) use of technological capacities" (technological sovereignty) or the governance challenge of proceeding with an ethics of constraints (innovation sovereignty) that may not only limit what is marketed but also dictate where it can be marketed.

The implications for a political theory of technology and innovation are significant. The concepts of technological and innovation sovereignty open a pathway to address existing gaps in the governance of technology and innovation. Both responsible innovation and technological sovereignty aim to embed socio-political objectives within the development of technology and innovation, affecting economic governance and providing directionality of technological capacities.

Responsible innovation operates within a deliberative democratic framework, encouraging societal actors to be mutually responsive and collaborate toward addressing societal challenges. It relies on a process that balances stakeholder interests and promotes an inclusive dialogue on the societal impacts of technology. This approach incentivizes collaboration and shared responsibility among public, private, and civil sectors, aligning innovation with socially desirable outcomes.

In contrast, technological sovereignty suggests a more politically guided approach to technological

[4] Solar sector employment peaked in 2011 with 156,000 employees, eventually reaching a bottom of just under 40,000 in 2017: https://www.statista.com/statistics/1453535/solar-photovoltaic-number-of-employees-germany/

development. It emphasizes the importance of reducing external dependencies and securing critical technological capacities through governance and policy intervention. This implies a more top-down direction for innovation, aiming to safeguard a degree of national or regional autonomy over essential technologies. The focus on sovereignty introduces a political dimension to innovation, where the state's role in shaping technology becomes more pronounced, potentially limiting market-led decision-making.

Taken together, these frameworks may signal a shift towards a more politically engaged governance model for technology, where innovation is not just a market-driven process but is actively shaped by socio-political priorities. Exploring how these concepts interact could help develop a political theory of technology that recognizes both the collaborative potential of responsible innovation and the protective, sovereignty-oriented dimensions necessary for resilient technological systems. This convergence could support a comprehensive approach to innovation governance, ensuring that technological progress aligns more closely with societal and democratic values.

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