

Emerging Technologies and National Sovereignty: The Political Implications of Artificial Intelligence, Quantum Computing, and Cyber Power

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Abstract: New technologies—artificial intelligence, quantum computing, and cyber electricity—are reshaping global electricity distribution by essentially specifying traditional notions of national sovereignty. This article examines how nations need to rethink sovereignty past territorial contains monetary, international monetary and payment matters. The assessment highlights an important concern: While states retain regulatory capacity within their borders, technological interdependencies and international networks constrain the true exercise of their sovereignty. Central powers face unique vulnerabilities as technological dependence creates heterogeneity that exposes them to strategic financial risks without viable independent technological pathways. The paper examines strategic responses through 3 focal points: the cyber power's ability to inflict political damage under the traditional border; and different approaches to virtual sovereignty, as exemplified by European, Chinese, and other national technologies. Evidence suggests that government funding for strategic technology, cybersecurity flexibility, and interoperability standards can reduce technology dependency—although it has not been abandoned now. However, the spread of emerging technologies, especially artificial intelligence, has dramatically increased the imbalance between advanced and emerging economies. The article concludes that national sovereignty is currently a process of fundamental change through proliferation across global networks, requiring states to adopt multidimensional strategies to maintain autonomy and protection in the digital age.

Keywords: Emerging Technology, National Sovereignty, Artificial Intelligence, Cyber Power, Quantum Computing.

1 Introduction

Emerging technologies – particularly Artificial Intelligence (AI), Quantum Computing (QC), and Cyber Power – increasingly shape individual and collective human existence across almost all dimensions, impacting not only economic and social prospects but also governance processes and

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forms. As a consequence, many countries emphasize safeguarding their own access to, control over and leadership in these pivotal technologies to secure the relevant development trajectories and address crucial regulation and governance decisions that will determine the long-term implications of these technologies for national populations. However, countries appear unable to adopt independent technological trajectories without incurring damaging dependencies upon more powerful and influential countries. For example, AI-related national strategies of the European Union (EU), intended to enhance European strategic autonomy and facilitate the adoption of human-centric AI, have remained largely dependent upon access to US models, platforms and tools like Google's, Microsoft's and OpenAI's widely adopted ChatGPT. Growing geopolitical arch-rivalry and conflict further complicate countries' search for an appropriate technological trajectory. The trajectory consequently chosen largely determines the high-level policies and national actions a country sets out.

Emerging technologies also reshape the very conception of sovereignty. Countries attempt to assert national sovereignty upon what they perceive as crucial technological techniques, disciplines and industries or sectors to erect barriers against damaging dependency and loss of leverage. Choice of sovereignty conception directly governs which technological techniques states pursue and under what structural conditions national strategies maximise feasible options. Within attention to the four dimensions of: territorial sovereignty; economic sovereignty; informational sovereignty; and cyberspace sovereignty; the paper arrives at the central hypothesis that the enduring agency and wield of middle powers remain not only compatible with but indeed enhanced by actively seeking national leadership in emerging technologies. Policies available to various countries for implementing strategic leadership in emerging technologies hinge upon individually established conceptions of state sovereignty.¹

2 The Concept of National Sovereignty in the Digital Age

Two primary approaches to state sovereignty exist in the context of the digital age: territorial and informational. Territorial sovereignty maintains that states exercise authority over land and resources and impose laws and regulations. Informational sovereignty, an evolving notion, encompasses access to, capacity to control, and ability to exploit information. Other forms of sovereignty linked to a state's ability to participate in a global information society include economic and social sovereignty. Many observers consider digital sovereignty a subcategory of informational sovereignty.

National sovereignty in the age of global networks presents states with a dilemma: although they have the ability to regulate and control what occurs within their borders, many regimes depend on foreign investments and joint ventures. Such global interdependence diminishes their autonomy in decision-making processes.² Sovereignty cannot rightfully be claimed when states participate in extensive global information exchanges. The coexistence of national sovereignty and global engagement constrains the exercise and enhancement of territorial, economic, and, most importantly, informational sovereignty.³

¹ Kalenzi, C. (2022). Artificial intelligence and blockchain: how should emerging technologies be governed?. *Frontiers in Research Metrics and Analytics*, 7, 801549.

² Shoker, A. (2022). Digital sovereignty strategies for every nation. *Applied Cybersecurity & Internet Governance*, 1(1), 1-17

³ Tretter, M. (2023). Sovereignty in the digital and contact tracing apps. *Digital Society*, 2(1), 2.

3 How do emerging technologies alter state sovereignty?

Sovereignty is a concept with Western origins developed against the backdrop of the Treaty of Westphalia (1648), which marked the end of the Thirty Years' War in Europe. It is traditionally defined in terms of internal control and external recognition of territorial integrity.⁴ In the currently contracted and interconnected world, sovereignty must be redefined in contemporary economic, informational, and cyber terms. Emerging technologies either reinforce or challenge sovereignty—cyberspace is among the first to emerge in the late 20th century that acts against national sovereignty. Rising powers central to the mid-20th century discourse exert extreme control over all existing on-line activities. Middle powers still maintain a significant level of sovereignty, with a plausible chance to keep middle powers functioning in a mid-range autonomy agenda.⁵ Game-theoretical concepts such as Nash equilibrium are applied to illustrate the rationale behind the exercise of sovereignty at different levels.

3.1 Can middle powers maintain strategic autonomy?

Discussions of technology adoption often emphasize the “digital divide,” a term that characterizes disparities in access to, use of, and engagement with digital technologies and associated services.⁶ This suggests that access to information and communication technology (ICT) represents the fundamental barrier to meeting an economy's full potential in the digital age. Yet, a related but distinct discussion stresses the importance of the supply of ICT and the economic gains from an economy's exploitation from such technologies. The concept of technological dependence captures this notion. Technological dependence can be defined as follows: an economy is technological dependent on the “producer” of a given hardware or software technology when it either imports a larger proportion of that technology relative to its domestic production, or the producer earns a significant proportion of the total sales revenue from the economy.

While middle powers such as Canada, Norway, and Sweden generate substantial royalties from natural resource extraction, their net gains from telecommunications or ICT appear minor. Consequently, they exhibit considerable dependence on external sources of these technologies. Strategic autonomy requires minimization of dependence on foreign suppliers of these emerging technologies. Specialization or adequacy of a country's education system represents secondary issues in this context.
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3.2 What policies reduce technological dependence?

The emergence of new technologies can create profound asymmetric interactions that strengthen some countries and expose others to strategic or economic risks. Technology dependence is often seen as particularly high on the part of middle powers—countries with neither the size of Great Powers nor the degree of interdependence of smaller nations. What policies can help reduce such dependence? Without advocating for an indiscriminate decoupling from Great Powers, three broad policy groups are usually discussed: targeted investments in strategic technologies, cyber security resilience, and greater

⁴ Adams, J., & Albakajai, M. (2016). Cyberspace: A new threat to the sovereignty of the state. *Management Studies*, 4(6).

⁵ Shoker, A. (2022). Op cit.

⁶ Ibid

⁷ Aggarwal, V. K. & Reddie, A. W. (2025). New economic statecraft and global technology conflicts: the dilemma for middle powers. *Business and Politics*.

technological interoperability.

Middle powers are often accused of "horizon scanning"—investing in many technologies without developing true strategic depth in any one area—leading to dependence on the technological leadership of larger powers. The development of quantum computing, advanced AI or hypersonic weapons can lead to severe strategic asymmetries; thus, targeted government investments in particular technologies, usually related to defence or security, are sometimes proposed. However, industry actors themselves argue against misdirected or politicized funding: new technologies are developed for the army by commercial actors and are overall well protected simply through the nature of the market. Even without specific government investments, the market itself should be able to generate effective deterrent capabilities for advanced countries.⁸

Another dimension of technology dependence is the critical infrastructure in the digital realm. With the advent of cloud computing and the proliferation of services over it, the security of companies and institutions is now largely contingent on whether the service providers can withstand an attack or resist a digital intervention. The fact that a country has a robust set of cyber capabilities does not necessarily secure its critical digital infrastructures; cyber resilience is a different matter.⁹

4 Quantum Computing and Strategic Implications for State Power

Quantum computing holds considerable strategic importance for state power. The potential to achieve quantum advantage threatens the confidentiality of sensitive information, leading organizations to expedite the transition to quantum-ready infrastructures and post-quantum cryptography.¹⁰ Nations with the capacity to implement these transitions effectively may enhance their strategic position. At the same time, the issuance of quantum-equipped capabilities and the possibility of utilizing quantum computers to compromise encrypted databases raise significant concerns regarding access to national critical infrastructure.¹¹ Grounding the technology's development within local organizations and promoting extensive collaboration among national stakeholders bolster technological sovereignty. Internationally, governance frameworks addressing the dual-use nature of quantum advancements, encompassing research, development, and utilization, remain inadequately defined.

4.1. Quantum Advantage and Defense

Quantum computers will break widely used encryption methods, straining data confidentiality, authentication, and integrity. Secure quantum communications can mitigate risks, but proven technologies are not guaranteed until post-quantum encryption reaches maturity. Defence strategies must counter quantum computing before post-quantum encryption (Krelina, 2021).

Sams and Flamm establish a potential timeline for quantum advantage application to common cyber-attacks. Controlling quantum processes becomes increasingly difficult as advancement accelerates. Timelines shrink from years to months with enhanced qubit control. Transitions to larger qubit systems increase material, optical, calibration, and control complexities. Despite these difficulties, governments

⁸ Li, X. & Ban, C. (2026). Financing technological innovation in China: Neo-developmental financial statecraft through government guidance funds. *Review of International Political Economy*

⁹ Ghaderi, Z., Beal, L., & Houanti, L. H. (2026). Cybersecurity threats in tourism and hospitality: perspectives from tourists engaging with sharing economy services. *Current Issues in Tourism*

¹⁰ Troyer, M., Violi Benjamin, E., & Gevorkian, A. (2024). Quantum for Good and the Societal Impact of Quantum Computing

¹¹ Baseri, Y., Chouhan, V., & Ghorbani, A. (2024). Cybersecurity in the Quantum Era: Assessing the Impact of Quantum Computing on Infrastructure.

should remain vigilant.¹²

4.2. Quantum-Ready Critical Infrastructure

Integration of quantum technologies within national critical infrastructure entails a deep concern for the security of data and systems governed by quantum laws and principles. The implementation of quantum technologies worldwide is limited to public sector projects, with the private sector still awaiting a clear regulatory framework. Nonetheless, careful consideration is required to prepare the infrastructure for the future quantum technology emergence.

Quantum technology influences the economy's national critical infrastructure. Countries worldwide embrace quantum development to leverage its advantage in economic growth, production efficiency enhancement, accessibility improvement, and technical breakthroughs provision. Quantum technologies incorporate quantum communication, quantum computing, quantum artificial intelligence, quantum measurement, and quantum sensing applications, with quantum communication listed as the forefront of development. In this regard, national regulation and preparation become imperative.¹³

4.3. International Governance of Quantum Technologies

Quantum technologies are often touted as a quintessence of dual-use technologies, i.e. technologies having both military and commercial applications. The appeal of quantum technologies resides in their projected potential for achieving speedup of computing tasks over classical computers (quantum advantage) and for securely transmitting, distributing and processing information (quantum communication). National governments are competing and cooperating to explore, encourage and stimulate development of quantum technologies which will impact their international competitive advantage.¹⁴ Emerging quantum technologies can confer a nation at least the following three potential strategic benefits: (1) thwart counterparty encryption, (2) enhance the resilience of critical infrastructure against quantum cyber-attacks, and (3) ensure national capabilities in quantum computing or quantum communication when other nations e.g. adversaries or rivals, are on the verge of quantum advantage breakthroughs. In order to mitigate risks associated with dual-use of quantum technologies, countries have initiated international regulations and guidelines. Quantum governance efforts now underway focus on improving quantum literacy, promoting coherent and coordinated quantum policy frameworks within nations and across borders, developing post-quantum secure protocols in cryptography, and nurturing quantum-ready communication systems like space-based quantum communication for provision of future-proof information security.¹⁵

5 Cyber Power, Deterrence, and International Stability

Emerging cyber capabilities and infrastructure strongly influence the understanding and practice of national security. Technology allows opportunistic states, rogue groups, and individuals to threaten vital interests with little risk of direct retaliation.¹⁶ Cyber capabilities enhance situational awareness and extend the reach of both coercion and deterrence. As with other forms of power, deterrence remains a key challenge and is tied closely to the stability of international relations. Cyber capabilities

12 Zwerver, A. M. J., Krähenmann, T., Watson, T. F., Lampert, L., George, H. C., Pillarisetty, R., ... & Clarke, J. S. (2022). Qubits made by advanced semiconductor manufacturing. *Nature Electronics*, 5(3), 184-190.

¹³ Ibid

¹⁴ Troyer, M., Violi Benjamin, E., & Gevorkian, A. (2024). Op cit.

¹⁵ Kalenzi, C. (2022). Op cit.

¹⁶ Mayer, M. (2018). Artificial intelligence and cyber power from a strategic perspective. Forsvarets hogskole, IFS Insights

influence state sovereignty and affect regulatory and operational approaches to internet governance. Cyber-attacks and country risk are among the most frequently cited risks in international investor surveys. Cyber capabilities are perceived as a strategically important tool, but the region is observed to be weak technologically and lacking a credible cyber deterrent compared to North America and Asia. The understanding of national security threats within a region must be carefully examined, as this varies greatly across countries. In Southeast Asia, cyber threats are seen as more of an opportunity than a risk by some policy-makers.¹⁷ Despite the high-profile nature of cyber-attacks reported in the media, the region remains relatively quiet compared with North America and Europe.

5.1. Cyber Capabilities and National Security

Cyber capabilities, the military use of digital instruments and denial of services to support political objectives, are now essential to a nation's power. Cyber power increases a nation's political leverage without necessarily challenging the target's territorial integrity or sovereignty. Cyber attacks can inflict injury on adversaries while remaining below the threshold of traditional deterrence. Cyber capabilities remain uncertain, orchestrating operations that mix physical elements with manipulation of bits.¹⁸

Two correlations govern the relationship between cyber capacity, nuclear weapons, and non-nuclear military capacity. Cyber tools and operations do not serve the same purpose as nuclear weapons but are related. The conditional deterrence of nuclear weapons and second-strike capability depends on a state's general military power, which includes non-nuclear capabilities and conventional deterrence. A significant cyber attack against a nuclear-capable power would not necessarily invoke a nuclear response but would modify a strategic calculus that excludes them from systematic defence discussion.¹⁹

National security legislation highlights cyber security as critical to national security in contemporary society. Digitalisation impacts not only freedom of expression, political accountability, and economic prosperity but also national security and defence issues.²⁰ Cyber attacks and their intensity have increased globally, making South Korea more susceptible to security threats than major powers.

5.2. How do digital infrastructures affect national security?

Global digital infrastructures and services, including the Internet, provide unprecedented opportunities but also create perilous challenges for states. Digital infrastructures facilitate instant connectivity, knowledge sharing, and the global transfer of goods and services. These opportunities, however, come at the price of reduced control over domestic technologies, which are often owned and operated by private actors. Such dependencies may jeopardize national interests during times of political tension. Moreover, digital infrastructures are vulnerable to espionage, sabotage, and manipulation. Affiliated actors can exploit these points of vulnerability to undermine state power and undermine confidence in institutions.²¹

Digital governance structures depend on the availability and distribution of digital services. Hence, space systems, such as satellites, Earth observation systems, and communication networks, are crucial

¹⁷ Laton, D. (2017). Manhattan, Project. exe: A Nuclear Option for the Digital Age. *Catholic University Journal of Law and Technology*, 25(1), 4.

¹⁸ Cavelti, M. D. (2025). Digital Capabilities as a Strategic Resource. *Strategic Trends*.

¹⁹ Mayer, M. (2018). *Op cit*.

²⁰ Laton, D. (2017). *Op cit*

²¹ Shoker, A. (2022). *Op cit*.

enablers of such services. Securing advanced technologies and infrastructure is critical to national security, especially for countries facing major geostrategic threats. In an environment characterized by strategic competition, the capacity to adopt, develop, and deploy digital technologies constitutes a powerful tool of power.

6 Case Studies in Sovereign Technological Leadership

Digital sovereignty must be on the agenda of every modern nation to protect vital digital assets, from essential services to advanced digital environments. It is a strategic necessity to safeguard assets from threats posed by both friendly and malicious states. Protecting operational resources, raw materials, and human expertise, as well as research and innovation, is crucial for sustainable sovereignty. Achieving digital sovereignty often requires cooperation rather than autonomy. Implementing digital sovereignty using principles from game theory, such as Nash Equilibrium, can help govern relations with rational states. A tailored digital sovereignty agenda based on each country's current status, priorities, and capabilities is essential. Developing a roadmap toward a sovereign digital nation involves leveraging state-of-the-art digital technology and emphasizing the need for further research from technological, economic, and geopolitical perspectives.²²

Sovereignty is often interpreted as a territory-based notion. However, in the digital context, sovereign leadership can exist without political territoriality. A significant amount of digital data and processing does not contain territoriality, enabling countries to establish digital sovereign leadership. Adequate arrangements can preserve and configure an entirety of the country's critical sovereignty while paving the way to generically more competitive, advanced, and elevated higher digital innovation.²³

6.1. Case Study A: European Union

Digital sovereignty, and the deployment of the related concept of “digital constitutionalism” to designate the judicial and legislative developments framing the data economy considered necessary to regain control over the member states' digital sovereignty, have increasingly become a dominant policy discourse in Europe.²⁴ The conception of digital sovereignty first appeared in the aftermath of the Cambridge Analytica scandal and the subsequent wiretapping revelations concerning European leaders, during which Emmanuel Macron encapsulated Europe's predicament by declaring digital technology to be the “fifth key” to the continent's sovereignty.

The “Digital Compass” policy statement, which was formally announced in March 2021, thoroughly articulated the European vision encompassing a “human-centred, sustainable and secure digital transformation.” This comprehensive initiative set forth several significant objectives, notably including the call to “invest in quantum technologies” alongside the urgent need to “develop leading-edge EU capacities in quantum technologies, high-performance computers and AI.” This ambitious vision is anticipated to materialise through an extensive initiative known as the Gaia-X project.²⁵

This project aims to establish a self-sufficient cloud infrastructure, which will play a fundamental role in ensuring data sovereignty and the development of AI technology across the European landscape. Furthermore, in September 2021, the European Commission proposed a “European Digital Identity”, a

²² Ibid

²³ Ibid

²⁴ Codagnone, C. & Weigl, L. (2023). Leading the Charge on Digital Regulation: The More, the Better, or Policy Bubble? Available at ncbi.nlm.nih.gov

²⁵ Håkansson, C. (2022). Where does the Compass point? The European Commission's role in the development of EU security and defence policy. *European View*, 21(1), 5-12..

robust framework designed to grant citizens and businesses secure access to essential services spanning various domains such as banking, health, education, and transport. This digital identity system prioritises data security by allowing citizens and businesses to maintain control over their personal information, enabling them to decide what details they wish to share and with which providers, thus enhancing privacy and trust in digital interactions.²⁶

6.2. Case Study B: China

China identifies information security as a national priority. It considers data as a key production factor alongside land, labor, capital, and technology, necessitating protection to maintain state sovereignty²⁷. As data flow expands, there is an increasing risk that information from China may be misused by other nations. The Chinese Ministry of Industry and Information Technology highlighted that AI, in light of big data, is transfer social structure and national governance. Since mid-2017, the central government has designated AI as a crucial component of national security strategy. The era of big data emphasizes the protection of information and data security, and AI technology has strategic significance for state governance and social security²⁸.

7 Conclusion

Digital sovereignty also cuts across several additional dimensions—telecommunications and networks, media, data and archives, and critical information infrastructures. The significance of these dimensions varies among countries. With the rise of global networks, national policies are now limited to a narrower portion of the national space. Tracing the evolution of norms established during the Westphalian era shows how the original paradigm is subjected to constant evolution. Whether emerging technologies can alter the contemporary paradigm of sovereignty remains an open question, but the trend is clearly toward further diffusion of sovereignty through global networks.

Upon thorough examination and careful consideration of the diverse characteristics that define state power, as well as the availability of various resources and the intricate socio-economic structures at play, one may ultimately conclude that the emerging technologies of our time, particularly those found in the rapidly evolving field of artificial intelligence, have significantly created an even greater divergence between the advanced economies of the world and the developing nations compared to what was seen with traditional technologies in the past. This marked divergence, in turn, enables the strategic autonomy of middle powers in the realm of emerging technologies and in the context of critical political and military issues to be remarkably sustainable, even as the underlying technological dependence on advanced economies continues to be sustained. Therefore, the policy measures that have been devised and implemented are able to effectively maintain a certain level of technological autonomy in various matters that are fundamentally related to artificial intelligence and its applications. Consequently, this situation fosters a landscape in which middle powers can navigate their own paths, despite the inherent challenges posed by their reliance on more advanced nations for technological resources.

²⁶ Coletti, P., Ducci, C., & Moro, F. N. (2025). Digital Sovereignty and the EU's Identity Between Technological Innovation and European Values. *JCMS: Journal of Common Market Studies*

²⁷ Chen, W. (2019). Now I know my ABCs : U.S.-China policy on AI, big data, and cloud computing.

²⁸ Min, C., Zhao, Y., Bu, Y., Ding, Y., & S. Wagner, C. (2023). Has China caught up to the US in AI research? An exploration of mimetic isomorphism as a model for late industrializers.

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