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Geopolitics of Technology: Technological Competition in Modern Global Politics

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Abstrak
Persaingan teknologi telah berkembang menjadi salah satu dimensi paling kritis dalam politik global kontemporer. Artikel ini mengkaji bagaimana kemajuan teknologi, khususnya kecerdasan buatan, semikonduktor, platform digital, dan teknologi energi hijau, telah membentuk ulang dinamika geopolitik antara kekuatan-kekuatan besar dunia. Melalui tinjauan literatur sistematis terhadap dua puluh publikasi akademik mutakhir, penelitian ini mengidentifikasi empat arena persaingan teknologi utama: (1) hegemoni platform digital dan kedaulatan data; (2) rantai pasokan semikonduktor dan kontrol ekspor; (3) transisi energi hijau dan ketergantungan mineral kritis; serta (4) kedaulatan teknologi dan kebijakan industri nasional. Temuan menunjukkan bahwa persaingan teknologi AS-China telah memasuki fase "Perang Dingin Teknologi" yang berdampak luas pada sistem perdagangan internasional, inovasi global, dan tatanan tata kelola digital. Implikasi bagi negara-negara berkembang, termasuk Indonesia, sangat signifikan, mengingat tekanan untuk memilih afiliasi teknologi dalam lanskap geopolitik yang semakin terpolarisasi.
Kata Kunci: geopolitik teknologi; kedaulatan digital; persaingan AS-China; nasionalisme teknologi; kebijakan industri

Abstract
Technological competition has emerged as one of the most critical dimensions of contemporary global politics. This article examines how technological advancements, particularly artificial intelligence, semiconductors, digital platforms, and green energy technologies have reshaped geopolitical dynamics among the world's major powers. Through a systematic literature review of twenty cutting-edge academic publications, this study identifies four primary arenas of technological competition: (1) digital platform hegemony and data sovereignty; (2) semiconductor supply chains and export controls; (3) green energy transition and critical mineral dependencies; and (4) technological sovereignty and national industrial policy. The findings reveal that US-China technological rivalry has entered a "Tech Cold War" phase with far-reaching implications for the international trading system, global innovation ecosystems, and digital governance frameworks. The implications for developing countries, including Indonesia, are significant, given mounting pressure to choose technological alignments in an increasingly polarized geopolitical landscape.
Keywords: technology geopolitics; digital sovereignty; US-China rivalry; techno-nationalism; industrial policy

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INTRODUCTION

The twenty-first century has witnessed a fundamental transformation in the nature of geopolitical competition. Where earlier centuries were defined by contests over territory, natural resources, and military power, the defining rivalries of the contemporary era increasingly revolve around technological supremacy (Khan et al., 2022). Control over critical technologies, including artificial intelligence, quantum computing, advanced semiconductors, and digital platform infrastructure, has become tantamount to strategic advantage in the global order, reshaping alliances, trade regimes, and the very architecture of international relations.

The intensification of US-China technological rivalry constitutes the most consequential expression of this broader shift. Since approximately 2017, the relationship between the world's two largest economies has transitioned from competitive interdependence toward systemic decoupling across key technological domains (Rolf & Schindler, 2023; Schindler et al., 2023). The imposition of export controls on advanced semiconductors, the contested status of platforms such as TikTok and Huawei's 5G networks, and the passage of landmark legislation such as the US CHIPS and Science Act collectively signal a new phase of techno-geopolitical competition with global ramifications (Luo & Van Assche, 2023).

Beyond the bilateral US-China dynamic, the geopolitics of technology encompasses a range of intersecting issues: the race to establish national artificial intelligence strategies and digital sovereignty frameworks (Bareis & Katzenbach, 2021; Monsees & Lambach, 2022); the geopolitical dimensions of the green energy transition and critical mineral supply chains (Lebrouhi et al., 2022; Su et al., 2021); and the broader contestation over the governance of digital infrastructures and data flows (De Goede & Westermeier, 2022). The European Union has emerged as a distinct third actor, pursuing technological sovereignty through industrial policy instruments while navigating dependencies on both American platforms and Chinese supply chains (Seidl & Schmitz, 2023; Broeders et al., 2023).

Despite a proliferating scholarly literature, the field lacks an integrative synthesis that maps the full spectrum of technological competition within a coherent geopolitical framework. Existing studies tend to examine specific technology domains, semiconductors (Luo & Van Assche, 2023), digital platforms (Gray, 2021), hydrogen (Lebrouhi et al., 2022), or AI governance (Nemorin et al., 2023), in isolation, without adequately theorizing the systemic interactions and feedback dynamics that characterize the broader technological rivalry. This paper addresses that gap through a systematic literature review covering twenty peer-reviewed sources published between 2021 and 2025. The research question guiding this study is: How has technological competition reconfigured geopolitical dynamics in the contemporary international system, and what are the implications for states, multinational enterprises, and global governance?

METHODOLOGY

This study employs a systematic literature review (SLR) methodology to synthesize scholarly knowledge on the geopolitics of technology. The SLR protocol follows an adapted PRISMA framework, organized across four phases: identification, screening, eligibility assessment, and final inclusion. The search was conducted across Scopus, Web of Science, and Google Scholar, using keyword combinations including "geopolitics of technology," "techno-nationalism," "US-China tech rivalry," "digital sovereignty," "semiconductor supply chain," "AI geopolitics," and "tech cold war."
The review was restricted to peer-reviewed journal articles and working papers published between 2021 and 2025, ensuring relevance to the contemporary geopolitical moment. All sources included in the final corpus were required to: (1) directly address technological competition as a geopolitical

phenomenon; (2) engage with at least one major power's technology strategy or policy; and (3) demonstrate methodological rigor through original empirical analysis, systematic review, or theoretically grounded conceptual contribution.

A total of 20 high-quality publications were included in the final synthesis. Data extraction focused on four analytical dimensions: (a) theoretical framing of technology-geopolitics nexus; (b) empirical focus, technology domain, geographic scope, and actor types; (c) key analytical findings; and (d) implications for global governance and developing countries. Thematic synthesis was employed to identify convergent findings and divergent analytical perspectives, enabling the construction of an integrative framework for understanding contemporary techno-geopolitical competition.

RESULTS AND DISCUSSION

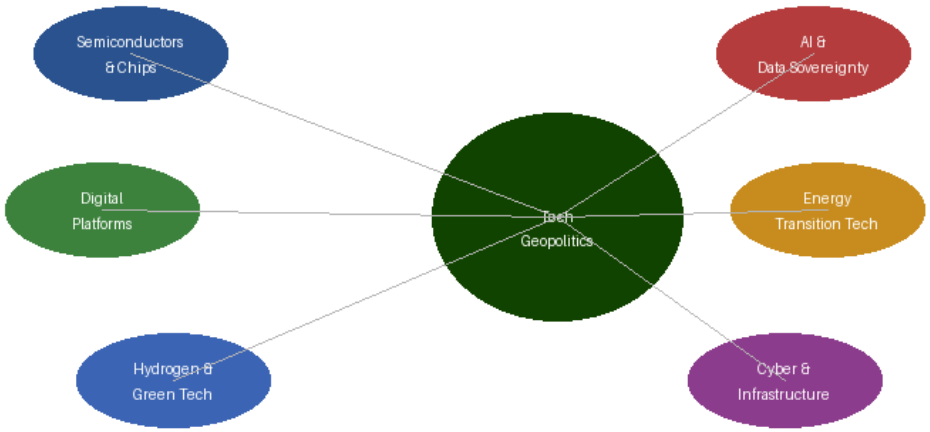
The following subsection presents the review's second major theme, how technology has emerged as a central geopolitical battleground, summarizing key findings on state strategies and strategic competition over advanced capabilities.

A. Technology as a New Geopolitical Battleground

Khan et al. (2022) provide one of the most comprehensive early analyses of technology as a geopolitical battleground, demonstrating that control over advanced technologies, particularly in the domains of artificial intelligence, quantum computing, and biotechnology, has become as strategically consequential as control over oil reserves or nuclear arsenals in previous eras. Their analysis reveals a systematic pattern in which major powers are deploying a full spectrum of policy instruments, export controls, investment screening, industrial subsidies, and standard-setting diplomacy, to achieve and defend technological advantage.

G'oes and Bekkers (2022) quantify the economic dimensions of this competition, showing that geopolitical conflicts generate measurable negative effects on trade flows, innovation productivity, and technological diffusion across the global economy. Their WTO-commissioned analysis estimates that a scenario of full technological decoupling between the United States and China could reduce global GDP by up to 5%, with disproportionate impacts on countries most integrated into contested supply chains. This finding underscores that the geopolitics of technology is not merely a great-power phenomenon but a systemic risk affecting the entire international economy.

Teece (2025) extends this analysis to the level of the multinational enterprise, arguing that the convergence of digitalization and geopolitical disorder has fundamentally transformed the strategic environment for globally operating firms. Multinational corporations now face the challenge of navigating between divergent regulatory regimes, technology standards, and geopolitical alignments, often simultaneously. This "world disorder" demands new organizational capabilities centered on geopolitical agility, supply chain resilience, and strategic ambidexterity.



Source: Synthesized from Khan et al. (2022); Schindler et al. (2023); Luo & Van Assche (2023)

Figure 1. Key Domains in the Geopolitics of Technology (Source: Synthesized from Khan et al., 2022; Schindler et al., 2023; Luo & Van Assche, 2023)

Figure 1 illustrates the six principal domains through which technological competition manifests in the contemporary geopolitical environment. Each domain, semiconductors and chips, AI and data sovereignty, digital platforms, energy transition technology, hydrogen and green tech, and cyber and infrastructure, represents a distinct arena of great-power rivalry. The interconnected nature of these domains means that competitive dynamics in one area frequently generate spillover effects across others, producing the complex, multi-dimensional character of contemporary techno-geopolitical competition.

B. The US-China Tech Cold War: Dynamics and Dimensions

Rolf and Schindler (2023) provide a theoretically sophisticated analysis of the US-China rivalry through the lens of "state platform capitalism," arguing that both powers have developed distinct models of state-technology integration that reflect deeper ideological and institutional differences. The United States has pursued a model in which private platform corporations operate as quasi-sovereign actors with significant geopolitical utility, while China has cultivated a model of state-directed platform capitalism in which technology giants serve explicit national strategic objectives.

Schindler et al. (2023) frame the broader competition as a "Second Cold War" in which the United States and China compete for centrality across four interconnected network domains: infrastructure (including digital infrastructure), production (including semiconductor manufacturing), digital platforms (including data infrastructure), and finance. This network-theoretic framework reveals that technological competition is not merely a contest over specific technologies but a struggle for structural power within the global economy, the capacity to set rules, standards, and dependencies that shape the behavior of other actors.

Luo and Van Assche (2023) examine the specific implications of the US CHIPS and Science Act, landmark legislation enacted in 2022 to revitalize domestic semiconductor manufacturing and research, for multinational firms operating in the semiconductor industry. Their analysis identifies five categories of techno-geopolitical uncertainty generated by the CHIPS Act: supply chain restructuring pressure, innovation ecosystem fragmentation, regulatory compliance complexity, talent mobility restrictions, and market access uncertainty. These uncertainties compel multinational enterprises to fundamentally reconsider their geographic footprints, partner ecosystems, and technology governance frameworks.

Tung et al. (2023) analyze the so-called "Tech Cold War" through the lens of international business scholarship, contending that the rising multipolarity of the global economy, manifested in increasingly distinct US-aligned and China-aligned technology ecosystems, constitutes a fundamental structural shift with wide-ranging consequences for international business practice and theory. Their work shows how geopolitical fragmentation and rapid technological change jointly reshape market access, supply-chain architectures, standards competition, and firms' strategic choices, forcing multinational enterprises to navigate divergent regulatory regimes, alliances, and security constraints. To capture these complex dynamics, Tung et al. argue for the development of new theoretical frameworks that explicitly integrate geopolitical risk, technological nationalism, and firm-

level strategic behavior; they label this emerging research agenda "techno-geopolitical international business." Such a perspective emphasizes how external state-driven pressures and technological bifurcation alter competitive advantage, resource allocation, and cross-border collaboration, and it calls for empirical and conceptual tools that reflect the coupled political-technical environment in which global firms now operate.

Table 1. Summary of Key Literature on Geopolitics of Technology (2021–2025)

Author(s)	Domain	Key Finding	Year
Khan et al.	Tech as battleground	Technology control equals strategic advantage; full policy-toolkit deployment	2022
Rolf & Schindler	State platform capitalism	US and China have divergent state-tech integration models	2023
Gray	Digital platforms (TikTok)	Platform governance as geopolitical instrument	2021
Luo	Techno-nationalism	Techno-nationalism produces counterproductive outcomes for firms	2021
Tung et al.	Tech Cold War / IB	Multipolarization redefines international business frameworks	2023
Lebrouhi et al.	Hydrogen geopolitics	Hydrogen development reshapes energy geopolitics	2022
Schindler et al.	Second Cold War networks	US-China compete for centrality across infra/production/finance	2023
Luo & Van Assche	CHIPS Act implications	Five categories of techno-geopolitical uncertainty for MNEs	2023
Seidl & Schmitz	EU industrial policy	EU pursues geo-dirigiste technological sovereignty strategy	2023
De Goede & Westermeier	Infrastructural geopolitics	Infrastructure increasingly weaponized in geopolitical contests	2022

***Note**. Synthesized from reviewed literature (2021–2025)*

Table 1. reveals several important patterns across the reviewed literature. First, the temporal clustering of publications around 2022–2023 reflects the acceleration of techno-geopolitical competition following the passage of the US CHIPS and Science Act and China's accelerated self-reliance agenda. Second, while individual studies tend to focus on a single technology domain, the cross-cutting themes of supply chain vulnerability, standard-setting power, and regulatory fragmentation recur consistently across domains, suggesting that these represent structural features of techno-geopolitical competition rather than domain-specific anomalies. Third, the US-China dyad dominates the literature, though

the European Union emerges as a significant third actor in studies concerning digital sovereignty and industrial policy. To further illustrate the competitive dynamics between the two leading technological powers, Figure 2 presents a comparative mapping of the strategic instruments deployed by the United States and China across the principal dimensions of their rivalry.

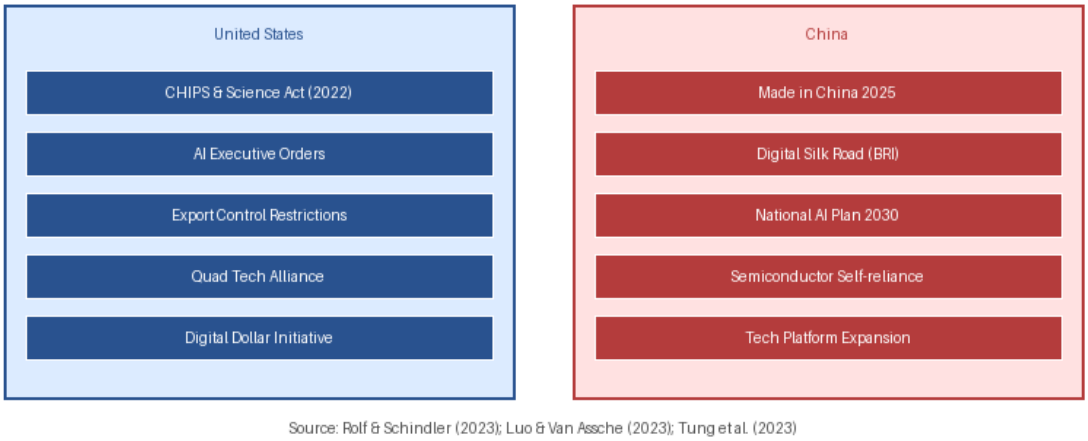


Figure 2. Dimensions of US-China Technological Competition (Source: Rolf & Schindler, 2023; Luo & Van Assche, 2023; Tung et al., 2023)

Figure 2 maps the principal strategic instruments deployed by the United States and China in their technological competition. The asymmetric but mutually reinforcing nature of these instruments, American emphasis on alliance-based export control regimes versus Chinese emphasis on self-reliance programs and the Digital Silk Road, reveals a competition that is simultaneously economic, technological, regulatory, and geopolitical in character.

C. Digital Sovereignty, Platform Geopolitics, and AI Governance

Gray (2021) offers an incisive analysis of the TikTok controversy as a prism through which to examine the broader geopolitics of digital platforms. The attempted ban on TikTok in the United States, and similar actions in India and other countries, reveals how digital platforms have become sites of geopolitical contestation, raising fundamental questions about data sovereignty, national security, algorithmic influence, and the appropriate boundaries of state regulation of digital infrastructure.

Bareis and Katzenbach (2021) examine the proliferation of national artificial intelligence strategies through the lens of performative politics, demonstrating how governments deploy AI narratives not merely as technology policy instruments but as mechanisms for constructing national identity, signaling international ambition, and disciplining domestic actors. Their cross-national analysis of fourteen national AI strategies reveals that the discourse of AI leadership has become a new form of techno-nationalist identity politics, with significant implications for international cooperation and AI governance.

Monsees and Lambach (2022) extend this analysis to the concept of digital sovereignty, showing how the EU's pursuit of digital sovereignty simultaneously reflects and reproduces European geopolitical identity. Their constructivist analysis demonstrates that digital sovereignty is not merely a technical or legal concept but a political imaginary that carries

powerful identity-constitutive implications for how Europe understands its place in the global technological order. Broeders et al. (2023) complement this analysis by examining the gap between the EU's normative ambitions as a digital power and its practical capacity to achieve strategic autonomy from American platforms and Chinese digital infrastructure.

Nemorin et al. (2023) contribute a critical perspective on AI discourse in international development contexts, documenting how AI has been "hyped" in ways that may distort development priorities and create new forms of technological dependency. Their horizon scan analysis of AI discourse across 48 countries reveals significant inequalities in the capacity to shape AI narratives and standards, inequalities that mirror and reinforce broader power asymmetries in the global political economy.

D. Energy Geopolitics, Critical Minerals, and Green Technology

The green energy transition has introduced a new dimension into the geopolitics of technology, creating novel dependencies and competitive dynamics centered on critical minerals, hydrogen, and renewable energy technologies. Su et al. (2021) demonstrate that the shift toward renewable energy is redefining geopolitical risk, as the dependencies associated with fossil fuel geopolitics are partially replaced by new dependencies on critical minerals essential for electric vehicle batteries, wind turbines, and solar panels.

Lebrouhi et al. (2022) provide a comprehensive technological and geopolitical overview of global hydrogen development, showing that hydrogen has emerged as a new arena of great-power competition as countries race to establish positions in what may become a major future energy carrier. Their analysis reveals that hydrogen geopolitics exhibits a distinct spatial logic from fossil fuel geopolitics, potentially enabling a broader range of countries, including those with renewable energy resources but no fossil fuel reserves, to emerge as significant energy exporters.

Altiparmak (2022) examines China's strategic positioning in lithium geopolitics, demonstrating how China has systematically acquired lithium assets across Latin America and Africa to secure its dominant position in electric vehicle battery supply chains. This analysis illustrates how technology geopolitics intersects with resource geopolitics in ways that give new strategic significance to countries previously peripheral to great-power competition. Hassan et al. (2024) extend this analysis to the broader renewable energy transition, documenting how the shift from carbon-based to renewable energy systems is redistributing geopolitical power in ways that are still incompletely understood

E. Technological Sovereignty and Industrial Policy Responses

Edler et al. (2023) offer a theoretically rigorous analysis of "technological sovereignty" as an emerging frame for innovation policy, tracing its intellectual genealogy and mapping the range of policy instruments associated with it. Their analysis distinguishes between defensive technological sovereignty, aimed at reducing critical dependencies, and offensive technological sovereignty, aimed at establishing leadership positions in emerging technologies. This distinction has important implications for evaluating the proportionality and likely effectiveness of different policy responses to techno-geopolitical competition.

Seidl and Schmitz (2023) examine the European Union's "geo-dirigiste" turn in industrial policy, a shift toward more interventionist, state-directed industrial strategies aimed at securing European technological sovereignty in key sectors. Their analysis

situates EU industrial policy within the broader context of great-power technological competition, arguing that the EU has concluded that passive reliance on market mechanisms is insufficient to secure strategic technological capabilities in an era of subsidized competition from both the United States and China.

Luo (2021) offers a critical counterpoint to techno-nationalist narratives, arguing that the illusions of techno-nationalism, the belief that national technological self-sufficiency is achievable and desirable, systematically underestimate the costs and overestimate the benefits of technological decoupling. Drawing on the example of Huawei's experience under US sanctions, Luo demonstrates that even the most technologically capable firms face severe performance penalties when cut off from global innovation networks—a finding with important implications for policymakers contemplating further decoupling measures.

Table 2. Policy Responses to Techno-Geopolitical Competition by Major Power Bloc

Policy Dimension	United States	China	European Union
Semiconductors	CHIPS Act; export controls on advanced chips	Made in China 2025; self-reliance initiative	European Chips Act; IMEC investment
AI Strategy	National AI Initiative; AI Executive Orders	New Generation AI Plan 2030	EU AI Act; Horizon Europe funding
Digital Platform	TikTok restrictions; CLOUD Act	Great Firewall; platform champions	Digital Markets Act; GDPR enforcement
Energy/Minerals	Inflation Reduction Act; critical minerals alliances	Lithium & cobalt acquisition (BRI)	Critical Raw Materials Act; H2 strategy
Infrastructure	Clean Network initiative; 5G restrictions	Digital Silk Road; Huawei 5G expansion	Digital Compass; open RAN push
Trade/Investment	CFIUS investment screening; export controls	Dual circulation strategy	FDI screening regulation; TSD

***Note**. Synthesized from Seidl & Schmitz (2023); Luo & Van Assche (2023); Schindler et al. (2023)*

Table 2. maps the principal policy instruments deployed by the United States, China, and the European Union across six key dimensions of techno-geopolitical competition. The table reveals both convergences, all three blocs are investing heavily in semiconductor capacity, and divergences in approach, reflecting different institutional arrangements, strategic priorities, and conceptions of the state-market relationship. De Goede and Westermeier (2022) theorize these divergences through the concept of "infrastructural geopolitics," arguing that the weaponization of infrastructure, including digital infrastructure, has become a defining feature of contemporary international competition.

CONCLUSION

This systematic literature review has demonstrated that the geopolitics of technology has emerged as a structural feature of contemporary international relations, reshaping patterns

of great-power competition, trade governance, industrial policy, and digital sovereignty. The US-China technological rivalry constitutes the defining axis of this competition, but the dynamics are genuinely multipolar, with the European Union, middle powers, and developing countries each navigating the techno-geopolitical landscape in distinct ways. Four principal arenas of competition, digital platforms and AI governance, semiconductor supply chains, green energy transition technologies, and technological sovereignty frameworks are jointly reshaping the global political economy in ways that will define international relations for decades to come. For developing countries and emerging economies, the central challenge is to leverage techno-geopolitical competition to secure favorable terms of technological access and development partnership without becoming captive to either technology bloc.

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