



FORESIGHT BRIEF

Geotechnomics

The interaction of geopolitics, technology, and economics

This foresight brief examines the changing balance of global power and influence.

The merging of geopolitics, technology, and economics is reshaping the rules of the international order, and will redefine economics, security, international relations, and values and ethics. The global race for technological dominance and the development of industrial policies are two elements of this shift.

This merger of geotechnomics will cause systemic changes and have implications in multiple policy areas. By reflecting on what might happen in the future, Policy Horizons Canada aims to strengthen decision making within the Government of Canada.

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Introduction

The merging of geopolitics, technology, and economics is reshaping the rules of the international order, and changing the existing balance of power and influence. Geostrategic power is increasingly determined by the ability to develop, control, and exploit frontier technologies. These technologies that are expected to reshape industries and societies, and potentially provide solutions to some of the major global challenges, range from advanced semiconductors to quantum, from biodigital to hypersonic technologies, and from 5G to artificial intelligence (AI) and Big Data.^{1,2,3} Rapid innovation driven by non-state actors amid the lack of global governance structures is creating unprecedented uncertainties.⁴

The widespread presence of dual-use technologies, developed commercially but with the potential for military or other disruptive applications, is leading to a convergence of economic and security concerns.⁵ Technology is both a source of power and a tool to exert power. Technological capabilities not only determine economic and military success, but also play a decisive role in shaping future prosperity and the ability to tackle systemic challenges such as food security, pandemics, and climate change.⁶ The rapid pace of technological advancement in frontier technologies is increasing the urgency and opportunity cost of government inaction.

Prominent actors use their technological superiority to expand their global influence, which ranges from digital dominance to creating strategic dependencies.^{7,8,9} Some countries become indispensable by developing critical capabilities as part of their security strategies.¹⁰ Others rely on foreign providers, finding themselves dependent on technologies that may not reflect their values and interests.¹¹ These technologies are often integrated into critical infrastructure, including transportation systems, energy grids, water supply systems, and telecommunication networks, exposing them to security threats such as cyberattacks and espionage.^{12,13}

Countries, institutions, firms, and people may need to think about the futures that could emerge when geopolitics, technology, and economics intersect and interact. This requires a deep understanding of the **complex dynamics at play, how these forces can reshape our societies, and what strategies and policies may foster resilience, project power, and protect values and interests.**

Failure to develop foresight may lead to critical dependencies and increased vulnerabilities. As such, it is important to examine the changes and the dynamics in various domains of the international order: economics, security, international relations, and values and ethics.

Economics

Industrial policies are coming back around the world.^{14,15} These policies play out differently across various countries depending on their national security considerations, political structures, and capacity for investment.¹⁶ All countries may increasingly have to navigate the trade-off between economic growth, access to technology, and security.

Governments have to decide what technologies qualify as dual-use.¹⁷ They may take control of those technologies from companies, potentially using legal measures previously reserved for national security sectors.^{18,19} Some companies may become highly regulated, quasi-nationalized, or run like utilities.²⁰ Regulations may include bans on investors or board members, export controls, restricted uses, and mandatory security clearances for employees in certain sectors. These regulations may have negative economic implications, such as limiting private capital investment and slowing innovation.

Innovation and high-tech advancements require large up-front and risky investments, but only a limited number of investors are capable of taking on such risks. Limits on potential markets due to export restrictions, sanctions, and embargoes make these investments riskier. This means that governments will be under pressure to hedge their bets to minimize bad investments, while at the same time facing pressure to enact industrial policies that pick winning technologies, sectors, or firms. There is also risk of path dependency: by picking winners, governments may mute market signals that would foster competition and innovation. It is unlikely that any one country can gain a strategic advantage in all areas or exclusive control of one particular frontier technology; countries may need to choose with whom to partner and which aspects of technology to prioritize.

Furthermore, the manifestations of industrial policies across governments may vary based on political systems.²¹ Market-oriented democratic governments must find a balance between the potential for government intervention to create advantage, and keeping their constituents' trust that such investments are economically sound and

impartial. Authoritarian regimes may be less motivated by such concerns and may take a more heavy-handed approach.

The dynamics between economics, security, and technology are likely to continue to evolve and shape industrial policies. As non-state actors could play a greater role in the future, governments and other stakeholders may want to consider what areas can provide a strategic advantage, which could create dependencies on foreign actors, who their allies are, and how they create alliances.

Security

Countries that can develop and control key technologies have a significant advantage in terms of both economic and military power.²² Originally developed for consumer markets and readily available to the public, dual-use technologies like satellites, drones, and facial recognition software are being weaponized.²³ Depending on the user, these technologies could undermine or bolster domestic security, while impinging on privacy and civil liberties.

The proliferation of these technologies makes it difficult for governments to draw boundaries and regulate their use. Traditional arms control regimes, designed to address conventional weapons, are not suitable to regulate emerging technologies.

Policy makers, decision makers, and stakeholders may need to anticipate which emerging technologies are most likely to have dual-use applications and how to respond quickly to new security threats.

International relations

Technological competition is changing the rules of international engagement and reshaping alliances among actors: those that can develop new technologies, those that can purchase them, and those that can do neither.^{24,25,26} Corporations that drive technological advancements, including in many dual-use technologies, are emerging as key non-state actors in the geopolitical sphere.^{27,28} New global governance structures may emerge and engage non-state actors.

To compete in this ever-changing global landscape, countries must not only be able to innovate and produce at scale, but also access strategic assets such as critical minerals, semiconductors, biochemical ingredients, and big data.²⁹ This may require cooperation between countries with divergent values.³⁰ Governments may have to engage in a continuous process of discovery, as what is strategically important today

may not be so tomorrow. They must also anticipate the possibility, even if low in probability, of losing cooperation with countries that supply essential or strategic goods.³¹

The pursuit of strategic advantage is also taking place amid a growing trend of deglobalization and protectionism.^{32,33,34} The ongoing high-tech decoupling between different economies is creating further uncertainty about the future path of globalization, particularly in the digital realm.^{35,36} The escalating race for technological domination and geopolitical influence between Chinese, American, and European systems, for example, may culminate in the establishment of disparate blocs with limited opportunity for collaboration.³⁷ Countries in one bloc may be excluded from innovations and advancements in other blocs.

In this context, countries might need to consider how to cooperate on transnational wicked problems. Moreover, new technologies that are inoperable across different blocs could limit collaboration by design. Policy makers, decision makers, and stakeholders might also need to consider how new global governance structures that incorporate non-state actors might look.

Values and ethics

Technologies are often embedded with the biases or values of those who develop them.³⁸ This may be unintentional, or intentional with the explicit aim of exerting political or economic power and influence. For instance, AI is trained on data selected by the developer and may reflect the biases of the data source.³⁹ When countries import technologies, they may inadvertently import undesirable values too.

Control over data is increasingly important for economic leadership and geopolitical influence, often leading to a pursuit of protectionist data regimes and digital governance frameworks.⁴⁰ The nature of existing data regimes in the United States, China, and the European Union vary significantly. The United States is primarily driven by economic considerations; China is focused on protecting state interests; and the European Union prioritizes safeguarding the interests of its people.⁴¹ In the absence of global norms, these ecosystems are unlikely to converge and may form a digital iron curtain.^{42,43,44}

There is also growing tension between the need for open research and the protection of innovation. Research institutions may have to choose with whom they work and collaborate. They also need to consider how their output might be used or

potentially stolen. This may increase the time horizon and cost of innovation, and limit access to cutting-edge technologies and opportunities for collaboration across borders.

Policy makers, decision makers, and stakeholders may need to identify biases embedded in technology, and which of these might be most harmful to their values and interests. They may also have to explore the feasibility of developing minimum ethical standards.

Conclusion

Technology is transforming the rules of the geopolitical game. Its intersection with power politics and economics has amplified uncertainty, challenging conventional assumptions about the future of the international order.

Today's fast-evolving global landscape and technological innovation require us to reassess the way we understand the international order, and our expectations about its future. The fluctuating interactions between these domains are resulting in systemic changes in the distribution of power and influence, which could have far-reaching policy implications. Strategic foresight⁴⁵ can help anticipate possible outcomes.

Policy makers, decision makers, and stakeholders may need to consider key questions, including: Where will power be concentrated? Who will the main actors be? What global or regional governance structures may emerge around technology? What role might Canada play in the global race for technological dominance? Which Canadian industries may gain strategic importance in the rapidly evolving global landscape? How might these changes affect the everyday lives of people in Canada? What course of action would best advance Canada's interests?

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Endnotes

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