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SYNOPSIS

This article examines how accelerating civilian technological innovation, blurred dual-use boundaries, and expanding national industrial policies are reshaping the global landscape amid heightened geopolitical tensions. Export controls, incomplete dominance in key industrial sectors, and interdependent supply chains are creating serious challenges for major powers and generating significant risks. In response, all nations must build resilience by balancing security concerns with forward-looking societal development to better prepare for the challenges ahead.

COMMENTARY

For decades, "dual-use" has been a commonly adopted tool for both regulating exports and protecting a country's military advantages. However, its meaning, scope, and specific policies have been evolving swiftly, especially in recent years. In line with the rapid development of numerous high-tech areas and the escalation of geopolitical tensions, many civilian innovations, as well as previously commercially driven endeavours, are now included under the national security priority.

In 2004, a dispute over large civil aircraft between Airbus and Boeing led the EU and the US to pursue trade retaliation at the WTO. This 17-year conflict is a well-documented example of how the dual-use landscape has evolved. In 1992, the US and the European Communities agreed on the Bilateral Agreement on Trade in Large Civil Aircraft, establishing rules for government support and balancing US grants for its industry against repayable loans to European manufacturers.

In 2003, Airbus outsold Boeing in the large civil aircraft category for the first time. In response, the US renounced the 1992 Bilateral Agreement and filed a WTO

complaint, claiming that Airbus received illegitimate state assistance. The EU retaliated with a similar case against US subsidies to Boeing.

After years of proceedings, in 2019, the WTO authorised nearly US$7.5 billion in US countermeasures. In October 2020, the EU, pursuing its own WTO-aligned case, imposed about US$4 billion in retaliatory tariffs on US aircraft and selected food and beverage products.

In 2021, when the state-owned Commercial Aircraft Corporation of China, Ltd (COMAC) rolled out the C919, Airbus's CEO opined that the Airbus-Boeing duopoly could become a triopoly by the end of the decade. With the industry shifting, both the US and European companies had fewer incentives to keep fighting yesterday's battles, leading them to agree on a five-year truce suspending the tariffs.

Historically, major innovations, from the steam engine to the airplane, often began as private efforts that were later put to military use. The same pattern can be seen in many recent technological areas, such as drones, mobile phones, and electric vehicles.

In contrast, the development of the Internet, spaceflight, satellites, and supercomputers was largely government-led. Today, large companies fund frontier technologies such as AI and semiconductors on a scale comparable to government, sometimes in partnership with governments. Consequently, the lines between military and civilian – as well as between public and private R&D – have become increasingly blurred.

Evolution and Popularisation of Industrial Policies

To understand these dynamics, it is useful to review how countries' industrial policies evolved.

In the US, the Independent Research and Development (IR&D) framework, dating to the 1930s, allowed companies to pursue R&D of interest to the Department of Defense (DoD) as an allowable cost. Firms such as Boeing, Lockheed Martin, GE, and Pratt & Whitney were encouraged not only to sell to the DoD but also to conduct additional R&D for future needs, with indirect government support through overhead reimbursement. Because many aerospace and defence products were dual-use, IR&D support could benefit both the military and civilian sectors, which sometimes contributes to international disputes.

As geopolitical tensions rise, governments, especially in advanced economies, have responded with new industrial policies. In the US, the CHIPS and Science Act and the Inflation Reduction Act (IRA) have allocated hundreds of billions of dollars to restart or strengthen strategic industries. Alongside expanded export controls, the US is reshoring semiconductors, clean energy, drones, and related sectors, while restricting China's access to frontier technologies such as AI, advanced chips, quantum computing, and biomedicine.

China's long reliance on industrial policy guided by five-year plans and initiatives such as Made in China 2025 has involved both central and local governments, with mixed results. In the 1980s, early reforms loosened state control, which unleashed market forces, stimulated innovation, and removed structural barriers, aided by special economic zones along the coast. Of the original four zones – Shenzhen, Zhuhai, Xiamen, and Shantou – Shenzhen has outperformed the others by far, benefiting from its proximity to Hong Kong and a strong consumer-focused industrial base.

The EU has also launched active industrial policies, most notably the Clean Industrial Deal, which allocates more than US$170 billion for industrial transition and clean technologies, with an emphasis on green industrial sovereignty and the security of critical raw materials. The progress and outcomes of these initiatives remain subjects of debate within and beyond the EU.

In many cases, governments have helped develop and scale major industries. TSMC (Taiwan), Airbus (EU), and Hyundai and Samsung (South Korea) received early support such as funding, tariff preferences, and technology assistance, and later benefited from low-cost financing, export aid, and diplomatic backing. While the form and intensity of support differed by country, governments repeatedly acted as risk-takers and planners, enabling firms to compete with established global leaders. Overall, industrial policies have been central to building globally competitive companies tied to national development strategies.

Clearly, not all industrial policies succeed. Effective ones require strong execution, financing, regulatory frameworks, and a dynamic ecosystem that facilitates and accelerates the development of strategic and emerging industries. Nevertheless, industrial-policy measures worldwide have surged over the past decade or two: Morgan Stanley estimated that the number of measures roughly doubled in the 2010s, and by 2023, three-quarters of major economies had introduced trade and industry-oriented interventions, reversing earlier globalisation-era norms that downplayed them.

Civilian Innovation for National Security

Industrial policy is growing in importance for several reasons. First, civilian technologies are advancing rapidly and converging across sectors, such as chips, materials, device miniaturisation, AI/data analytics, and advanced lower-cost manufacturing, each reinforcing the others. Second, military and civilian boundaries are blurring, as exemplified by personal drones. Third, funding is plentiful, driven by ultra-wealthy entrepreneurs and governments' willingness to invest.

Industry consolidation typically follows a cycle: early fragmentation, rapid growth and expansion, intensified competition, and eventually an oligopoly of a few major players. Sectors such as automotive, aerospace, semiconductor manufacturing, solar, and wind energy have repeatedly illustrated this pattern. For today's growth sectors like AI and chips, green transportation (ground, air, and water vehicles), robotics, eVTOLs, and low-earth-orbit satellites, similar consolidation is likely. However, this time, national interests and geopolitics are key drivers.

Fast-moving civilian innovation with national security implications, combined with likely consolidation of players in critical sectors, poses high stakes and significant risks for every nation, especially the leading ones.

Implications

The above points have several significant implications.

1) Industrial policy, dual-use regulation, and export control are shaped by each country's immediate interests and desires to secure their future advantage. Consequently, little meaningful international agreement can be expected.

2) No country currently holds a competitive advantage across all or even most critical technological areas. In view of the complex, interlinked supply-chain relationships spanning raw materials, processed parts, components, sub-systems, and finished systems, decoupling across these critical areas is neither realistic nor productive. Attempts to do so only increase friction and mistrust. These trends are unlikely to decline soon.

3) Many rapidly advancing technologies originated in civilian endeavours but are now subject to growing concerns related to national security. Yet attempts to deny perceived adversaries' access to these technologies are proving extremely challenging and problematic, and have triggered strong counter-measures.

4) Like-minded countries with compatible strategic interests are seeking to align their policies and form blocs. Resource rich countries, particularly those with critical minerals, are also being actively courted by states reliant on such resources. But countries that neither seek global dominance nor possess strategic resources, particularly those still pursuing development, are feeling the squeeze. As rivalry intensifies, the international order itself is being distorted.

5) Trade disputes have spilled over into everyday life and commerce. Tit-for-tat tariffs on goods like soybeans, beef, and wine now exist alongside restrictions on computer chips, electric vehicles and rare-earth minerals. The US is pursuing "managed trade" to safeguard supply chains and jobs, but replacing Chinese-made components is not easy. Meanwhile, China faces growing challenges in attracting US investment to offset its domestic slowdown. Geopolitical barriers are causing the advancements in AI, space, and related critical areas to be divided between the US and China, which affects other countries' participation and future development.

Going Forward

A balance is needed between great-power rivalry and development opportunities for others. Satellite orbits, for example, require global consideration, as no system operates solely over a single country. The world needs a more inclusive, pragmatic framework so all nations can grow in ways suited to their circumstances.

All states must build resilience in a fracturing global environment: There is a need to strengthen critical thinking, enhance science and technology competence, invest in R&D, and ensure that universities, industries, and not-for-profit organisations are included in a diverse, innovative ecosystem. Because innovation is inherently unpredictable, there are no shortcuts. Wealth inequality, which persists and is worsening across societies, must be addressed as a high priority.

Frontier innovation is well underway among a handful of nations and is highly competitive. However, no country can afford to remain on the sidelines; if it does not secure a front-row seat now, the window to participate may soon close.

Professor Wei Shyy is a Chair Professor at the Hong Kong University of Science and Technology, Guangzhou [HKUST(GZ)], and a former president of HKUST. He is an internationally recognised expert in aerospace engineering and higher education. He is a Fellow of the AIAA and ASME, an Academician of Academia Sinica, and a recipient of numerous international honours, including France's Officer of the Legion of Honour and, recently, the 2024 Meir Hanin International Aerospace Prize. Professor Shyy will deliver the S. T. Lee Distinguished Annual Lecture titled "From Low Altitude to Low Earth Orbit – Access, Rivalry and Resilience" on 23 April 2026, organised by the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), Singapore.

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