



Export Control and Emerging Technology Control in an Era of Strategic Competition

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Cover image: Shutterstock 1958033443: Newton's cradle. Balls with the state symbols: China, USA, Russia, European Union, United Kingdom. 3d rendering

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Introduction

The nature of export controls is changing. In recent years, the export control landscape has been evolving as a result of strategic competition between the United States and China. However, Russia’s invasion of Ukraine on 24th February 2022 had an instant catalyzing effect on the evolution of export controls. While in recent decades export controls have been relatively geopolitically neutral tools aimed at preventing Weapons of Mass Destruction proliferation and preventing WMD terrorism, the tools are evolving to become a central instrument through which the US and allies are seeking to stem the development of advanced military capabilities in an emergent China and a revisionist Russia. An important aspect of this relates to so-called emerging and foundational technologies.

The purpose of this article is to provide an overview of changes taking place in relation to export controls, particularly from a US perspective. The article focuses on the issue of emerging technology. However, in the context of the targeted export control measures adopted by multiple countries against Russia following its invasion of Ukraine, this article also examines the broader context of the evolution of controls. The article briefly examines the future of multilateral export controls and argues that the measures adopted against Russia may provide the foundation for a new form of export control coordination. The article identifies specific tools that states should adopt and also emphasizes emerging technologies that should be considered for control in the context of strategic competition.

What Are the Implications of Strategic Competition for Export Control?

Before turning specifically to the question of emerging technology control, it is useful to set out how strategic competition is affecting export controls. During the Cold War, export controls were largely polarized along East-West lines, with, for example, western countries grouping together under the now-defunct COCOM export control regime specifically to manage the security-related risks of trade with Warsaw Pact countries.¹ Since the end of the Cold War and the demise of COCOM in 1994, export controls have not been directed at any specific country or group. Instead, the purpose of multilateral export control has been to provide a neutral framework through which subscribing states can coordinate control on potentially sensitive trade where this trade could contribute to destabilizing accumulations of arms, WMD, or terrorism. While there are certain presumptions of denial around specific technologies which are linked to a clear end use of concern (i.e., ballistic missiles and ballistic missile production facilities), multilateral export controls could not be said to be aimed at any particular country.

Instead, it is a separate instrument – sanctions – that has been used to target specific countries and actors of concern. The sanctions that have been developed have generally built on the ‘targeted sanctions’ rubric developed at the UN in the 1990s. Targeted sanctions seek to prevent specific actors of concern from pursuing a specific activity of concern through a number of tools such as by preventing their access to the financial system or preventing the actor from acquiring controlled technology.²

Strategic competition is driving a new approach to export controls which is less country agnostic than the controls of recent decades and which looks more like sanctions. In recent years, the China challenge has driven the evolution of export controls at the national level in many countries. China, in turn, is taking reciprocal measures intended to counter US export controls. In 2021, China adopted its first criminal export control law which expressly included measures intended to counter the other country’s abuse of export control laws

¹ See, for example, Cupitt, Richard T., and Suzette R. Grillo. “COCOM Is Dead, Long Live COCOM: Persistence and Change in Multilateral Security Institutions.” *British Journal of Political Science*, vol. 27, no. 3, Cambridge University Press, 1997, pp. 361–89, <http://www.jstor.org/stable/194122>.

² On targeted sanctions, see, for example, Drezner, Daniel W. “Sanctions Sometimes Smart: Targeted Sanctions in Theory and Practice.” *International Studies Review*, vol. 13, no. 1, Wiley, 2011, pp. 96–108, <http://www.jstor.org/stable/23016144>.

in a way that could harm China's national security.³ China expressly seeks to indigenize the production of many strategic technologies through its 5-year science and technology plans, aiming to reduce reliance on foreign suppliers. The United States regularly highlights that China operates a strategy known as 'Military Civil Fusion' through which any actor in China – be it state or non-state – can be compelled to assist in strategic technology indigenization.⁴

Additionally, overnight, the Russia challenge became more urgent and pressing as a result of Russia's invasion of Ukraine in February 2022. Almost as soon as the invasion started, the United States announced that it would adopt new restrictions on the transfer of US-origin dual-use technology to Russia and that many additional countries would take parallel steps including the European Union, Australia, Japan, Canada, New Zealand, the United Kingdom, and Taiwan.⁵ The specific provisions being adopted by the US and other countries include presumptions of denial or outright prohibitions for exports of listed dual-use items to Russia, prohibitions on exports to military end users in Russia, and prohibitions on exports related to specific sectors, including some emerging technology sectors.⁶ The US provisions also include elements aimed at preventing transfers of US-origin technology situated in third countries. The sectors included semiconductors and communications technology.⁷ Finally, the US also added many Russian entities to its entity list which imposes additional restrictions on exports.

Export controls are thus becoming more country specific due to strategic competition. This, in turn, also carries important implications for the nature and scope of controls as well as their ability to effectively address the challenges posed by states that work to systematically undermine and evade controls.

³ See for example, "China's Export Controls, The State Council Information Office of the People's Republic of China, December 2021, First Edition 2021". Available online at: <http://www.scio.gov.cn/m/zfbps/32832/Document/1718303/1718303.htm> (Accessed 1 February 2022)

⁴ See for example, "Military-Civil Fusion and the People's Republic of China". US Department of State. Available online at: <https://www.state.gov/wp-content/uploads/2020/05/What-is-MCF-One-Page.pdf> (accessed 1 February 2022)

⁵ <https://www.whitehouse.gov/briefing-room/press-briefings/2022/02/24/press-briefing-by-press-secretary-jen-psaki-and-deputy-national-security-advisor-for-international-economics-and-deputy-nec-director-daleep-singh-february-24-2022/>

⁶ <https://www.commerce.gov/news/press-releases/2022/02/commerce-implements-sweeping-restrictions-exports-russia-response>

⁷ *ibid*

Multilateral Export Controls?

This strategic competition is also driving a reconsideration of how multilateral export control *should* work. Presently, multilateral export control is coordinated through the four main multilateral export control regimes: the Nuclear Suppliers Group, the Wassenaar Arrangement, the Missile Technology Control Regime, and the Australia Group. These regimes have become fixtures of the international landscape in recent decades even though they have been criticized in the past, in part due to the exclusivity of their membership. It should be kept in mind that China and Russia are members of the Nuclear Suppliers Group and Russia is a participant in the Missile Technology Control Regime.

The fundamental question in relation to multilateral export controls is whether these regimes can be effective at coordinating controls when Russia and China are participating members. If not, should a new regime be created or can ad-hoc coordination among like-minded countries be effective? Prior to Russia's invasion of Ukraine, there was quiet discussion of the possibility of creating a new regime to coordinate the implementation of controls on emerging technology in the China context, in particular. The international response to the Russian invasion of Ukraine included a commitment by more than 30 countries to adopt similar export control measures specific to Russia, thus creating a *de facto* group of like-minded countries in the Russia context. The conversation will naturally turn to how best to efficiently coordinate the implementation of these measures, including through common interpretations and understandings; something that would usually fall to an export control regime. In this context, some have called for Russia's expulsion from the Wassenaar Arrangement or, if that is not feasible, the creation of a new regime among like-minded countries.⁸

There may also be other mechanisms that will be considered. For example, China put forward a General Assembly resolution in 2021 on “Promoting International Cooperation on Peaceful Uses in the Context of International Security.”⁹ Many western states voted against the resolution on the basis of

⁸ Discussion with Emily Kilcrease, Center for New American Security, 28 February 2022

⁹ “The 76th UNGA First Committee Adopted Resolution Promoting International Cooperation on Peaceful Uses in the Context of International Security”, Ministry of Foreign Affairs, People's Republic of China, 4 Nov 2021. Available online at: https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/jks_665232/kifywj_665252/202111/t20211104_10442353.html (Accessed 4 March 2022)

both procedural and substantive concerns.¹⁰ However, China's purpose in proposing the resolution was clear; China recognizes that export controls are being adopted to counter China's strategic technology indigenization efforts.¹¹ The resolution seeks to introduce a UN mechanism to advise on export control matters which could, in the long term, result in a shift of focus on export controls from the multilateral export control regimes to a UN-based mechanism.¹² While this initiative did not receive universal support, it does highlight that some states believe that more universal instruments are needed to manage strategic technologies on a global basis.

What States Should Do

Regardless of the question of through which forum to coordinate export control policy, it is clear that strategic competition is resulting in an evolution of controls, including with regards to what is expected of states. States will come to their own views on strategic competition and how the state should position itself. Nonetheless, states should ensure that they at least have instruments, systems, and processes to provide visibility of potentially problematic transfers or cooperation with states of potential concern, even if they ultimately decide to approve transfers. The underlying purpose of export controls is to provide a framework through which to assess and manage risk.

The toolset needed to monitor and manage strategic trade is different now than it has been in recent decades when the principal threats were non-state actors and so-called 'rogue states' such as Iran and North Korea. Particularly in the case of China the country is so integral to the global market and supply chains that controls must be carefully calibrated so as not to unduly harm the implementing state. The specific trends and tactics of strategic technology acquisition in an era of strategic competition include, but are not limited to, the following:

- Procurement of equipment, material, and technology

¹⁰ "Explanation of Vote Delivered by Ambassador Linda Thomas-Greenfield on Draft Resolution L.55, "Peaceful Uses in the Context of International Security", United States Mission to the UN. 2 November 2021. Available online at: <https://usun.usmission.gov/explanation-of-vote-delivered-by-ambassador-linda-thomas-greenfield%E2%80%AFon-draft-resolution-l-55-peaceful-uses-in-the-context-of-international-security/> (accessed 4 March 2022)

¹¹ Interview with Fu Cong, Director General Arms Control and Nonproliferation, China Ministry of External Affairs, 2 March 2022

¹² *ibid*

- Buying out of companies and the transfer of their technology and production lines to China
- The hiring of international staff to work in China on, for example, running production lines for strategic technology
- Cybertheft of export-controlled information and other data
- At least in the case of Russia, use of front companies to acquire western-origin materials for programs of concern.

In this context, there is a growing expectation that states should:

- Enact a military end-use control. Such controls allow the state to stop transfers of even unlisted technology when destined for military end uses of concern. Globally, the existence of military end use controls has generally lagged behind WMD end use controls, perhaps because the latter is an expressed requirement of UNSCR 1540. For example, it was not until December 2021 that the United Kingdom had a military end use control that could be used in the China context.¹³
- Promulgate lists of entities connected to strategic programs of concern. This may include authorized arms manufacturers, as well as state-owned enterprises and research institutes linked to programs of concern.
- Set out standards for cybersecurity of export-controlled information that technology holders and exporters must meet. Presently, few countries address the cybersecurity of export-controlled information.¹⁴
- Ensure nonproliferation controls are being implemented in universities and research institutes.

Additionally, states should consider implementing vetting and deemed export controls in pursuit of this objective. Presently, many countries do not have adequate controls in place to safeguard sensitive technology held in universities and research institutes which are hotbeds for innovation in both the private and public sectors. Furthermore, in many countries, these actors have not been adequately engaged regarding export controls by their governments.

¹³ See for example, “NTE 2021/14: updates to the export control regime”, Department of International Trade, 8 December 2021. Available online at: <https://www.gov.uk/government/publications/notice-to-exporters-202114-updates-to-the-export-control-regime/nte-202114-updates-to-the-export-control-regime> (accessed 1 February 2022)

¹⁴ CNS currently has a project focusing on this issue and will provide further commentary on this topic in the future.

Emerging Technology Specific Considerations

Addressing the points above would provide a solid foundation for governments to manage strategic trade in an era of strategic competition. However, in relation to emerging technologies there is a need to enact controls on specific types of technology. CNS has identified a number of recommendations in this context from its ongoing research.¹⁵ The suggestions below are separate from initiatives being undertaken by the US, EU, and in the export control regimes.

Artificial Intelligence: The term Artificial Intelligence is a misnomer as generally what is meant is machine learning. Machine learning can be used to make predictions about any subject provided that an appropriate library is fed appropriate training data. The libraries used to train models (i.e., TensorFlow) are open source and the hardware used for training algorithms are relatively generic and ubiquitous. Given this, while there are many ways in which machine learning can be misused, CNS research suggests that the focus of control should be on training data and the trained models where either of these has been developed in relation to specific military or WMD end uses. Some countries may go further in controlling these in relation to human security considerations (i.e., facial recognition, etc.). The potential elements to be controlled are thus as follows:

- The training data where the training dataset was designed to address a specific military or WMD-related end use. For example, the identification of tanks from aerial reconnaissance video streams.
- The trained model resulting from use of such training data. The model will typically be one or more computer files.

While many machine learning models can be deployed on generic computer hardware, for certain systems custom hardware is developed. For example, Tesla has designed its own hardware for running its machine learning model in Tesla cars. For many military deployments of machine learning, it is perhaps likely that custom hardware would also be designed. For example, a military aircraft where the hardware must be designed to meet the operating and environmental considerations associated with the aircraft. As such, CNS research suggests that hardware specifically designed for running machine learning algorithms in military systems be subject to control.

¹⁵ Note: this is a list derived from ongoing CNS research and should not be considered complete; it may be updated in the future.

It is likely that some applications of machine learning to military end uses already falls within the scope of military export controls, which apply also to software and libraries associated with many controlled items. However, as the nexus of the machine learning sector is largely separate from the defense sector, there is value in tailoring controls to the machine learning domain.

High-Performance Computing:¹⁶ High-performance computers – or supercomputers – are generally carefully designed and connected to standard computer cores. Supercomputers can use either CPU core or GPU cores – versions of which can be found in every PC or laptop. Large numbers of either or both types of cores are interconnected to achieve the required performance characteristics. There is thus nothing particularly unique in the processing hardware of supercomputers, but factors that do not relate directly to the processor hardware such as network latency, energy use, and cooling are among the main factors that must be considered. In this context, there are two principal modalities through which a supercomputer transfer could occur. First, many CPUs, GPUs, or a type suited for use in a supercomputer could be acquired by an actor in a country of concern. Second, a company could be contracted to design and build a supercomputer, perhaps to include the sourcing of computing cores. The provision of either of these services should be controlled such that scrutiny can take place on the entities and the end uses to which the supercomputer will be put.

Semiconductor: Presently only two companies – Samsung (headquartered in South Korea) and TSMC (headquartered in Taiwan) can produce small feature size (sub 10nm) semiconductors at a commercial scale. While there are several barriers to this, one main barrier is the need for precision specialist production equipment which is only manufactured by one company – ASML in the Netherlands. In the absence of this, countries such as China and Russia must procure finished devices or outsource the manufacturing of sub 10 nm to these companies. Given this, relevant government actors should scrutinize the export of semiconductor manufacturing equipment, material, and technology to China and Russia with the purpose of building assurance that produced semiconductor devices cannot be used for military or strategic purposes in those countries. Additionally, they should closely examine the provision of semiconductor manufacturing services and the export of semiconductor

¹⁶ Note: CNS is also examining quantum computing to provide recommendations soon.

devices to ensure that they are not inadvertently used for military and strategic uses.

Aerospace and Space: A particularly prominent aspect of the new era of strategic competition has been the high-profile testing of novel weapons systems such as hypersonic missiles. For example, a Chinese July 2021 test captured world headlines.¹⁷ However, it is not only China that is testing such novel weapons systems; Russia has been experimenting with a nuclear-powered cruise missile and the United States is working to develop and deploy various hypersonic systems. CNS research highlights that a particular challenge in the context of China is the lack of separation between the entities involved in the military program and the civil space program. Given this, countries should ensure they have adequate mechanisms in place to review all cooperation with space-related entities in China. This could include an expressed callout in the military end use controls or publication of a list of Chinese space-related entities. End use controls are instruments that allow states to stop any transaction when it involves an end use of concern, whether the item or technology appears on the export control list or not. Presently while many countries have WMD end use controls, few have military end use controls.

Composites: It is not correct to call composite materials an emerging technology as materials such as carbon fiber are used for a wide variety of civil and military uses. Nonetheless, the importance of composite materials to many cutting-edge military capabilities results in a need to prioritize the effective control of certain types of composite material. Presently, there are few countries or companies with the capability to manufacture carbon fiber filament which makes the material a particularly important ‘chokepoint’ technology. As a result, countries should consider carefully whether to export carbon fiber production equipment to countries of concern, including China, where the equipment would raise the country’s capability to develop higher performance carbon fiber including for military purposes. Additionally, countries should examine what steps can be taken to control the provision of expertise and know-how to these production facilities. CNS research has highlighted instances in which China has sought to recruit foreign staff to run carbon fiber production facilities.

Genomics: The biological domain is undergoing substantial evolution at present which will carry many implications for export controls. There is a need

¹⁷ Financial Times, “Chinese hypersonic weapon fired a missile over South China Sea”, 21 November 2021

to safeguard genomic information. Such information is presently widely transferred in insecure ways including to entities in countries of potential concern. Such information can potentially be misused, including developing genetic weapons that target specific populations. Mechanisms to allow for scrutiny of transfer of such data are thus essential. Furthermore, cybersecurity standards for such data are also important considerations.

Conclusion

The export control landscape has changed markedly. In recent years, the principal driver for this has been concern about an emergent China. However, in the context of Russia's invasion of Ukraine, new approaches to export controls were adopted almost overnight. States such as China and Russia have been working to indigenize strategic technologies and utilize novel technologies for strategic and military uses for many years. Given the national imperative of strategic technology acquisition in these countries, it can be expected that these states will pursue all necessary approaches to acquire technologies for these ends. China and Russia can also be expected to increase cooperation to avoid being constrained by western export controls. Strategic competition may also require a rethinking of the purpose of multilateral export control regimes. There is a paradoxical desire among states for more inclusive regimes while in parallel there is a perceived need to coordinate controls without China and Russia in the room. This tension will impact the evolution of the multilateral export control regimes in years ahead.

In the context of strategic competition, there are specific additional technology acquisition modalities that are being observed and that must be addressed through an updating of controls regardless of whether governments would ultimately authorize (i.e., issue a license) the transaction. This, in turn, results in specific areas where controls should be strengthened such as military end use controls and controls in universities. Finally, there are specific areas concerning several emerging technologies where it would be advantageous to strengthen control. The process of identifying such areas is likely to be an ongoing one resulting in a need for a continuous process to monitor emerging technologies and the nuanced ways in which such technologies are acquired.

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