CHINA-RUSSIA COOPERATION IN ADVANCED TECHNOLOGIES: THE FUTURE GLOBAL BALANCE OF POWER AND THE LIMITS OF 'UNLIMITED' PARTNERSHIP

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Executive summary

Advanced technologies are a key factor in the evolving international balance of power. The United States-allied group of states, including Australia, are still generally technology leaders. But the People's Republic of China (PRC) is making major gains in some fields, spurred by growing pressure on its access to foreign technologies. What impacts might the PRC's cooperation with Russia have on this equation?

This report provides an overview of Sino-Russian collaboration across four broad fields:

- Telecommunications, artificial intelligence and cyberspace;
- Machine tools, 'fourth industrial revolution' applications and microelectronics;
- Defence-oriented technologies; and
- Uses of outer space.

These fields are all consequential for next-generation technologies that will increasingly shape national capabilities and the world's escalating 'geo-technological' competition.

Key takeaways include:

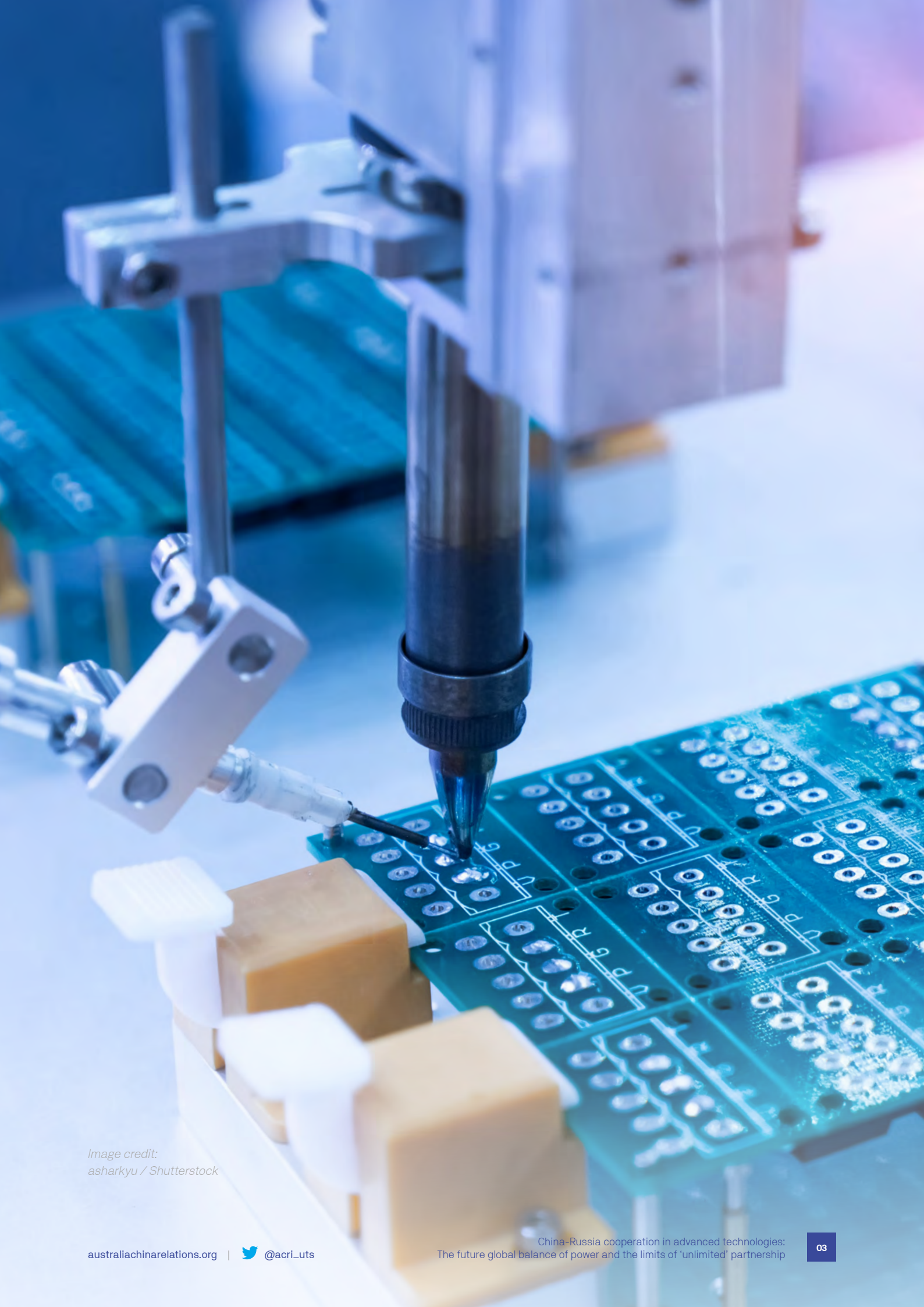
1. PRC collaborations with Russia in all these fields are often less deep than suggested by official descriptions. They are also frequently outweighed by the benefits the PRC receives from collaborations in the same fields with US-aligned advanced economies.

2. Increasingly, Russia is exchanging legacy knowledge for growing PRC strengths, raising questions about the sustainability of these collaborations. Russia's invasion of Ukraine has also imported risk into technology collaborations from the PRC's viewpoint, in particular being caught up in sanctions levelled against Russia by the US-aligned advanced economies. The PRC may circumscribe bilateral exchanges with Russia to reduce the risk of further constraints on PRC access to economic opportunities and technology from the US and its allies, though this will become less important the further that these countries' 'decoupling' from the PRC proceeds.

3. There are, however, cases where Russian strengths provide the PRC with technological resources hard to obtain elsewhere. And there remains a strategic logic driving Sino-Russian cooperation, in technology specifically, and more broadly. This stems from mutual threat perceptions towards the US and its allies, and the imperative for Beijing and Moscow to boost their separate positions in this strategic competition. With Sino-US hostility now seemingly implacable, Beijing will not abandon a nation that provides its only counterweight to US-led coalitions.

Sino-Russian technology collaboration must, therefore, be monitored for potential adverse flow-on effects to Australian interests. Judgements about how far this collaboration might extend need to be arrived at critically, factoring in the limitations imposed by the PRC's own varied interests. Faced with expanding US and US-led controls targeting PRC access to foreign technologies, there is no prospect of Beijing pursuing an 'unlimited partnership' with Putin's Russia in practice.

Nevertheless, the rise of the PRC's own technological capability and the influence this gives Beijing worldwide, especially in Australia's own region, remains the most important factor changing Australia's strategic environment. For some strategic technologies, partnership with Russia may help the PRC at the margins in competition with the US and its allies, even as Russia generally falls further behind the global technological frontier.



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01

Introduction: Interpreting the PRC-Russia relationship and technology cooperation

Much political commentary today portrays a global 'axis of authoritarianism' in which the People's Republic of China and Russia are the major actors, opposed to the United States and its allies. This frame for understanding Sino-Russian cooperation, which highlights the internal political features of each country, was reinforced by the rhetorical 'unlimited partnership' announced by Beijing and Moscow just before the latter's attack on Ukraine in February 2022. Such a frame suggests interpreting PRC and Russian cooperation as a top-down joint enterprise to reshape the world to fit shared ideological preferences.

In fact, this relationship shows few features of a shared political project or an 'alliance' on the model of US security partnerships. Post-Cold War cooperation between the PRC and Russia began soon after the USSR's collapse, with a 'strategic partnership' announced under Boris Yeltsin's presidency in 1996. It long predates either Vladimir Putin's or Xi Jinping's autocratic leadership, having developed over the better part of three decades despite persistent mutual suspicion and conflicting interests.[1]

Fundamentally, this cooperation aims to maximise both states' strategic options towards their perceived primary threat: the US. This is especially true where advanced technologies are concerned. As Xi Jinping himself put it, the PRC's greatest danger lies in 'core technologies' being under the control of others, referring to the US and its allied countries.[2] The technological lead of these advanced industrial states in many industries and military applications is a critical national security problem from a PRC or Russian viewpoint.

This logic has been reinforced by both countries' growing tensions with the US-allied group of states, increasingly expressed through restrictions on commercial and technological exchange. Following sanctions imposed on Russia due to its annexation of Crimea in 2014, the Kremlin reportedly conducted a comprehensive review of Russia's relationship with the PRC and concluded that the risks entailed by closer engagement were tolerable and outweighed by the benefits to Russia's overall international position.[3] Subsequently, links between the two countries have substantially thickened. This has included Russian adoption of PRC-provided information technology and initiation of bilateral state-led technology development projects.

The PRC's commercial and technological links with the US and its allies also began coming under pressure from the start of the Trump administration, driving the broadening and institutionalisation of Sino-Russian science and technology (S&T) cooperation. This is now spread across numerous personnel exchanges, joint 'Techno-Parks' and joint investment funds for promoting S&T development.[4] During the 'China-Russia Year of Scientific and Technological Innovation' of 2020-2021, the two sides initiated a wide range of activities, including PRC involvement in a Russian nuclear science mega-project (NICA), with bilateral cooperation described as having moved beyond basic research into applied research and industrialisation.[5] The joint statement issued during Vladimir Putin's visit to Beijing in February 2022 made frequent mention of S&T, including as a priority for exchanges among the BRICS states.[6]

Cooperation has increasingly taken the form of Russia exchanging legacy technology and expertise for PRC markets and products, the fruits of the PRC's integration into the globalised economy being on a completely different scale to post-Soviet Russia. But even as Russia's industrial and technological development has generally stagnated, it has continued pushing the frontier in some military niches. As a rule, in defence-related technologies Moscow can still offer significant value-add to Beijing, while in commercially oriented fields the benefits increasingly flow from the PRC to Russia, raising questions about the sustainability of many specific collaborations as their value to the PRC diminishes.

For the time being, however, expansion of Sino-Russian technological cooperation is a core dimension of the bilateral partnership, which will increasingly provide a barometer of the wider relationship's development.[7] Strategically, it is directed against the US, aiming to equip both countries to resist US-led pressure on their access to advanced technologies in general, and to improve their odds in the race to develop military and space technologies particularly. Deepening US-PRC hostility and sanctions on Russia following its invasion of Ukraine mean that closer Sino-Russian integration raises risks

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for other countries linked to the PRC's economy, in the context of a US-PRC political relationship that has deteriorated for years and seems set for permanent antagonism.

Because the Sino-Russian partnership is grounded in grand strategic calculations, it is unlikely to be jettisoned due to the war in Ukraine, although the war's course and outcomes may shape the relationship's scope.[8] For the PRC, the benefits of technological cooperation with Russia have diminished as its own capabilities have improved. But these benefits remain significant enough, and the wider partnership with Russia remains strategically important enough for Beijing to have made clear it will continue cooperation despite the elevated risks.[9] While the 'unlimited partnership' announced during Putin's last visit has proved to have significant limits, there is no sign that PRC leaders have changed their minds over the basic need for the partnership.

Putin, for his part, seems to have long since concluded that PRC dominance in a bilateral context is preferable to a global system dominated by the US.[10] Moscow's choices are constrained by the lagging state of Russian industry, now isolated from technologically capable economies other than the PRC. One exiled Russian analyst described his nation's future as a 'giant Iran', largely autarkic but dependent on the PRC for critical technologies as it faces the prospect of persistent hostility with the US and potentially with most European nations.[11]

This report provides a current overview of Sino-Russian collaboration across four broad areas of advanced technology: telecoms, artificial intelligence and cyberspace; machine tools, 'fourth industrial revolution' applications and microelectronics; defence-oriented technologies; and uses of outer space. It does not cover other notable areas of Sino-Russian cooperation, such as nuclear energy and offshore hydrocarbon extraction. The latter fields are significant to the Chinese and Russian economies, but are of relatively less consequence to competition with the US and its allies for national prosperity, global influence and military capacity. The fields surveyed in this report are the most consequential for next-generation technologies that will increasingly shape national capabilities and the international balance of power.

Across such a broad technological front, it is unlikely that a Sino-Russian bloc in isolation could compete with a larger, US-oriented community of advanced economies. But despite the efforts of the US and some allied governments, it remains far from clear whether many countries will 'decouple' from the PRC's economy.[12] To the contrary, the balance of data since Russia's invasion of Ukraine suggests that Beijing will continue to benefit from links with advanced industrial economies while also preserving its strategic partnership with Moscow.[13] In this context, the PRC's gains from technical cooperation with Russia may have major consequences for its prospects in the world's escalating 'geo-technological' competition.

02

Telecommunications, satellite-based navigation, artificial intelligence and cooperation in cyberspace

2.1 Telecommunications

Telecommunications are the foundation for society's use of digital technologies, whether for civilian or military applications. PRC firms' growing capabilities in this field have made them internationally competitive players in the development of fifth and sixth generation (5G and 6G) telecoms, supporting Beijing's aspirations for global leadership in new technologies that will utilise 5G and 6G.[14] Since 2014, PRC industry leader Huawei has risen to dominance in Russia's telecoms infrastructure market. But with the 2022 invasion of Ukraine and the sanctions in response, it is unclear whether Russia now has the option of further PRC assistance, particularly if the decision is left to PRC firms reluctant to risk additional sanctions from the US and its allies.

Huawei's presence in Russia's telecoms infrastructure dates from the late 2000s. As has commonly been the case, Huawei's market expansion was supported by loans from PRC state-owned policy banks. The PRC firm became the favoured equipment vendor for Russia's telecoms operators following the imposition of sanctions from 2014 and overtook the imposition its European competitors Ericsson and Nokia to dominate the market, with fellow PRC vendor ZTE also acquiring market share. Huawei also benefited from the Russian government's designation of a frequency range for 5G telecoms for which Huawei is the only equipment vendor available, and from perceptions in Russia that the threat of PRC vendors enabling state surveillance and espionage was no more serious than that of Western vendors doing the same.[15]

However, the Russian government also initiated an import substitution policy that specified market share targets for domestically developed 5G technology and for manufacture of 5G base stations within Russia. The state-owned conglomerate Rostec unveiled a 5G base station prototype in 2020.[16] Huawei played to these priorities by establishing a Russian R&D centre, which by 2020 was employing 2000 personnel. Huawei's growing emphasis on Russia also reflected the PRC firm's need for new opportunities as it was subjected to US export controls and increasing obstacles in Western countries.[17] Russia's initial 5G implementations in 2021 employed Huawei products.[18]

The relative priority and approach regarding 5G import substitution has been subject to elite contestation within Russia, with choices constrained by Russian firms' lack of relevant technical capabilities.[19] But in any case, these debates have been overtaken by the course of events since February 2022. Huawei reportedly ceased accepting new Russian orders in March and has stopped equipment deliveries under existing contracts.[20] Avoiding further tightening of targeted US controls is critical to Huawei's larger prospects, with existing US controls having significantly impacted Huawei's revenue and its capacity to service the PRC's own 5G infrastructure roll-out. Whether foreign and especially US sanctions on Russia are sustained will be the major factor affecting future PRC involvement in Russia's telecoms sector.

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A Rostec announcement in May 2022 suggests that Russia is doubling down on indigenous development of 5G technologies, based on the Open RAN architecture that is gaining ground as a basis for next-generation telecoms infrastructure.[21] PRC firms remain significant players in the global development of Open RAN.[22] But such novel technical approaches will not obviate the effectiveness of US sanctions in deterring PRC firms from supplying Russia, which has limited capabilities in underlying technologies, particularly semiconductors, as discussed below.

2.2 Artificial intelligence (AI) and software development

AI is among the most prominent emerging 'dual use' technologies that are expected to have far-reaching impacts on society and warfare. The US is increasingly targeting the PRC's access to foreign semiconductor technology with the aim of restricting development of PRC AI capabilities, justified on national security grounds.[23] The complementary nature of Russian and PRC strengths in AI development will likely attract increasing attention to the two nations' collaborations in this field, although on the commercial side, sanctions on Russia are a deterrent to PRC firms.

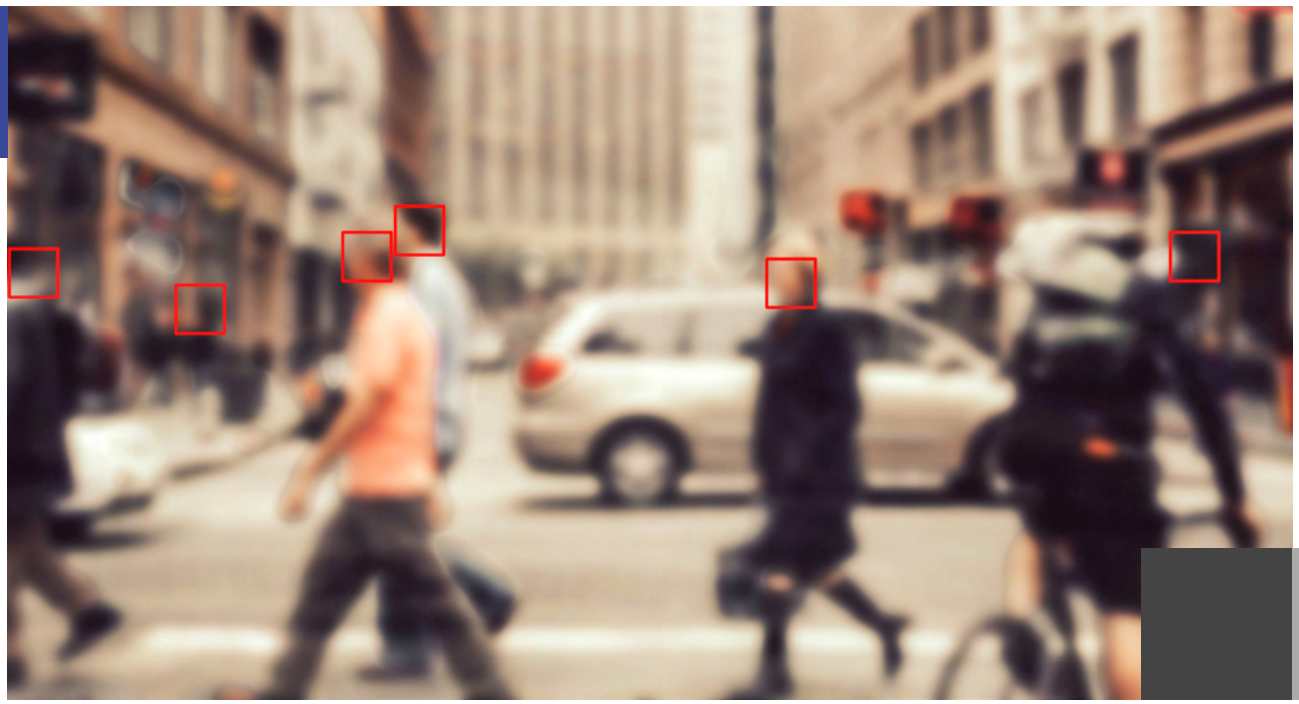
Russia's defence innovation system has prioritised AI for some time, and Russian military theorists emphasise a 'systems destruction' approach (targeting enemy command, control and communications) to employing AI, with similarities to that favoured by their PRC counterparts.[24] The latter's concern about falling behind the US in military applications of AI provides a strong motive for learning from the Russian military's recent experience of combat operations in Syria and Ukraine.[25] Cooperation on military AI could leverage both countries' significant unmanned platform capabilities and extant bilateral cooperation in robotics (discussed in section 3.2).

Putin's judgment that whoever leads in AI will 'rule the world' has been reflected in a disparate range of initiatives in Russia promoting AI's development and application.[26] But these have not added up to a broad-based and self-sustaining ecosystem to drive AI development. Following the invasion of Ukraine, Russian progress in AI now also faces the combined impact of sanctions, severed international partnerships and brain drain through emigration of skilled workers.[27] The PRC, by contrast, is often described as the world's second emerging AI superpower, although by some analyses it lags the US across most metrics of capacity for AI development.[28]

Several PRC firms have entered AI-related partnerships in Russia. Huawei led the way with the acquisition of Russian-developed facial recognition technology, and soon proclaimed its ambition to develop a broad-based AI ecosystem in Russia by 2025. By 2020 Huawei had joint laboratories at 10 Russian universities, working on various AI fields including computer vision and deep machine learning.[29] Huawei also partnered with Russian cybersecurity vendor Kaspersky to provide security for cloud computing services, and with Sberbank, Russia's largest state-owned bank, to provide cloud services for Russian businesses.[30] At the time, Huawei had ambitious plans for integrated AI and cloud services development, and Sberbank itself has notable capabilities in AI development.[31]

PRC firms have been attracted by Russia's capable research institutions and skilled labour pool, while the prospect of access to PRC markets attracted Russian partners, although the latter reportedly have widespread concerns about intellectual property protection and asymmetrical benefit to the PRC.[32] Russian development of an operating system (OS) for mobile devices (Aurora) was particularly attractive to Huawei, after the PRC firm lost access to Google's Android OS-based product suite due to targeted US controls. Huawei's Russian labs have been engaged in development of Huawei's own proprietary OS, Hongmeng, and Huawei is working with Russian software firms such as search engine giant Yandex to develop a Hongmeng-based product suite.[33] Huawei has invested in network development in Russia built atop Huawei's proprietary computer processors, and in 2021 it opened a data centre in Moscow based on these technologies.[34]

It is uncertain how such partnerships will fare in the face of foreign sanctions and the difficulties of rapid business reorientations in response. Huawei broke up its recently merged AI and cloud business group in 2021.[35] Loss of access to advanced semiconductor manufacturing brings into question the sustainability of Huawei's plans, with even



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its existing Moscow data centre likely built using stockpiled chips. Kaspersky was put on a US government security risk list in March 2022, while Yandex is under growing pressure from targeted sanctions and supply chain disruptions.[36] In June 2022, Sberbank, targeted by US and EU sanctions, suspended transactions in PRC renminbi.[37]

Nonetheless, PRC actors will probably keep seeking to tap Russian talent in software fields that cannot yet be adequately serviced by the PRC's domestic labour force and existing corporate expertise. This is especially true for cybersecurity, where PRC capacities significantly lag its requirements.[38] In 2015, Kaspersky partnered with PRC state-owned conglomerate CETC to develop cybersecurity capabilities.[39] Huawei has been recruiting Russian cybersecurity specialists.[40]

AI has been repeatedly highlighted as a cooperation priority by officials in both countries and in bilateral statements, most recently in February 2022.[41] This political imperative must now work against the reluctance of commercially oriented PRC firms to continue business with Russia in the face of sanctions.[42] But military applications of AI are relatively siloed in development, and collaboration between the two defence industrial complexes is unlikely to be similarly constrained.

2.3 Cyberspace governance and information security

The PRC's and Russia's aligned stances on the global stage of cyberspace governance are often cited to support claims that they are prosecuting a joint agenda driven by shared ideologies of authoritarianism. But in reality, this is again a matter of instrumental cooperation, with the two nations' interests diverging in their respective capabilities and basic interests. While sanctions pressure may drive Russia to seek true autarky in digital networks, the PRC's leadership still prioritises maintaining international connections. For the PRC, with its key role in global electronics supply chains and the expanding 'internet of things', being at the centre of an international economic web built on top of a globalised internet is a far greater prize than splendid isolation in Russia's company.[43]

The PRC and Russian governments have long emphasised 'cyber sovereignty', a vague concept focusing on state control of activity on digital networks, in international forums that discuss issues of cyberspace governance. The PRC supported Russia's initiation of an alternative United Nations forum for such discussions (the Open-Ended Working Group, OEWG), and the two states maintain positions opposed to those of the

US and its allies, such as the need for a bespoke international law regime for cyberspace.[44] The February 2022 joint statement issued during Putin's visit to Beijing reiterated the two governments' vision of cyber sovereignty and 'willingness to speak with one voice' in the OEWG, as the sole global forum for discussing information security.[45]

The joint statement also declared mutual interest in 'greater participation at the International Telecommunications Union (ITU) in addressing these issues'. As PRC firms' technical capabilities have increased, PRC influence in forums like the ITU that make decisions relevant to digital networks' design and operation has raised alarm in the US and allied countries, with even relatively innocuous proposals being characterised as serving PRC political goals.[46] This growing political focus on technical standardisation, management of digital data transfers and other matters of global cyberspace governance will be inflamed by the prospect of closer coordination between Beijing and Moscow on these issues, especially given the limited support worldwide for the US-led rival vision.[47]

In 2015, Beijing and Moscow signed an agreement on 'cooperation in ensuring international information security'.[48] It specifies 15 fields for cooperation that include establishing channels for joint responses to threats, cooperation on securing critical information infrastructure, technology exchanges to support computer emergency response, and joint training in specialised higher education institutions.[49] At the senior (Kremlin chief of staff) level, a joint policy coordination mechanism was established in 2016 with working groups for mutual study of best practices, including one for internet governance.[50] Exchanges on information security practices also occur at various other levels. For instance, in 2018 Huawei and a PRC information security standards body hosted Russian parliamentarians and officials to discuss issues ranging from security of digital financial transactions to the root servers of the Internet's global domain name system (DNS).[51]

From 2019, Russia amended its laws to require internet service providers to install state-provided equipment 'for counteracting threats', impose centralised management of telecoms networks, and mandate implementation of a Russian DNS.[52] These measures provide the basis for the 'sovereign

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internet' (RuNet) aspiration declared by Putin.[53] In December 2019, Moscow claimed to have successfully tested disconnection from the global internet and independent operation of the internet within Russia , although the scope and legitimacy of this exercise are disputed.[54]

The DNS is a global addressing system for the internet, the upper tiers of which are administered through a US-based organisation (ICANN). It relies on connections to globally authoritative root servers. A self-contained national DNS with its own root servers would allow a state to run the internet inside its borders without reference to a global authority like ICANN, and to control cross-border communications with the global internet less onerously than the PRC's 'Great Firewall', which imposes significant efficiency penalties and vulnerabilities.[55] Russia's capacity to realise such a goal, and other elements of the envisioned RuNet, now likely depends on PRC assistance, given that Western information technology firms have generally abandoned Russia since February 2022.

Previously, PRC experts presented a proposal at the ITU for a nationally partitioned DNS. This system would have remained interoperable across borders, similar to the telephone numbering system that is regulated by national governments but according to a global standard. The PRC proposal, which was not progressed, included independent root servers for each national DNS.[56] PRC organisations are also involved with a long-running international project (YETI) associated with potential development of an alternative DNS root.[57]

However, the incentives seem insufficient for the PRC to actually implement an independent DNS, let alone with the added burden of supporting one in Russia. Moscow's RuNet ambitions have been impeded by the realities of Russia's dependence on international economic links and the internet's global infrastructure.[58] An independent, national DNS would still require agreement from other states to be interoperable. Beijing is not likely to prioritise integration with Russia above compatibility with other states it wants to connect to the PRC's digital economy and infrastructure, for example the new blockchain services network.[59]

Despite the image of a convergent Sino-Russian vision for cyberspace, the PRC has pursued its own approach to managing this domain, which is deemed vital to sustaining the Communist Party's rule, and so will not be tied to another state's strategic priorities.[60] Russia is not mentioned in the PRC's 2016 International Strategy of Cooperation on Cyberspace, or in Beijing's 2021 Global Data Security Initiative.[61] If the PRC really does threaten the 'democratic future of the internet', Russia's contribution will be marginal next to the expanding influence of the PRC's own digital economy.[62]

03

Machine tools, ‘fourth industrial revolution’ and microelectronics

PRC and Russian policymakers have long aspired to broaden Sino-Russian commercial and technological exchanges beyond state-led projects, thereby changing the situation of so-called 'hot politics, cold economics' (in Chinese *zhengre jingleng*). As societies worldwide transition to next-generation technologies, three areas stand out as critical deficiencies for Russia, which it is unlikely to remedy for many years absent major PRC assistance. But PRC actors' own limitations and foreign dependencies in these fields mean that even if they are willing to engage in wider exchanges, these are unlikely to solve Russia's problems.

Sustaining the PRC's foreign industry partnerships against 'decoupling' pressures is hard enough without adding to the risk of sanctions from cooperation with Russian actors. Many US sanctions on Russia target the whole country and assert extraterritorial jurisdiction, applying to any engagement in the targeted sectors with Russian actors worldwide.[63] US controls of the type targeting Huawei have led to a significant fall in the PRC firm's revenues and a quantifiable slowdown in the PRC's 5G infrastructure roll-out.[64] Avoiding further such measures is a priority as the PRC strives to develop a 5G innovation ecosystem over the coming decade, providing the foundation for fourth industrial revolution (4IR) leadership.[65]

3.1 Machine tools

Machine tools – machines used for precision shaping of rigid materials – provide a vital capital equipment base for manufacturing across sectors. Having lost access to Western and Japanese machine tools since February 2022, the best hope for Russian industry to access this key enabling technology is closer integration with the PRC, which is itself trying to upgrade technologically through partnerships with the same countries that are sanctioning Russia. For mature industries like machine tools, the PRC's priority is not autarky nor global leadership, but achieving baseline domestic capacity while using foreign exchanges to help the PRC's drive to lead in next-generation technologies.[66] This requires not being drawn into Russia's global sanctions trap, at least not until PRC industry can support the nation's requirements with excess capacity to spare.

Russia's machine tools industry was hollowed out over the 1990s, leaving Russian manufacturing almost wholly dependent on imports of machine tools. Russia began import diversification and substitution efforts in the late 2000s, but as of 2015 it was still importing more than 80 percent of its requirements.[67] By one estimate, in 2020 imports still met more than 70 percent of Russia's machine

Image credit: Dmitry Kalinovsky / Shutterstock

tool consumption.[68] Lack of domestic capacity in machine tools has impeded Russia's defence industry modernisation and scaling-up production of Russia's COVID-19 vaccine.[69] This deficiency is linked to Russia's reliance on imported components for even its flagship aerospace and defence projects, some of which have now ground to a halt under the effects of sanctions.[70]

While the PRC holds the largest share of the global machine tools market, most PRC firms still make relatively unsophisticated products, with advanced machine tools largely supplied by German and Japanese firms. In 2017, almost 80 percent of Russia's machine tool imports by value and more than 50 percent by metric tonnage came from countries that imposed sanctions on Russia in early 2022. Russia's diversification away from this group of suppliers since the late 2000s, with most of the reorientation by tonnage going to PRC suppliers, seems to have been achieved by substituting more sophisticated machine tool imports with less sophisticated ones. This implies that pivoting to the PRC and other relatively friendly states has downgraded Russian industry's manufacturing capabilities.[71]

Beijing's 2015 plan 'Made in China 2025' set a target for more than 80 percent of the PRC's demand for advanced (computer numerical controlled) machine tools to be met by PRC firms by 2025. This suggests that even in a best-case scenario, PRC machine tool production will, for years to come, be unable to supply Russia's advanced manufacturing sectors without prioritising them over the PRC's own needs. Moreover, PRC experts assess that the PRC's advanced machine tools sector still significantly lags global industry leaders in performance and faces major development challenges.[72]

3.2 Fourth industrial revolution (4IR) technologies

The 4IR is an umbrella term for digitally enabled technological fusion that achieves paradigm changes in applications.[73] For example, software-controlled and data-driven 'smart manufacturing' promises step changes in resource efficiency, production flexibility and logistical optimisation.[74] In this field, too, Russia is hobbled by anaemic industrial development in recent decades, although Russian research strengths remain attractive to PRC partners. But the prospect of Russia 'plugging in' to the PRC's enormous and vibrant markets for 4IR technologies has once again been overshadowed by the comprehensive sanctions regime imposed since the 2022 invasion of Ukraine, and PRC priorities to maintain links with the European, Japanese and Korean leaders in this field.

In 2016 and 2018, Russia created dedicated agencies (ARF/FPI and Era[75]) to drive development of next-generation technologies and their integration into Russia's defence industries. Putin himself has said that those who fail to ride this technological wave will submerge and drown.[76] First-mover application of the 4IR is seen as a means of leapfrogging '20 years of stagnation' in Russia's defence industrial base and military technology compared to its US and NATO adversaries.[77]

The PRC is a leading development and testbed country for 4IR technologies, including in partnership with foreign industry leaders.[78] For more than a decade, the PRC state has been driving evolution of 'smart manufacturing', intelligent connected vehicles and other digitally networked applications under the 'internet of things' (IoT) rubric.[79] This drive is led by the PRC's top information technology firms, which are increasingly bringing the 4IR into their foreign business. For example, the 'industrial internet' featured prominently in Huawei's development plans for Russia, with aspirations to jointly develop integrated software and hardware solutions with Russian suppliers.[80]

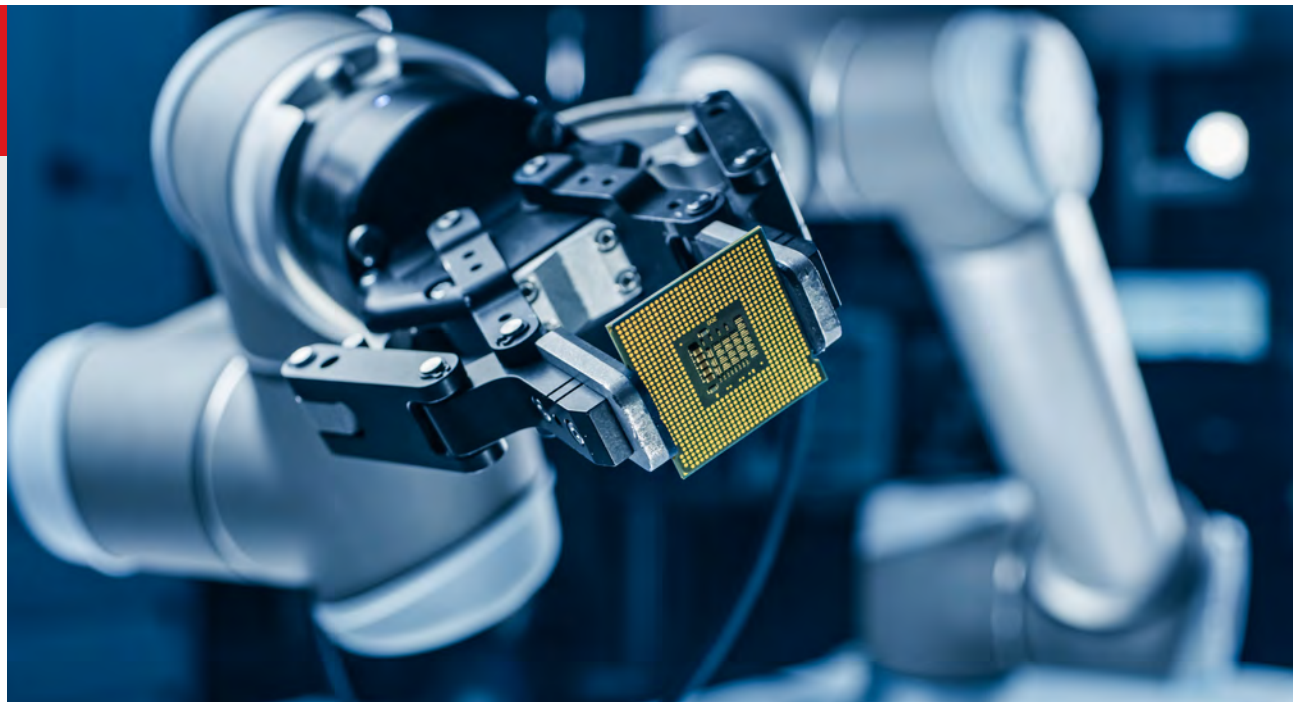
Robotics is a 4IR field in which Sino-Russian cooperation seems particularly developed. In 2015, a PRC venture capital fund entered a US$200 million agreement with Skolkovo – an agency created by then-premier Dmitry Medvedev to develop a Silicon Valley-type cluster in Moscow – to create a joint business incubator, investment fund and robotics R&D centre.[81] Through this arrangement, the Russians aimed to access PRC investors, production lines and customers, while the PRC aimed to access Russian research and technical expertise.[82] The two governments have facilitated agreements between their relevant industry and technical associations.[83] Robotics is a priority field for Russian strategic and defence technology R&D, while PRC research into dual-use applications of robotics can be traced back at least to the mid-1980s.[84]

Generally speaking, the PRC's important 4IR partnerships are not with Russia but with the internationally leading players in these fields, for example through the state-led Sino-German Industrie 4.0 Cooperation.[85] The PRC's success in meeting 4IR development targets has been patchy enough that PRC officials still avoid publishing statistics like the share of smart manufacturing software or core robotics components sourced domestically. With tightening investment screening regimes abroad obstructing direct acquisition of foreign technology and knowledge, collaborations with Japanese and European (especially German) actors have become still more important.[86]

3.3 Microelectronics

Semiconductors and the miniaturised systems built from them are foundational to electronic devices, and thus increasingly to almost every sector of economic and military activity. The PRC has long tried to develop domestic capacity in these highly complex technologies. It is redoubling these efforts under the growing pressure of US export controls targeting PRC access to foreign inputs into the semiconductor value chain.[87] But as the salient example of a globalised industry with high barriers to entry, the prospect of PRC independence in semiconductor production is remote. The best the PRC can expect is to boost its role within a web of close integration with the US and its allied states.[88] This presents a grim picture to a Russia that has almost no domestic capability in recent generation microelectronics, although the difficulty of policing international movement of these products means that Moscow will probably be able to continue meeting a baseline of military requirements, even with only passive cooperation from Beijing.

Russian industry's lack of capacity in this field has been highlighted by the extensive use of foreign-made semiconductors discovered in Russian military equipment captured or abandoned in Ukraine. The PRC's role in this Russian military sourcing seems to have been primarily as a transhipment hub for semiconductors mostly designed and manufactured elsewhere, with many of these products being free from export controls before February 2022.[89] While some PRC-based companies have been blacklisted by US authorities for supplying sanctioned Russian entities, the US government has not to date characterised the PRC as especially culpable with regard to supplying the Russian military with microelectronics.[90] Some analysts assess that PRC industry remains incapable of providing the chips found in Russian equipment, which are mostly from US, European, Japanese and Taiwanese firms. Others express



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doubt that foreign governments can effectively monitor transfers of microelectronics from the PRC to Russia.[91]

Since 2014, Russia has diversified its microelectronics suppliers away from NATO states towards the PRC, Taiwan and Malaysia. In 2020, the PRC supplied around 57 percent of Russia's semiconductor imports and 20 percent of Russia's integrated circuit imports.[92] That year, Moscow approved a development strategy for Russia's electronics industry that included a domestic market share target for Russian firms of 59.1 percent by 2030.[93] Later in 2020, Rostec published a highly ambitious roadmap for developing domestic semiconductor manufacturing.[94] This electronics indigenisation drive seems initially to rely on licensing technology from PRC firms, aiming to phase it out by the mid-2020s.[95]

PRC industry has developed some capacity in each segment of the semiconductor supply chain, although generally PRC firms' abilities and market share remain well behind those of global industry leaders. Even where they produce competitive products, PRC firms still often use intellectual property (IP) owned by foreign firms, especially US industry leaders like Qualcomm and Intel.[96] For example, the PRC's Zhaoxin computer processors – developed by a joint venture between the Shanghai government and a Taiwanese firm with rights to Intel's processor architecture – have significantly lower performance than chips from Intel and AMD.[97] But these US firms have stopped business with Russia, which may now need to rely on Zhaoxin chips, in motherboards built by the Russian division of a PRC company.[98] Russia has also been cut off by the other main source of processor architecture IP, the UK-based company ARM, in compliance with UK sanctions.[99]

A potential alternative to IP owned by Western firms is the open-source RISC-V architecture, which PRC firms are betting on heavily.[100] In 2021 a Russian consortium began developing a RISC-V-based processor adequate for government and education systems, scheduled for 2025.[101] But RISC-V could also be targeted by US export controls or those of Switzerland, where the RISC-V foundation is located, and which has adopted extensive sanctions against Russia. Furthermore, the planned Russian RISC-V chip design (specified at 12 nanometres) could not be manufactured at the 28-nanometre process node that Moscow is now reportedly aiming to have indigenised by 2030.

According to reports in April 2022, the Russian government is developing a new two-step plan for its electronics sector. The first step involves re-engineering foreign electronics and transferring their production to Russia and the PRC by the end of 2022. The next step is achieving self-sufficiency in semiconductor fabrication at 90 nanometre process nodes by 2022 and at 28 nanometres by 2030.[102] Where production within Russia is not possible, items will be sourced from the PRC.[103]

With PRC cooperation, such Russian semiconductor ambitions seem theoretically feasible. At least two PRC semiconductor foundries (SMIC and Hua Hong) operate 28 nanometre production lines, while PRC industry now appears capable of largely or wholly equipping 90 nanometre production lines without imports.[104] Despite 28 nanometre process nodes lagging the global industry leading-edge, they are sufficient for many applications, including various IoT functions.

However, once again, serious obstacles appear when accounting for PRC industry's own requirements and foreign dependencies. These dependencies have been increasingly targeted by US controls and pressure on US-allied states. For example, Dutch equipment vendor ASML has yet to receive an export license to sell SMIC its most advanced machines, required for process nodes smaller than 14 nanometres. Much of the planned 28 nanometre production in the PRC is owned by Taiwanese firms, which are now subject to their own government's export controls targeting Russia, and which previously cut off Huawei to comply with US export controls.[105] More so than for most industries, in the semiconductor sector the PRC's priority is to avoid further expansion of restrictions on its own firms' access to foreign technology and partners. This goal will certainly come before assisting Russia's handful of semiconductor firms, which have now been extensively sanctioned.[106]

The one point in the semiconductor supply chain where Russia has some influence is in supply of the noble gases neon, xenon, krypton and helium, all used in semiconductor manufacturing.[107] In early 2022, an estimated 40 percent of neon used in semiconductor production worldwide was supplied by Russia and Ukraine, the latter's refineries relying on Russian-sourced steel by-product as inputs for neon production. Russia supplies an estimated 30 percent of the world's neon,[108] xenon and krypton, while prior to Russia's 2022 invasion Ukraine supplied some 50 percent of global neon consumption.[109]

In June 2022, Russia suspended noble gas exports until 31 December, subject to government permission. The express intent was to 'rearrange those [supply] chains that have now been broken and build new ones'.[110] Unfortunately for Moscow, the PRC is a self-reliant neon producer that also supplies many foreign semiconductor industry leaders, especially those with activities in the PRC. The fact that businesses in the PRC began diversifying their suppliers of neon after Russia's 2014 takeover of Crimea, and that PRC neon producers were already taking up the slack in Ukrainian neon exports by late February 2022, illustrates again how Russia's changing strategic priorities are running into the reality on the PRC side of divergent incentives and lack of mutual coordination.[111]

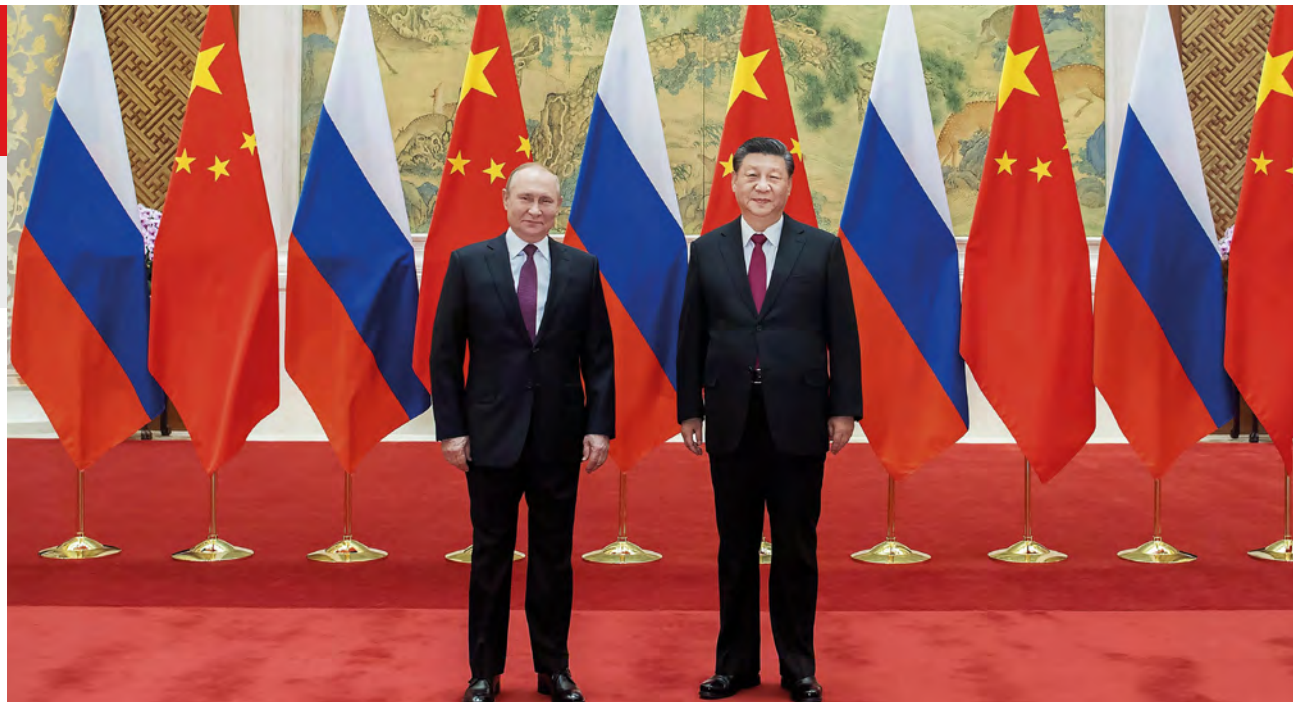
04

Defence-oriented technologies

Sino-Russian exchanges in defence technology have evolved in recent years, with a decrease in PRC purchases of complete Russian systems and an increase in joint development projects and Russian subcontractors working on PRC projects.[112] This reflects growing cooperation in the wider defence relationship, which since the mid-2000s has involved regular joint military exercises and personnel exchanges, and a three-year military cooperation roadmap agreed in 2017 at Russia's instigation.[113] Defence relations have been driven from the top, with Xi and Putin's February 2022 meeting continuing discussions on military technical cooperation.[114] This established a trend towards reciprocal and long-term interdependencies in defence capability before the 2022 Ukraine war, the implications of which for Sino-Russian defence cooperation are difficult to separate.[115]

These extensive defence sector links could theoretically be used to lead bilateral integration in the commercial economy, which both Russian and foreign experts have argued is Russia's best prospect to address its growing technological deficiencies.[116] However, as described above, under conditions of extensive sanctions on Russia by all the world's other advanced economies, such expanded integration is not aligned with PRC business interests nor with the PRC state's strategic development priorities. Even defence sector cooperation is not frictionless, with Russia long refraining from selling the PRC 'crown jewel' systems, and Russian officials complaining even in recent years about unauthorised PRC copying and reverse engineering of Russian technology.[117]

In Russia's post-February 2022 circumstances, however, it may need to accept the direction and scope of exchanges set by the PRC, simply to maintain a tolerable level of defence capability vis-à-vis the US and NATO. For its part, the PRC's defence industry has made significant progress in recent decades, but entrenched systemic problems mean that even when directly indigenising complex Russian systems, it still benefits from assistance by the original developers.[118] The discussion below focuses on bilateral cooperation, or prospects for it, in next-generation military technologies.



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4.1 Aviation

While the PRC has largely substituted Russian-supplied military aircraft with its own domestic models, its reliance on Russian aircraft components and particularly turbofan engines remains significant.[119] Conversely, the dependence of Russia's civilian aircraft sector on Western-made planes has exposed it to the PRC's growing role in the relevant supply chains, with conflicting reports post-February 2022 regarding whether the PRC will supply Russian airlines with aircraft parts.[120] Russia also mediated sales to the PRC of aviation engines by the Ukrainian company Motor Sich, until PRC interests acquired a controlling stake in the late 2010s.[121] In 2021, Ukraine re-nationalised Motor Sich, and its engine factories were reportedly destroyed by Russian attacks in May 2022.[122]

Aviation is the showcase sector for Sino-Russian state-led technical cooperation. For example, PRC and Russian defence firms are working on joint projects to modernise Russian turbofan engines for fighter aircraft, and to develop a heavy-lift helicopter based on the Soviet-era Mi-26.[123] Aviation-related S&T agreements also feature prominently in regular institutional exchanges.[124] In 2016, the two states signed an agreement on IP protection in aerospace technologies, which paved the way for the closer space program cooperation discussed below.[125]

Another result was the progression of long-running discussions to jointly develop and produce a wide-body airliner (CR-929), competing with the global Boeing-Airbus duopoly. In 2017, the two states established a joint venture with R&D primarily located in Moscow and manufacturing in Shanghai.[126] But, like the PRC's extant 'indigenous' passenger airliner (CR-919), this project was planned around extensive use of Western-sourced components. The post-February 2022 sanctions on Russia will greatly complicate what was reportedly already a problematic working relationship.[127] Media reporting in July 2022 indicated that disagreements within the CR-929 project were intensifying, as the PRC side sought to involve Western companies in the plane's development.[128]

Beyond legacy IP and expertise, it is unclear what Russia can offer long-term in aviation to a PRC that increasingly has the resources to go it alone, assuming that it maintains access to US and EU-sourced inputs.[129] The situation is reflected in a Russian minister's comment in 2020 about reconciling divergent expectations for the CR929 project, specifically the PRC's appetite for technology transfer and its bid to monopolise sales of the aircraft within its domestic market (sales to the PRC being perhaps the major attraction to Russia from this partnership).[130] However, the particular complexity of aircraft engines, and the relative youth and inexperience of the PRC's workforce, means that its aviation industry should still benefit from Russian assistance for some time to come.[131]

4.2 Air and missile defence (AMD)

Russia's 2015 sale to the PRC of its S-400 AMD system marked a qualitative upgrade in the PRC's AMD capacity, a cornerstone of the PRC's so-called 'anti-access and area denial' approach towards projecting military power from its shores.[132] In 2019, Putin announced that Russia was helping the PRC develop a missile attack early warning system, previously fielded only by Russia and the US, which promises to give national leaders time to consider a response to an incoming nuclear strike. The amount of known cooperation in this area raises the prospect of integration of the two states' AMD systems, which would bring significant synergies but is not indicated in public statements.[133]

With its relatively advanced electronics industry, the PRC now appears to be pulling ahead of Russia in radar and sensor technology, although not yet in surface-to-air missile capabilities.[134] The PRC's AMD capabilities will also benefit from its advanced position in quantum technologies, although observers are sceptical of PRC claims to have developed 'quantum radar' capable of detecting stealth aircraft.[135] PRC capabilities in AI are also supporting AMD advances to deal with next-generation hypersonic missiles.[136] While the priority placed on strategic autonomy by both Beijing and Moscow will likely preclude them from building a truly integrated AMD system, each country's separate capabilities already present serious problems for the US and its allies, given their reliance on airpower in military operations.[137] Sino-Russian cooperation in this area is thus a major security challenge that must be accounted for in defence force structure and spending choices.

4.3 Hypersonic vehicles (HVs)

Hypersonic vehicles (HVs) refer to new-generation weapon systems travelling faster than the speed of sound, which are slower than intercontinental ballistic missiles but fly closer to the Earth and are manoeuvrable throughout their flight path. Because extant AMD systems are not well suited to intercepting HVs, they have potential to be strategically destabilising. The US, Russia and the PRC have deployed HVs, and other countries are developing them.[138] While the PRC and Russia are leaders in HV technology, there is no clear public information to date about bilateral collaboration. Given the military advantages that HVs could confer vis-à-vis the US, this merits close monitoring, although the subject's sensitivity means it is likely to remain largely a black box.

Russia has prioritised development of HVs expressly for strategic deterrence, aiming to reduce the protection afforded by AMD systems to US strategic nuclear forces, and to expand Russia's non-nuclear capabilities to contest the battlefield against NATO forces.[139] Russia was the first nation to deploy a HV in 2019 and now has at least three HV systems, including one used against Ukrainian targets in early 2022, which all seem capable of carrying both nuclear and non-nuclear payloads.[140]

In July and August 2021, the PRC conducted two HV tests, described by Beijing's Foreign Ministry spokesman as directed at verifying reusable spacecraft technology.[141] In the July test, the HV fired a separate missile mid-flight, a capability not previously demonstrated by any nation and described by commentators as more advanced than Russian or US capabilities. US officials characterised this test as developing orbital bombardment and nuclear first-strike capabilities that can evade or destroy US AMD systems, in the context of PRC expansion of its nuclear arsenal.[142] From the PRC's viewpoint, the tests may have been directed at improving the survivability of Beijing's second-strike capability against US attack, and to hedge against further development of US AMD systems.[143]

Recently, PRC researchers claim to have developed various capabilities related to HV employment, including infrared imaging (heat-seeking) precision guidance technology, and identification and tracking technology allowing HVs to hit targets the size of a commercial drone.[144] These capabilities' use of AI and sensor technology will likely increase the attractiveness of HV-related collaborations to Russia, which will probably fall progressively behind the PRC in these fields.

4.4 Unmanned platforms

Prioritised in Russian defence innovation, unmanned aerial vehicles (UAVs, 'drones') are now present across Russia's military force structure, and have been used extensively in Syria and Ukraine.[145] Russia has produced multiple UAV models, although development has been slowed by constrained access to foreign microelectronics and import substitution efforts (discussed in section 3.3).[146] Forward development priorities for UAVs include introducing AI elements, integrating UAVs with manned aircraft, and swarming technology (discussed below).

The PRC is the world's leading producer of civilian-use drones. It also produces a range of military UAV models and is a leading exporter of armed UAVs, which have seen combat use by other states.[147] In 2018, a Russian defence firm began joint development with PRC partners of a rocket artillery-launched reconnaissance UAV, although reportedly without interest from Russia's defence ministry. The PRC side's interest in this case may indicate that the PRC military is relatively more advanced in developing operational concepts for using UAVs in combat.[148] At a military procurement event in April 2022, a People's Liberation Army logistics officer was quoted on PRC state media as saying 'we are gradually developing a whole system of unmanned intelligent equipment'.[149]

In March 2022, the US reportedly shared with its allies' intelligence asserting that after the start of its invasion of Ukraine, Russia had requested military equipment from the PRC including drones. But sanctions risk is now a major deterrent to PRC cooperation, especially by private firms. In April, the world's leading commercial drone producer, DJI, suspended business in Russia.[150]

Apart from microelectronics, the most productive field for Sino-Russian cooperation on UAVs would probably be integrating AI and developing its applications (discussed in section 2.2). Both countries are working on human-machine teaming and on swarming technology, which offers potential to overwhelm adversaries through

self-coordinating swarms of relatively cheap UAVs. PRC researchers are now demonstrating drone swarming in complex environments like bamboo forests, while the PRC's civilian industry is at the forefront of developing and implementing AI for intelligent connected vehicles.[151] PRC researchers have also been working on applying swarm concepts to hypersonic vehicles.[152] Russia could contribute operational experience with adversary UAVs in Syria and Ukraine, with the continuing war in the latter country potentially providing a testing ground for drone swarming, as Western countries step up provision of arms to Ukraine.[153]

Both the PRC and Russia have extensive development programs for maritime and underwater unmanned vehicles (UVs).[154] In May 2022, the PRC announced what is claimed to be the world's first AI-controlled 'drone mothership' carrying smaller maritime UVs that integrate to form an observation network. The following month, sea trials were conducted for another AI-controlled vessel with stealth characteristics.[155] Such vessels, alongside autonomous submersibles, will assist wide area maritime observation – with the PRC having already deployed a UAV-integrated surveillance network to monitor its vast maritime claims in the South China Sea.[156] Undersea UVs also support the extensive seabed exploration activities being conducted by both the PRC and Russia, with potentially large economic implications given the expected commencement of deep seabed mining in the near future.[157] They also have significant military utility, and for the PRC especially could help favourably shifting the undersea military balance in the western Pacific.[158]

4.5 Anti-satellite (ASAT) capabilities

US reliance on satellites to support military operations has incentivised both the PRC and Russia to develop and test ASAT capabilities, Russia most recently in November 2021.[159] Despite this test having apparently not been pre-notified to the PRC, and the resultant debris putting PRC space assets at risk, the PRC did not publicly condemn it. A US intelligence agency report published in April 2022 did not speculate about possible PRC-Russia cooperation on ASAT capabilities but assessed that both countries have already deployed a range of such technologies that include electronic warfare and directed energy systems (lasers and microwaves) alongside kinetic weapons, with both states' ASAT capability suites expected to expand significantly over the coming decade.[160]

Sino-Russian cooperation in this field will be encouraged by the US military's enlistment of firms such as Elon Musk's SpaceX to develop widely distributed satellite-based tracking and early warning systems, potentially enabling interception of hypersonic platforms.[161] PRC researchers are openly discussing new ASAT approaches to deal with numerically extensive low Earth orbit (LEO) satellite constellations, notably SpaceX's Starlink.[162] PRC ASAT capabilities will benefit from the PRC's increasing strengths in imaging and sensing technologies (discussed in section 4.3), with recent claimed advances by PRC defence institutions in ASAT-specific applications.[163] As the PRC moves towards deploying space-based ASAT capabilities – more effective than terrestrial systems – it could benefit from additional launch capacity that Russia could provide (discussed in section 5.1).

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05

Uses of outer space

The PRC and post-Soviet Russia have a long history of cooperation over space technologies.[164] In 2017, the two nations' space agencies signed a bilateral agreement on joint space exploration over 2018-2022, facilitating the cooperative initiatives described below. Despite recent resumption of US-Russia cooperation over flights to the international space station, the collapse of Russia's relations with the US and its allies likely leaves the PRC as Russia's only partner for new initiatives in space, even as global competition heats up to lead humanity's move into the 'final frontier'.[165] The following sections focus on the most prominent public aspects of bilateral space cooperation.

5.1 Launch capacity and space flights

As for other technology categories described above, bilateral cooperation has increasingly taken the form of Russia exchanging high-performance legacy technology for PRC-made electronics. Specifically, Russia is receiving production technology from the PRC for space-age radiation-resistant electronic components in exchange for Russia's RD-180 rocket engine, an agreement reached in the context of political pressure in Washington to stop using the RD-180 for US space launches.[166] Russia suspended exports of rocket engines to the US in March 2022.[167]

Spurring Sino-Russian cooperation is the widening US lead in the number of deployed satellites, thanks to launch activity by private firms such as SpaceX and Blue Origin. SpaceX's StarLink constellation in particular has attracted attention as a security threat, requiring the PRC to develop similar constellations of numerous LEO satellites.[168] Commercial terrestrial telecoms will increasingly depend on satellite constellations like StarLink, and the PRC aims to leverage its own fast-growing private space industry to catch up.[169] Sanctions by the US and allied states on Russia's space industry and Moscow's reciprocal embargo on these countries' use of its launch services have made more launch capacity available for the PRC, although sanctions risks may deter PRC firms.[170]

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The PRC, for its part, will increasingly have problems finding technologically capable partners apart from Russia for activities in space. In addition to the US Congressional ban on NASA cooperating with the PRC, exchanges with the European Space Agency, which included plans to send European astronauts to the PRC's space station, are now in doubt given European concerns about the PRC's stance towards Russia since February 2022. Prospects for cooperation with European commercial actors have also been soured by the collapse of a Sino-German joint venture for satellite launches, with claims from the German side that the PRC partners used the arrangement to obtain scarce licensing slots for satellite launches outside the partnership to serve the PRC market.[171]

The PRC's pending completion of its manned space station may benefit from Russian cooperation, with bilateral talks at space agency head level scheduled for July 2022.[172] Russian work on a reusable space plane comparable to NASA's space shuttle may also assist the PRC's own projects in this area.[173] The PRC's July 2021 hypersonic vehicle test (discussed in section 4.3) was officially described as directed at developing reusable spacecraft, which is a plausible employment for a system of this type.[174] The race against US competition again provides strong motivation for PRC-Russia collaboration on reusable space flight, with SpaceX's Starship reusable heavy lift rocket scheduled for operations by 2023.

5.2 Satellite-based navigation

The PRC and Russia have been developing separate satellite-enabled navigation (SATNAV) systems, Beidou in the PRC and GLONASS in Russia, to avoid dependence on the US-controlled GPS. Since 2015, both sides have worked to build interoperability between Beidou and GLONASS. This coordination includes direct government oversight and service performance assessment, building of infrastructure on each other's territory, development of electronic components that support both systems, and mutually standardised applications.[175] In 2017, tests of this interoperability began across a 7000-kilometre route of rail tracks in Russia, branded as promoting 'New Silk Road' PRC-Europe connectivity.[176] A new agreement was signed in February 2022 to ensure 'complementarity of system timescales' between Beidou and GLONASS, facilitating burden sharing and thereby increased coverage.[177]

Given the growing importance of SATNAV to various civil and military applications, Sino-Russian cooperation in this field has raised concerns abroad. It makes PRC and Russian SATNAV capabilities more extensive and robust against hostile interference, and it gives both states more capacity to conduct such interference against third parties.[178] This reflects the wider pattern in Sino-Russian defence cooperation, which improves the independent positions of Moscow and Beijing for various contingencies without the degree of integration common in US security partnerships.[179]

Image credit: HelenField / Shutterstock

5.3 Joint lunar base

In March 2021, the PRC's and Russia's space agencies signed an agreement for construction of a joint facility on the moon, a 'comprehensive scientific experiment base with the capability of long-term autonomous operation'.[180] This project, which is open to participation by other states, competes with the US-led Artemis program for lunar basing and further space exploration. The international agreements under Artemis cover lunar mining and provide for participating nations to designate exclusion zones on the moon's surface, raising Beijing's and Moscow's concerns about being locked out of access to lunar mineral resources, which have uses on Earth and are critical to enabling further space exploration.[181] But while prior to February 2022 this partnership would have looked to Beijing like a net asset in the contest to shape the moon's emergent regulatory regime, Russia's involvement is now likely an impediment to attracting support from third states.

In 2020, Russia declined to participate in the lunar-orbiting Gateway station project with the US and its allies. In the post-February 2022 environment, joining forces with the PRC again seems Russia's only option to stay competitive in the demanding, high stakes and long-term project of first exploring and exploiting the moon, and then further space. But disproportion in the two states' budgets for their space programs, and the slim record of tangible results from bilateral cooperation to date, raises questions as to whether this will really be a partnership of equals. In uses of outer space, Russia's unfavourable situation subjects it to the same risk as for other fields of advanced technology: that once the PRC has obtained what it needs from Russian legacy technology and knowledge, further cooperation will stall.[182]

06

Conclusion: A lasting Sino-Russian technology partnership and its implications for Australia

Viewing the PRC-Russia partnership as an ideologically driven 'axis of authoritarianism' – or 'arc of autocracies', to quote former Australian Prime Minister Scott Morrison[183] – is not very useful in explaining Sino-Russian cooperation. A better case can be made that Beijing and Moscow have major conflicts in their preferences for 'international order', highlighted by the risks that Russia's invasion of Ukraine have imported into the relationship from the PRC's viewpoint.[184] As of June 2022, PRC exports to Russia had fallen 38 percent compared to the second half of 2021, in line with the average for nations that have not imposed sanctions on Russia.[185] The first half of 2022 was the first six-month period in which the PRC and Russia concluded no new investment agreements under the rubric of Beijing's flagship 'Belt and Road' initiative.[186]

PRC leaders' reluctance to support Russia can only have increased with the expansion in mid-2022 of US export controls targeting the PRC's access to advanced technologies, and a Presidential Executive Order that will further tighten PRC actors' prospects of investing in advanced technology sectors in the US.[187] The same applies to Putin's reframing of Russia's war in Ukraine as an existential struggle against the US and its allies, when announcing military mobilisation during September 2022. The cool reception Putin received from Xi at the Shanghai Cooperation Organisation summit the preceding week seems to confirm that Beijing's priority is to contain the fallout from association with Russia, in the context of Putin's choice to escalate the conflict rather than to cut his losses.

However, the PRC-Russia partnership will persist for pragmatic strategic reasons, since both states see it as needed to counterbalance the US and its allies. Since February 2022, various PRC interests have curtailed exchanges with Russia to reduce their risk exposure vis-à-vis advanced industrial economies. But even in worst-case scenarios for the outcome of Putin's gamble in Ukraine, the negative dynamic driving US-PRC relations precludes Beijing simply ending cooperation with Moscow. As one commentator said: 'Nothing the West can offer the PRC leadership... would compensate it for taking such a drastic step'.[188]

At the heart of this shared strategic interest is cooperation on advanced technologies. This should be expected to continue evolving, even as it raises Russian dependency on the PRC and the risks to PRC actors of punishment by third parties. Such cooperation will be stimulated rather than deterred by US allies' growing focus on the security implications of alignment between Moscow and Beijing. For example, the NATO Strategic Concept adopted at the June 2022 Madrid summit states that 'the deepening strategic partnership between [the PRC and Russia] and their mutually reinforcing attempts to undercut the rules-based international order run counter to our values and interests'.[189]

The attendance of Australia's Prime Minister at the Madrid summit will have been interpreted in the PRC as an additional act of strategic hostility, independent of Beijing's relationship with Moscow. But PRC views about Australia's positioning on development of strategic and especially military technologies are likely to be already set. For instance, the official fact sheet on implementation of the new AUKUS partnership with the US and UK refers to cooperative development of hypersonic and counter-hypersonic weapons.[190] Canberra's stance towards Moscow likely has marginal significance in PRC calculations about the future global balance of technological power.

Cooperation with Russia is just one aspect of the PRC's broad-based approach to technology development. With some arguable exceptions, Russian contributions are less useful to the PRC than exchanges with the world's most advanced economies, all of which are US allies or at least aligned with the US sanctions regime against Moscow. Where forced to make a choice, Beijing will likely prioritise these exchanges over collaborations with Russia, especially since many actors in these countries are keen to continue business with the PRC. For example, in May 2022 the German multinational Merck – one of the leading chemicals suppliers for the semiconductor industry – announced a new production cluster in the PRC, stating that 'we believe a golden era for China's semiconductor industry has just begun'.[191]

This means that the policy challenges for Australia raised by the PRC's technological progress are largely independent of PRC-Russia collaboration. So far, the latter does not appear to be significantly impacting the PRC's commercial and research exchanges with many advanced economies, nor the continuing expansion of PRC technological actors within Australia's own region.[192] Russian contributions to PRC technological success deserve monitoring, but they are a factor shaping Australia's strategic environment over which Australian policymakers have little influence.

To the extent that PRC-Russia cooperation encourages the US to expand its export and investment controls targeting the PRC, this will impact Australian exchanges with the PRC, both directly and involving third parties. President Biden has described sanctions on Russia as aimed at long-term degradation of its economy by denying it access to technology.[193] While the sustainability of the coordinated international sanctions regime imposed from February 2022 remains in question, the dominance of US firms in many advanced technology supply chains, and Washington's readiness to assert its laws extraterritorially, makes unilateral US commitment to retarding Russia's technological progress a viable project. This implies escalated coercive measures to deter PRC technological exchanges with Russia, and enforcement of such measures against third parties.

Even before February 2022, the narrowly based Sino-Russian economic relationship was not proportionate to either Beijing's or Moscow's long-term interest in mutual cooperation, nor even with goals outlined in the bilateral strategic partnership announced in 1996.[194] Russia's current circumstances and the growing US pressure on the PRC's access to foreign technology have only intensified the logic for greater collaboration, although from a PRC viewpoint this will be weighed against the risk of losing access to other partnerships. This will further complicate Australian policy choices, in a context where much of the world is not yet prepared to cut ties with Beijing.

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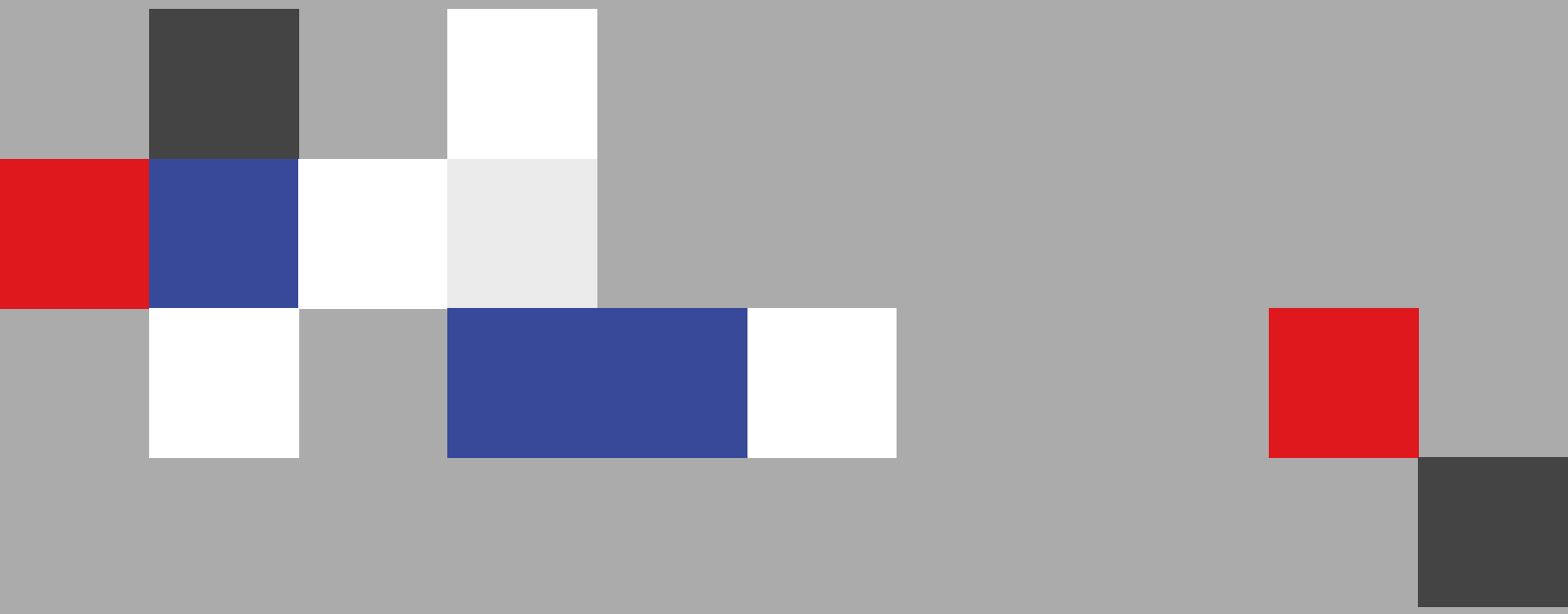

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