



Geopolitical Instability and Escalating Conflicts: The Impact on East Asian Defence Innovation Systems

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Abstract

Utilising the analytical framework for defence innovation systems previously developed by the author, this article analyses the impact of geopolitical events on continued defence industrial reform efforts in China, Japan, and South Korea. The scope covers the period from late 2021 to March 2023, the changes in the organisational set-up of defence procurement agencies, regulatory frameworks, networks, and the defence industrial policy portfolio. The three countries are assessed as separate case studies, followed by a comparative analysis. The analysis showcases that the trends identified by Steindl (2022) for the period 1991–2021 have continued and partially accelerated. The reform efforts implemented during the period provide the base for the South Korean defence export successes in 2022, and can enable China and Japan to follow suit if market opportunities are effectively utilised and administrative hurdles decreased. The shifting international system also presents new challenges to the three defence industrial bases, most notably in respect to semiconductor supply chain reliance and increasing polarisation of competing blocks.

Keywords

defence innovation systems – defence industrial policy – defence industrial base – national systems of innovation – East Asia

1 Introduction

The Russian invasion in Ukraine as well as the increasing competition between the United States and China, specifically with respect to the question of Taiwanese independence, have accelerated rearmament efforts in both Europe and East Asia. Following a temporary decrease of arms transfers in the wake of the COVID-19 pandemic, their volume has now exceeded those prior to the pandemic. This follows the overall trend of rising arms sales since the mid-2000s (SIPRI 2023: 1).

Both the South Korean and Chinese defence industries benefited from this trend, occupying the third and fourth place respectively in regard to the annual growth of exports in 2021 (SIPRI 2022: 2). In 2022, South Korea even became the exporter with the largest relative increase in arms exports (*ibid.*: 3). The position of East Asian defence industries on the global market and respective domestic policies have already undergone considerable shifts since the end of the Cold War. After 1991, defence production within the region has grown both in volume and quality. Whereas arms exports doubled (from 3.5 to seven per cent of the global share) and imports decreased (from one third to eighteen per cent of the global share), military expenditure rose from eight to more than twenty per cent of the global share (SIPRI 2021a; 2021b).

As I have outlined elsewhere (Steindl 2022), this transition is interlinked with deep defence industrial reforms implemented in China, Japan, and South Korea. During the assessment period of 1991–2021, approaches in all three countries have consecutively aligned and been driven forward through advanced innovation theory approaches. Concurrently, both the success and the timeline of implementation have varied, and notable differences continue to exist.

Concerns that the COVID-19 pandemic and the related economic stress would put pressure on national economies, and thus check the increase of defence budgets or even reverse them, forestalling defence innovation promotion efforts, have not materialised. Instead, the Russian war of aggression against Ukraine has deepened threat perceptions and accelerated both the urgency of rearmament and defence innovation. In East Asia, the spectre of North Korean aggression and Chinese and Russian revisionism have led the Japanese government to abandon the historical limit of one per cent of GDP for defence. For the first time since World War II, this entails a doubling of the budget to two per cent of GDP until 2027 (Yeo 2022). Both the South Korean and Chinese defence budgets have continued their growth patterns. For the former, the defence budget will reach 2.54 per cent of GDP in 2023 (Grevatt and

MacDonald 2022). In China, a growth of seven per cent has been announced, which will thus exceed the expected economic growth of five per cent.

Building on the analytical comparison I provided in a previous study (Steindl 2022), this article assesses the impact of recent events (between 2021 and 2023) on the defence industrial trends identified in the three countries during the post-Cold War period. The research approach follows the analytical framework developed in my prior study (*ibid.*) based on the national systems of innovation approach. Although the period is too short for an analysis in line with the defence innovation system framework, this article directly connects to the previously presented results (*ibid.*) and thus complements them.

2 Background: Defence Innovation Systems

Utilising a new analytical framework based on the national systems of innovation approach (NSI), I have analysed the defence innovation systems (DIS) of China, Japan, and South Korea (Steindl 2022). Thus, a research gap in respect of the lacking application of the NSI for the defence sector was therein addressed. The analytical framework presented below¹ outlines the main elements. Organisations, actors, institutions, and networks were adopted from the static and process NSI approaches (see Edquist 1997; Edquist and Johnson 1997; Bergek et al. 2010), and the policy portfolio was adopted from Fagerberg's (2014) integration of Smits and Kuhlman's (2004) strategic innovation system management into the synthetic NSI approach. The analytical framework previously applied (Steindl 2022) thus comprises of the elements from these NSI approaches but was designed to capture the unique characteristics of the defence sector:

- Organisations: “public ‘formal structures that are consciously created and have’ the ‘explicit purpose’ of implementing the policy portfolio in the defence sector and conduct the tasks of the NDO², such as defence procurement” (Steindl 2022: 61).
- Actors: “public and private ‘formal structures that are consciously created’, are part of the DIS, and supply products, research, or services for the NDO” (*ibid.*).

¹ In a shortened form. For the full version, see Steindl 2022: 60–70.

² National Defence Organisation: the nation state's sole authority for national defence and overseas military operations, which can be summarised as its “National Defence Organisation” (Markowski, Hall, and Wylie 2010: 2).

- Institutions: “laws and regulations that are utilized to affect the activities and the interactions between organisations and actors in the DIS” (ibid.: 62).³ These include ownership and investment, defence market entry, intellectual property right (IPR) regulations, as well as arms and technology exports controls.
- Networks: “formalized networks, such as agglomeration and clusters, formal civilian-military partnerships, and their respective existence and development” (ibid.).
- Policy portfolio: “the public actions that influence innovation, processes, i.e., the development and diffusion of (product and process) innovations’ in the defence innovation system” (ibid.). These contain overarching tenets, planning instruments, as well as linkage, financial, acquisition, and human resource policies.

3 East Asian Defence Innovation Systems, 1991–2021

The comparative analysis of China, Japan, and South Korea during the post-Cold War period has yielded that defence industrial policies have indeed increasingly aligned during these three decades. All three countries follow the same overarching principles of techno-nationalism, indigenisation, absorption, and domestic supply reliance. Likewise, the employed portfolio of planning instruments has consecutively been broadened and deepened. Dedicated plans addressing the defence industrial base (DIB), its sub-sectors, and for certain parts of the industrial-life cycle have been introduced.

In 1991, notable overlaps of the three DIS only existed in the fragmented defence procurement agencies (both vertically and horizontally), the presence of strict intellectual property classification regulations that impeded knowledge diffusion, the utilisation of the licenced production of Russian weapon systems in China and U.S. systems in Japan and South Korea, as well as a policy focus on nurturing policies. Of the three countries, South Korea played the role of regional trendsetter in implementing liberalisation reforms, with China following and Japan lagging.

Figure 1 displays the crucial similarities between the three DIS in 2021 in the centre of the triangle, while similarities between two of them are noted on the edges. This comprises: 1) the continuous integration of defence procurement agencies (DPA) along horizontal and vertical lines, leading up

³ Defence Innovation System (DIS).



FIGURE 1
 Most important similarities and differences between the three compared countries in 2021
 STEINDL 2022: 199

to the establishment of unitary bodies in Japan (ATLA)⁴ and South Korea (DAPA)⁵ and dual organisations within the Chinese Military Commission; 2) the liberalisation of regulations impeding knowledge transfers – including IPR classification – and private investments, and the integration of civilian and defence sectors in the national economies; 3) policy foci on boosting and enabling knowledge diffusion between civilian and defence industries, research producers and system integrators, high-technology small and medium enterprises (SME), and major defence enterprises; 4) the retainment of financial nurturing programmes, including a slow shift towards policy approaches focusing on enablement as advocated by advanced innovation theory.

More precisely, the crucial alignment has occurred in the following areas:

- Ministries of Industry have gained a mandate for defence industrial policy.
- Domestic and foreign private investments have been allowed but remain regulated.
- Defence industries have gained access to the stock market to gain additional sources of investment.
- Defence procurement contracts have been opened to all – including civilian – enterprises and are thus only regulated directly through acquisition policies.
- Organisations have gained, or been created with, mandates to manage classification policies and promote knowledge diffusion.
- The focus of financial nurturing has shifted to a more overarching perspective of enablement and an all-of-government approach.

4 Acquisition, Technology & Logistics Agency.

5 Defence Acquisition Programme Administration.

- Human capital is directly recruited from universities with dedicated mechanisms and processes to confront the fierce competition with more attractive civilian industries.

At the same time, notable differences continue to exist, primarily linked to the variation in economic systems and foreign policy factors. These result in a “the odd one out” situation, as similarities are only shared between each two of the DIS. The most important ones of these are: 1) the dominant role of state-owned defence industrial enterprise groups (DIEG) in China, although civilian and private industries receive increasing access to the market; 2) the successful integration efforts in China and South Korea, encompassing both civilian and defence as well as private and state-owned sectors, industries and research institutes, and universities. In Japan, conversely, the government has encountered considerable opposition in integrating universities in the Japanese DIS; 3) the limitations on international collaboration for China and Japan. In the case of China, this is linked to growing international competition and the advancing sanctions regime, which limits Chinese collaboration with Western countries to dual-use fields. In Japan, the long-standing voluntary ban of defence exports and collaboration has not yet been overcome. Even though it was formerly abolished after decades of gradual weakening and replaced by the “Three Principles” in 2014, the Japanese industry still experiences little interest by foreign partners due to its own hesitancy to commit to deeper collaboration.

Although the overlaps between all three DIS have increased in the period 1991–2021, the Chinese and Japanese approaches are limited in their similarities. Conversely, the South Korean approach has considerable overlaps with both the Chinese and Japanese DIS. There is thus no coherent “East Asian defence innovation approach.” The success of policies has varied likewise, with the aforementioned struggle in Japan to integrate universities in formal and informal knowledge transfer networks, and the effort to sustain the defence industrial base, being exemplary. Each DIS also has specific strengths. In China, this is the overarching approach of the military-civilian fusion policy and linked funding programmes, under which defence and dual-use clusters are created. In Japan, it is the depth of civilian and defence sector integration, as these industrial sectors – contrary to China and South Korea – were never separated. In South Korea, it is the extensiveness of international collaboration, spanning both geographical and international political separations, as well as the extensive governmental export promotion system.

Although the policy goal of boosting indigenous innovation capabilities and enforcing supply reliance has not changed throughout the assessment period, policy instruments have. Government interventions linked to classical

innovation theory are still present in the policy portfolio of all three countries, but the shift to consecutive network-centred innovation theory approaches is clearly visible. Most notable were the integration of civilian and defence economic sectors and the integration of defence industrial policy tenets in overarching economic policies. The establishment of defence and dual-use clusters and promotion of collaboration from an enablement perspective also fall in this category.

4 People's Republic of China

The Chinese defence innovation system has undergone a fundamental transformation since the end of the Cold War. In the early 1990s, the defence industrial base was inhibited by systemic problems in all relevant areas: infrastructure, institutions, interaction, and actor capability (e.g., Woolthuis, Lankhuizen, and Gisling 2005). In line with the continued modernisation programme of the People's Liberation Army (PLA), both defence procurement agencies and the defence industrial base were subsequently overhauled. These deep reforms have gradually established inter- and intra-sectoral linkages, culminating in the moderately successful civilian-military integration (CMI) policy of 2004 and the more overarching military-civilian fusion (MCF) policy of 2016. The restructuring of the Chinese defence industrial base is boosted by the PLA's modernisation towards "informatised warfare" and the rapidly expanding defence budget (Steindl 2022: 69–108).

4.1 *Organisational Reform: the Two Sessions 2023*

The Chinese DIS organisations have undergone continuous reforms since the 1990s. The Chinese Military Commission (CMC) went through two important reorganisations in 1998 and 2016, with the latter one establishing the current duality structure of the Equipment Development Department (EDD) and the Science and Technology Commission (STC). Civilian organisations also play an important role in guiding the Chinese DIB, further underscored by the economic integration efforts of the MCF. Most notable in this regard are the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT),⁶ and the Ministry of Science and Technology (MOST).

6 With the civilianisation of the Commission of Science, Technology and Industry for National Defence (COSTIND) in 2018 into the State Administration of Science, Technology and

In the March 2023 session of the National People's Congress, a further organisational reshuffling was announced, with the Chinese Communist Party (CCP) absorbing more government functions. Inter alia, this will entail the creation of a Central Science and Technology Commission (CSTC) within the party structures, with a reorganised MOST merely implementing the CSTC's decisions in the future (Lam 2023). The ensuing set-up will not only further delegate decision making to the party and implementation to the ministries. The creation of the CSTC will also mirror the structure of the CMC STC created in 2016. Close alignment of CSTC and STC can be expected in order to further boost MCF efforts, including potential personnel overlaps.

4.2 *Consolidation and Reform of Defence of State-owned Enterprises (SOES)*

The three-year state-owned enterprise reform plan (2020–2022), encompassing expanding party oversight, efficiency, and innovation incentives, was also concluded in early 2023. The plan was deemed a success in light of rising revenues of DIEGS, with major conglomerates such as the CSGC⁷ and the CTEC⁸ reporting increases by twenty-eight and forty per cent, respectively. The consolidation of the Chinese DIB, previously already implemented through mergers of the nuclear, aviation, and shipbuilding DIEGS, has continued with CTEC's absorption of the China Putian Information Industry Group in 2021 (McGerty and Nouwens 2022). SASAC⁹ has already outlined its next reform wave, further focusing on mixed-ownership reforms and deepened collaboration of state-owned and private enterprises (Nan 2023).

4.3 *New Sources of Funding*

Mixed-ownership reforms have been introduced to the DIEGS since 2006 and encompassed the gradual permittance of private investments for subsidiaries. Further liberalisation in this respect would provide additional funding for China's defence industrial base. Whereas the military has in general supported such measures, previous reform efforts were lagging due to the CCP's reluctance of giving up control (Yang 2017). Chinese DIEGS have long profited from the contractual support of the PLA but increasingly rely on the revenue of international arms sales and private sector investments (Mankikar and

Industry for National Defence (SASTIND) subordinated to the MIIT, the latter gained the authority over defence industrial policy formerly located under the CMC.

7 China South Industries Group Corporation, responsible for producing ordonnance.

8 China Electronics Technology Group Corporation. It was established in 2002 and it is assessed as a de facto DIEG.

9 State-owned Assets Supervision and Administration Commission of the State Council, established in 2003 as holding company and oversight body for China's state-owned enterprises.

Bommakanti 2022). The continued growth of the national defence budget by a 7.2 per cent increase in 2023, following a previous one of 7.1 per cent, further adds to this income. The budget will thus exceed the expected annual economic growth of five per cent, with outgoing premier Li Kèqiáng 李克强 indicating that continued budget growth will primarily be steered towards further military modernisation efforts (Xie, Chan, and Ng 2023).

4.4 *Potential New Markets*

With the rapidly increasing domestic demand on defence industries in Russia, another window of opportunity has opened for Chinese armament exporters. Russia has continuously ranked as the second biggest global exporter, and kept this spot in 2022. In the wake of its invasion of Ukraine, Russian defence exports have nonetheless decreased by nearly one third in 2022, specifically towards its two biggest buyers, China and Egypt (SIPRI 2023: 3–5). But should the war against Ukraine continue beyond 2023, this could have an increasing impact on the international arms export market. China has already made inroads in Africa, where Russia controls nearly half the arms market. Specifically in Sub-Sahel countries, China has already emerged as the dominant arms supplier due to its cost-effective solutions. Chinese enterprises are also increasingly able to substitute Russian systems, as the rumoured sale of advanced air defence systems to Algeria shows (Nyabiage 2023a; 2023b).

Both the war demand on the Russian defence industry and new Western sanctions may enable China to supplant Russia as a source for those countries where cost or political considerations prevent governments from acquiring Western arms. China has already considerably expanded its economic and political footprint in Africa, including regular exchanges with the armed forces of the Former Liberation Movements of Southern Africa (FLMSA) (Nantulya 2021). Although not yet determined, current trends may thus enable the Chinese defence industry to further expand its profile on the international arms market.

4.5 *Challenges: Supply Chains, Recruitment, and Sanctions*

Challenges for ensuring indigenous innovativeness and high-technology supply reliance have increased in line with the deterioration of relations between China and the U.S. China occupies a highly preferable position in respect to critical minerals, as it has control of fifty per cent of all concentrated minerals with defence applications. Another forty per cent are controlled by countries with close relationships to China, such as Russia and South Africa (Kuo 2022).

In contrast to that, China is highly reliant on semiconductor machinery and technologies supplied by Western companies. The Chinese government had already established a fund to nurture semiconductor industries in 2014, but has

been impeded by anti-graft probes (Bloomberg News 2023). In October 2022, the U.S. imposed export controls on both equipment and materials as well as U.S. citizens working for Chinese enterprises (Sun 2022). In January 2023, the U.S. reached an agreement with the Netherlands and Japan to follow suit, bringing the only other two countries with manufacturers of advanced chips machinery into the fold (Haeck 2023). The Chinese industry could thus lose access to the most advanced semiconductor machineries, further hampering indigenisation efforts, with detrimental effects for advanced weapons production.

Increasing recruitment problems are interlinked with this new challenge. The Chinese government has utilised one of the historically most extensive recruitment programmes. These encompass more than two hundred talent recruitment programmes, the most notable being the Thousand Talents Plan. Through these plans, both Chinese overseas and foreign experts are recruited, including in sensitive fields of artificial intelligence (AI), nuclear physics, and additional defence-related technologies (Joske 2020). Exemplary is the “Los Alamos Club” of Chinese researchers recruited for military programmes from the Los Alamos Laboratories (Strider 2022). Increasing scrutiny both in respect to semiconductor experts and other crucial technology fields has decreased the outreach of these programmes, and recruitment efforts have further been hampered due to the pandemic and China’s Zero-COVID policy (Sun 2022). Hence an essential pathway for knowledge transfer is weakening.

In addition, the subjugation of governmental institutions under the party – a step back before the reforms conducted under Dèng Xiǎopíng 邓小平, starting in 1978 – and the insertion of party control in state-owned and private enterprises may hinder the newly developed innovativeness of the defence industry. China’s new defence minister General Lǐ Shàngfú 李尚福 may mitigate this effect, considering that he is the former head of the CMC EDD and, before that, commander of the Strategic Support Force (Zhang, Kwon, and Chen 2023). Enabling the PLA’s modernisation shaped his career, but it is not foreseeable in how far this expertise will balance increasing party-control of defence industrial enterprises that have historically struggled with promoting innovativeness, and growing pressure on supply-chains.

5 Japan

Following the war against Ukraine, of the three compared countries Japan has undergone the most extensive reorientation in respect to its defence posture but also defence industrial reform plans. The country has followed a gradual path from its entrenched pacifist stance towards a “normalisation” of defence

matters during the preceding three decades. Growing domestic support for Japanese rearmament, with sixty-eight per cent of Japanese supporting it, further boosts this transformation (The Yomiuri Shimbun 2022).

Previous reform efforts have targeted overall defence industrial policy, acquisition policies, linkages, and defence R&D promotion (Steindl 2022: 109–137). Following the 2007 transformation of the Japanese Defence Agency (JDA) in the Japanese Ministry of Defence (JMoD), all DPA tasks were merged into the civilianised ATLA in 2015. Both organisational reforms strengthened the position of the defence establishment, which previously had been subordinated to other ministries. In 2013, the *kokusanka* 国産化 policy was abandoned, which had entailed nurturing workshares for all system integrators but impeded competition and innovativeness. Most notably, in 2014, the overarching ban on defence exports and technology transfers was replaced by the still strict but more open “Three Principles of Defence Export” (Steindl 2022: 109–137).

5.1 *The National Defence Strategy 2022 and the Defence Build-up Programme*

In late 2022, the Japanese administration under Fumio Kishida 岸田 文雄 launched Japan's new National Security Strategy (NSS) and National Defence Strategy (NDS). In addition, the new Defence Programme (DP) was introduced, which replaced the previous Medium-Term Defence Programme (MTDP). Moreover, the Kishida administration approved a budget increase of 7.8 per cent for the new fiscal year and an overall increase of the budget to two per cent of the GDP until 2027. This equates to an increase of 56.5 per cent over the originally scheduled five-year plan (Takahashi and Kadidal 2022). The new iteration of the NSS for the first time not only includes a paragraph on the defence industrial base, but the new DP also provides a much more specific development roadmap compared to the MTDP (Delamotte and Suzuki 2023).

This adaption of Japan's defence planning instruments follows a continuous recalibrating and the introduction of more focused documents. Since 2006, Japan's Ministry of Defence created new regularly updated instruments focusing on defence technology strategy, technology outlook, as well as technology visions. In 2014, the Strategy on Defence Production and Technological Bases replaced the previous basic policy for defence equipment that established the *Kokusanka* policy (Steindl 2022: 112). Despite that, Japanese DIS planning instruments have not yet established continuity (ibid.: 176–177). Thus, the new DP presents a further recalibration of the planning instrument portfolio that has continuously been expanded.

Complementing that, ATLA has received additional authorities and responsibilities over the last two years. These include: the Future Capabilities Development Centre, focused on harnessing new functions from cross-technology

fields throughout the industrial-life cycle; the Technology Collaboration Support Division, focused on enabling spin-on technologies from civilian and private research providers; and the planned Defence Industrial Policy Office, which will focus on promoting collaboration within the defence industrial base. Additionally, ATLA has gained a technology think tank function to conduct technology foresight (JMoD 2022a: 452–453; 2021: 32).

5.2 *Profitability of the Defence Industrial Base*

Japan's defence industry has long struggled to remain profitable, leading to the exit of more than one hundred enterprises from the sector within the last twenty years (Kosuke 2023). Defence accounts for less than one per cent of Japan's overall industrial output (Hughes 2019: 404). Even Japan's biggest defence contractor Mitsubishi, which receives on average a quarter of all defence contracts, conducts only ten per cent of its sales in defence (ibid.: 408). Profit margins in the Japanese defence sector were on average two to three per cent, compared to ten per cent in Europe and the U.S. (Kosuke 2023). Major enterprises have thus withdrawn from the defence business, but the SME in their supply chains dominantly rely on the defence sector (JMoD 2022a: 469). Although the *Kokusanka* policy entailed the nurturing of major system integrators, the real damage thus unfolded in the defence supply chains (Steindl 2022: 118–119).

The considerable increase of Japan's defence budget and improved planability due to the DP can only partially mitigate these obstacles. Hence, last year's defence white paper and the new DP outline the further pursuance of acquisition reforms focusing on competitive bidding and long-term contracts (JMoD 2022a: 461–462). In January 2023, another new policy was introduced that will increase profit margins by fifteen per cent and recognise price fluctuations of up to five per cent (Kosuke 2023). Just a month later, the government approved an additional bill that will allow the nationalisation of defence industrial facilities when their owner exits the market and their subsequent leasing to other defence industrial enterprises. This is designed to minimise risk and investment levels for defence enterprises (NHK 2023).

5.3 *Promotion of Knowledge Transfers*

Another hindrance to Japanese reform efforts is the enablement of both domestic and international linkages. The "Innovative Science & Technology Initiative for Security" programme of 2015 was designed to attach universities to the DIS, but resulted in an outcry and fell below expectations (Steindl 2022: 124). Based on the Integrated Innovation Strategy 2021, JMoD (2022a: 456) thus participates in the respective council to strengthen collaboration with other

ministries, agencies, but also civilian industries and universities. The establishment of ATLA's Technology Collaboration Support Division in the same year has further formalised these efforts within the DPA.

At the international level, the aforementioned easing of the Three Principles may also open further areas of collaboration. Since 2013, ATLA has concluded agreements with the United Kingdom, Australia, France, Germany, the Philippines, Malaysia, Italy, Vietnam, and Indonesia. Under a whole-of-government approach, domestic defence industries are supported in identifying the demands of specific buyers, addressing them, and exploiting potential export options. Respective efforts have so far targeted India and Vietnam (JMoD 2022a: 479).

Like China, Japan could benefit from new opportunities emerging in markets currently dominated by Russia. Indian reliance on Russian munitions stands at roughly seventy per cent (E. Lee 2022). Similarly, Vietnam's defence equipment originates primarily from Soviet and Russian sources, with the ratio approximated between sixty and seventy per cent. The Vietnamese ambition to both develop a dual-use defence industrial base and reduce reliance on Russian suppliers while expanding collaboration with other partners, may open a door for the Japanese defence industry – if cost-related issues are sufficiently addressed (Nguyen 2022). Financial support to target countries and low-interest loans for domestic defence enterprises are already being made available for that purpose (Sasaki 2023).

In the scope of collaboration, Japan strives to intensify its linkages with NATO countries. In January 2023, a new Memorandum of Understanding (MoU) on Research, Development, Test, and Evaluation Projects was signed between JMoD and the U.S. Department of Defence. The MoU provides the legally binding base for intensified collaboration in emerging technologies. In addition, a non-binding security of supply arrangement was signed between the two organisations to improve supply chains (U.S. Department of Defense 2023). The agreements will further deepen the relationship with Japan's historically most important defence partner, both in respect of collaboration and rationalisation efforts of acquisitions through the Foreign Military Sales scheme.

Aside from the U.S., the most meaningful collaborations have been established with the United Kingdom and Italy. The three countries' defence industries jointly develop a next generation combat aircraft. This is expected to achieve valuable knowledge transfers, an upgrading of both the Japanese defence industrial and human resource bases, as well as provide the launch pad for further bi- and tri-lateral collaboration in other fields (Carrer 2023). Japan's Prime Minister Kishida also participated at the NATO Madrid Summit

in June 2022, signalling closer engagement. The NDS 2022 further outlines the ambition for deeper collaboration with the Scandinavian, Baltic, as well as Central and Eastern European countries, which may also cover deeper defence industrial ties (JMoD 2022b: 22).

5.4 *Challenges: Supply Chains, Arms Export, and Technology Retention*

The biggest obstacle for defence industrial profitability remains with both current export restrictions and the legacy of the overall ban. Until 2022, the Japanese defence industry landed only one major contract, the supply of warning and control radars to the Philippines in 2020 (Abe 2020). Following the new NSS, the Japanese government is thus reviewing the Three Principles, pending further liberalisation, and will create a new forty-billion-yen fund to subsidise defence exports (NHK 2023; Kosuke 2023). Considering increasing competition with China and a potential war over Taiwan, Japan is also addressing supply chain issues. The Japanese government is thus subsidising the founding of a second semiconductor plant by Taiwan's TSMC, the global leader in semiconductor manufacturing (Ishida 2023).

While Japan thus aims to expand collaboration and enable knowledge transfers, knowledge retention also remains an issue. ATLA adopted its "open and closed" strategy on classification in 2016, necessary due to the abandonment of the ban on technology transfers in 2014 and the previously lacking control of dual-use knowledge exports. These efforts are ongoing, encompassing intellectual property management to balance diffusion and retention, technology control, and information security support for enterprises. JMoD also developed the Defence Industrial Cybersecurity Standard and other support schemes for SME (JMoD 2021: 34; 2022a: 469–470).

6 Republic of Korea

Starting with the Yulgok defence industrialisation project launched by the administration of Park Chung Hee 박정희 (1962–1979) in 1974, the South Korean defence industry has made its way from producing licenced small arms to becoming one of the most advanced defence industrial bases in the world (Steindl 2022: 138–175). This process was driven by both financial constraints and the permanent threat of North Korea, and it was achieved through continuous restructuring and recalibration of both the DPA system and nurturing policies. In 2008, the defence sector was defined as an economic growth engine for the overall South Korean economy. Subsequent administrations have followed up on the overarching support for the DIB. Although South

Korean defence enterprises are predominantly in private hands, with notable exceptions such as Korean Aerospace Industries, defence R&D was handled by the Agency for Defence Development (ADD). Beginning in the early 2000s, this part of the industrial-life cycle has also been outsourced to private agents, with ADD narrowing its scope to crucial projects and technology fields.

Important milestones in this respect were the foundation of DAPA as unitary DPA organisation in 2006, merging eight different bodies, as well as complementary linkage mission-oriented bodies after that. Another important step was the abolishment of the specialisation system in 2009, thus opening the defence market to companies that were not designated as defence enterprises. The South Korean government has supported its DIB with extensive public export promotion, spin-on and -off support, and linkage policies.

6.1 *South Korea's "Export Oriented" Defence Industry*

Independently of political orientation, consecutive administrations have continued to support the South Korean DIB and further developed defence industrial policies. Following the Defence Acquisition Program Act of 2018, the Moon Jae-in 문재인 administration (2017–2022) promulgated the Defence Science and Technology Innovation Promotion Act and the Defence Industry Development Act in 2021. These are the most recent iteration of other defence industrial acts aimed at boosting defence innovativeness and international competitiveness. The current administration under President Yoon Suk Yeol 윤석열 has declared its intention to make South Korea the fourth largest arms exporter by 2027, following a decade of the country being among those with the largest relative growth of arms exports (Choe 2023).

In parallel, South Korean governments have also consecutively increased defence spending. This has entailed growing shares for force modernisation and defence R&D in the budget. In 2023, the budget will grow by 4.6 per cent, with the force modernisation growing by two per cent to thirty per cent of the overall budget. The defence R&D allocation is increasing to 8.8 per cent, with a goal of reaching ten per cent of the budget in the near future (Grevatt and MacDonald 2022; Ministry of National Defence [MND] 2022: 141). Defence enterprises have thus profited from both broad public support schemes enabling increasing revenue on the international market and growing domestic demand.

6.2 *Defence Industrial Consolidation*

Despite growing profits, the South Korean defence industrial landscape has undergone a consolidation process similar to Western DIBs. On the one hand, this has been the result of public policy – such as the creation of Korea

Aerospace Industries (KAI) – and, on the other hand, due to market pressures, specifically in the shipbuilding sector. The process is continuing with Hanwha's acquisition of DSME, following the failed overtake of the latter by Hyundai Heavy Industries due to monopoly considerations. Part of Hanwha's reorganisation, the pending acquisition is the last part of its emergence as the dominant South Korea defence industrial enterprise. The holding groups have the stated goals of becoming "Korea's Lockheed Martin" and rising to the top-10 of global defence enterprises (Grevatt 2022a; J. Lee 2022). In addition, the most recent defence white paper states the ambition to include private sector R&D for core defence technologies. This signals a further privatisation of defence R&D on crucial technologies currently administrated by ADD (MND 2022: 142).

6.3 *Evolving SME Support Schemes*

In recent years the focus of defence industrial policy has been on SME, which play a crucial role for innovation within the sector. The 2010s already saw an influx of SME, following the end of the specialisation system (Jang, Song, and Kim 2019: 129). In September 2022, a new Defence Technology Innovation Fund was created, as well as additional measures providing financial support to SME (MND 2022: 142). The effort to further incentivise SME to participate in defence projects also includes the reduction of administrative barriers, joint-bidding schemes, as well as an Offset Promising List that brings foreign and domestic suppliers together for component manufacturing and technology co-operation (Grevatt 2022b; 2022c).

Historically, the offset policy was utilised to further nurturing of the domestic industry and promote technology transfers. The focus has increasingly shifted to the latter with rising domestic capability, and the policy was formerly replaced by the Industrial Co-operation Programme in 2019. The programme is now utilised to implement localisation efforts through local component quotas and boost exports by enabling knowledge transfers to receiving countries (Steindl 2022: 158–159). The funding for localisation projects established in 2010 has been dramatically expanded in recent years, with allocations growing sixfold since 2020. According to DAPA statements, the number of funded projects – fifty-one in 2021, i.e., more than combined during the previous five years – and budget allocation will continue to grow (Grevatt 2022d).

SME support is interlinked with South Korea's emerging dual-use and defence cluster policy. De facto clusters already existed with the Changwon National Industrial Complex, the spawning cell of the Republic of Korea's (ROK) defence industry, and the science and research centre in Daejeon 대전. In recent years, however, further clustering was promoted by local and

national government bodies, and are now recognised and promoted by the MND (Steindl 2022: 161–163; MND 2022: 142).

6.4 *Emerging Defence Export Powerhouse*

Defence industrial efforts and nurturing policies of the last decades have already made South Korea the fastest growing arms exporter. The country had risen to eighth biggest arms exporter and accounted for 2.8 per cent of the global export market in the period 2017–2021, compared to one per cent in the period 2012–2016 (MND 2022: 148). In 2022 alone, South Korean arms exports rose by 140 per cent due to major contracts placed by Poland, Egypt, and the United Arab Emirates (UAE) (Choe 2023). This has not only been enabled by the rapidly growing capability of the South Korean DIB, but also the extensive export promotion schemes.

The K9 Thunder is exemplary for this export success, accounting for fifty-five per cent of the global self-propelled howitzer market in the period 2000–2021. The system's attractiveness for customers was increased through flexible repayment schemes, offset and technology transfer packages, defence industrial collaboration offers, and the adaption of systems to national requirements (Dominguez 2022; Tiwari 2023). The K9 was bought by India, Turkey, Egypt, Finland, Norway, Estonia, Australia, and is under consideration in the United Kingdom and Romania. Components, such as originally German engines, were increasingly localised and have been substituted. Showcasing South Korea's transformation from knowledge importer to exporter, production lines for the K9 will be established in Australia and Poland. Turkey and Poland have received technology transfers for the production of their domestic T-155 and AHS Krab howitzers (E. Lee 2022).

With growing market shares in Europe and Southeast Asia, South Korea is thus well set up to capitalise on growing global demand, as displayed by the contracts for 1,000 tanks and 672 howitzers to Poland and up-to-date air defence systems to Saudi Arabia and the UAE in 2022 (E. Lee 2022; SIPRI 2023: 9–11). By 2022, South Korea had signed Memoranda of Understanding for Defence Co-operation with forty-eight countries, establishing the basis for deeper co-operation and creating export opportunities (MND 2022: 324). The lacking industrial capacity of NATO countries could open additional opportunities in Europe. Both the ROK government and Hanwha have already declared their intention to supply the U.S. and European NATO members, following closer political alignment and collaboration (Tiwari 2023).

Even better than China and Japan, South Korea is well positioned to also substitute for the aforementioned fall of Russian exports. Its defence enterprises

already have entered the Indian market, and agreements on defence cooperation and quality assurance exist with Vietnam (MND 2022: 324). Egypt has become the first African country to acquire South Korean weapons in 2022 (E. Lee 2022).

6.5 *Challenges: Political Alignment and Supply Chains*

South Korea's advantageous position of collaboration notwithstanding, political alignment also increasingly comes under pressure. Under the Yoon administration, South Korea has more firmly aligned with Western countries. The president participated in the NATO Madrid Summit in June 2022, and at the same time South Korea established a permanent mission at NATO headquarters in Brussels (Pardo 2022). South Korea has so far declined to supply weapon systems directly to Ukraine (Choe 2023). Despite that DAPA gave permission for the export of Polish AHS Krab howitzers, based on the K9 chassis, to the Ukrainian Armed Forces in 2022 (Smith and Lee 2023). This alignment will increasingly inhibit collaboration with Western competitors, such as Russia, with whom ADD had for example jointly developed the Cheolmae-2 surface-to-air missile system. The same deterioration of international security that boosts South Korean defence exports will eventually also limit the extent of future collaboration possibilities.

The advancement to sophisticated platforms nonetheless also increases international competition for the South Korean defence industry. It is furthermore faced with the same pressure on supply chains as other countries, specifically in respect to advanced semiconductors. Notwithstanding the permanent need for the export of critical minerals, this may be alleviated by Samsung Electronics' ambition to invest \$230 billion over the coming twenty years and create five semiconductor plants in South Korea (Kim 2023). The MND also pursues further measures targeting supply chain security, including deeper collaboration with the U.S. (MND 2022: 142, 148).

7 Comparative Analysis

The broad reforms implemented in the period 1991–2021 have set up the Chinese, Japanese, and South Korean DIBS to capitalise on the expanding international arms market. South Korea's defence industry has already been able to do so, with the Chinese one geared to fill domestic demand and potentially also in African markets that cannot be covered by Russian enterprises. Japan's defence industry remains obstructed by overarching export controls,

high pricing, and inexperience in the international market. Utilising the DIS analytical framework, this brief assessment shows that previously identified trends have persisted and partially accelerated (Steindl 2022: 176–201). Despite the short period, these include:

1. **Organisations:** following a period of horizontal and vertical DPA integration, the assessed countries now establish dedicated organisations with the mission to promote linkages. The Chinese approach continues to differ from the South Korean and Japanese models.
2. **Actors:** having overcome the financial pressures of the 1990s and 2000s, defence industrial consolidation and the emergence of major system integrators continues. This corresponds to the consolidation and monopolisation dynamics driven by increasingly complex systems and rising prices (Steindl 2022: 52).
3. **Institutions:** the Japanese policy discussion towards a further easing of export restrictions continues, with a liberalisation due to political and public support being expectable. No notable regulatory changes have occurred in China or South Korea.
4. **Networks:** following the policy focus of integrating civilian and defence sectors by counteracting geographic agglomeration tendencies, the promotion of clustering in China and South Korea continues. Likewise, the formalisation of civilian-military networks is promoted in all three countries.
5. **Linkage Policy:** following the policy focus of integrating civilian and defence sectors by abolishing regulatory separation, attention has now shifted to the sustainment and integration of SME and universities as crucial knowledge producers.
6. **Financial Policy:** the ongoing, considerable increase of national defence budgets entails accelerated (re)armament as well as increasing force modernisation and defence R&D allocations. In addition, Japan follows South Korea's path of boosting export promotion schemes.
7. **Acquisition Policy:** while data on China is missing, both Japan and South Korea carry on acquisition policy reform. The Japanese focus on increasing profitability, with plannability and new contract schemes being carried on. Financially, South Korea expands its localisation and offset policies.

The characterisation of South Korea as regional defence industrial policy trend setter is likewise still applicable. This is specifically relevant in respect to export promotion schemes, with Japan envisioning a similar policy and SME support schemes. The deterioration of security in the international system confronts

all three countries with new opportunities and challenges, with the former including the rising demand for armaments in the home region and Europe, but also the potential to absorb Russian market shares in Africa and in South and Southeast Asia.

Challenges are mostly nation specific. For China, the possibility to recruit experts and graduates from Western countries is decreasing and will negatively impact this implicit knowledge transfer. Increasing scrutiny of collaboration in dual-use technology fields with Chinese enterprises and research actors, as well as of investments in China, will also decrease knowledge transfers from Western countries. The expansion of direct CCP decision-making, subjugating governmental bodies, and increased party oversight of defence enterprises may impede innovativeness in the defence sector. Whereas it is too early to assess effects, such party control has historically proven detrimental to reform efforts and was a major obstacle to overcome during the early defence industrial reform phase of the 1990s (Steindl 2022: 71–84).

The polarisation of the international system and closer alignment with NATO will eventually decrease collaboration opportunities for South Korea with partners such as Russia. For Japan, the challenge lies in timely implementing its defence build-up, easing export restrictions, and developing export promotion schemes. If this does not occur, the Japanese DIB will continue to struggle with profitability, market exits, and absorption or replacement by foreign suppliers.

One overarching challenge affects all three countries, namely, supply chain reliance. This is due to the supply chain disruptions experienced during the COVID-19 pandemic and the spectre of accelerated economic decoupling between the U.S. and China. The effect of sanction regimes, such as those on high-technology products targeting the Russian DIB or semiconductor machinery targeting China, have highlighted this threat. Both Japan and South Korea aim to implement measures to increase supply chain security, among other, through collaboration with the U.S.

The issue of semiconductor supply chains has emerged as the most crucial one. Akin to the recently established funding programmes to nurture domestic semiconductor industries in the U.S. and the E.U., China, South Korea, and Japan have already created financial incentives. This is a logical continuation of the indigenisation and supply reliance tenets pursued in all three countries. Considering the uneven distribution of advanced machinery located in the “Western block” and critical minerals in the “China-friendly block,” supply reliance will take a long time to become achievable for both sides. Supply chain disruptions due to decoupling efforts or an actual shooting war could thus wreak havoc on East Asian, but also Western, defence industries, and thus remains the biggest challenge for their continued success.

8 Conclusion

The impact of the Ukraine war, and to some extent the COVID-19 pandemic and bi- and multi-lateral competition, on the international scene has rapidly accelerated armament needs around the globe. The general success of defence industrial reforms in China, Japan, and South Korea has not only provided these countries with capable defence industrial bases and a certain level of domestic supply reliance, but it has also set up their defence enterprises to potentially capitalise on the growing need for advanced weapon platforms.

This is especially relevant considering the preliminary lessons learned from the attrition battles between Ukrainian and Russian armed forces that have highlighted the extensive need for main battle tanks, artillery, air defence, and unmanned systems. South Korea was the country to benefit the most from this increased demand in 2022, building up on its extensive network of collaboration agreements established in the three decades prior. Chinese DIEG s will likely follow suit, on the one hand by absorbing Russian market shares in Africa, Southeast Asia, and in the domestic market, and on the other hand by continuously fulfilling Russian demand for dual-use systems such as civilian unmanned aerial vehicles (UAVs) (Greenwood 2023). Pending political considerations of the Chinese government, this might even extend to military systems in the future. Japanese enterprises, on the contrary, continue to be impeded by export restrictions and may find it hard to assert themselves in the competitive international market. Nonetheless, they too will likely profit from the growing domestic demand of the Self Defence Forces.

The increased sophistication of the three DIB s and the quality of their output is also underlined by policy foci and challenges, most notably increasing SME support schemes and semiconductor supply chain difficulties. Specifically, the South Korean DIS will increasingly encounter the challenges linked to the transition from innovation follower to leader, but the same also applies for at least some technology sectors of the Chinese and Japanese defence industries. Considering increasing Japanese and South Korean alignment with multilateral alliance networks, such as NATO, AUKUS, and the Quad, may ease these pressures through more extensive collaboration networks. Comparable collaboration opportunities are not available for China, as they will remain limited to Russia, Israel, and lagging DIB s such as those of Iran or Pakistan. The subjugation of government agencies under CCP bodies established during the National People's Congress in 2023 and party oversight of DIEG s may also hamper the innovativeness of the Chinese defence industrial base.

The analysis has also underlined the utility of the presented analytical framework for defence innovation systems. Identified trends correspond to

both the case studies presented in my previous study (Steindl 2022) and the transitional defence sector concept. The application of the framework for follow up assessments of the three case studies, and more importantly for additional DIS, will allow further calibration of the framework.

Abbreviations

ADD	Agency for Defence Development
AI	Artificial Intelligence
ATLA	Acquisition, Technology & Logistics Agency
CCP	Chinese Communist Party
CMC	Chinese Military Commission
CMI	Civilian-Military Integration
COSTIND	Commission of Science, Technology and Industry for National Defence
CSGC	China South Industries Group Corporation
CSTC	Central Science and Technology Commission
CTEC	China Electronics Technology Group Corporation
DAPA	Defence Acquisition Programme Administration
DIB	Defence Industrial Base
DIEG	Defence Industrial Enterprise Groups
DIS	Defence Innovation System
DP	Defence Programme
DPA	Defence Procurement Agencies
EDD	Equipment Development Department
FLMSA	Former Liberation Movements of Southern Africa
IPR	Intellectual Property Right
JDA	Japanese Defence Agency
JMoD	Japanese Ministry of Defence
KAI	Korea Aerospace Industries
MCF	Military-Civilian Fusion
MIIT	Ministry of Industry and Information Technology
MND	Ministry of National Defence
MOST	Ministry of Science and Technology
MoU	Memorandum of Understanding
MTDP	Medium-Term Defence Programme
NDO	National Defence Organisation
NDRC	National Development and Reform Commission
NDS	National Defence Strategy
NSI	National Systems of Innovation

NSS	National Security Strategy
PLA	People's Liberation Army
ROK	Republic of Korea
SASAC	State-owned Assets Supervision and Administration Commission of the State Council
SASTIND	State Administration of Science, Technology and Industry for National Defence
SME	Small and Medium Enterprises
SOE	State-owned Enterprise
STC	Science and Technology Commission
UAE	United Arab Emirates
UAV	Unmanned Aerial Vehicle

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