



Security Nexus Perspectives

EMERGING NEW MILITARY TECHNOLOGIES IN NORTHEAST ASIA AND IMPLICATIONS FOR SOUTH KOREAN DEFENSE STRATEGY

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I . Introduction

Military rivalry in Northeast Asia is intensifying, though there is a great disparity in military power among the countries of the region. The recent emergence of innovative military technologies is therefore proving attractive to many. There is now a race to develop a variety of ambitious high-end next-generation weapons and systems, with such platforms expected to offer some military edge in a future war.

It is difficult to predict the consequences of the general development and spread of the emerging new military technologies. It could result in a rapidly accelerating arms race among the countries of Northeast Asia. But the high cost of these technologies, together with incidental demographic factors, could encourage some countries to consider arms control as a more desirable objective.

Emerging military technologies are already impacting South Korea's national security and defense policies, with a quiet revolution currently underway. The ROK-US global comprehensive strategic alliance is no longer focused entirely on combating the North Korean threat: following the Biden-Moon Summit of April 2021 in Washington DC it is now looking beyond the Korean Peninsula to the wider Indo-Pacific region. In line with this broader vision, South Korea is recapitalizing its defense budget, and its five-year defense acquisition plan for 2023-27, published January 21, 2023, includes R&D into various disruptive military technologies intended to increase preparedness for a future war.¹

¹ Sarah Kim, 'Yoon calls for massive upgrades to defense,' *Korea JoongAng Daily*, May 12-14, 2023, p. 2.

II . Why are High-end Military Technologies Needed?

The great power competition between the US and China is indisputably the central strategic issue for Northeast Asia.² US allies need to secure appropriate military capabilities to maintain interoperability and facilitate interaction with the US, and emerging military technologies are becoming more important for this.

Another issue of concern for the countries of Northeast Asia is the development of military technology, which may not continue to be the dominant military power in Northeast Asia.³ Is it time now, or will it soon be time, to shift military capabilities away from a US-dependent and hardware-based alliance towards a more self-reliant defensive strategy? This would imply significant increases in defense budgets and a recapitalization aimed at developing high-end, advanced, and sophisticated military technologies.

Recent developments in hypersonic propulsion will impact both conventional and nuclear weapons and systems, demanding a new level of urgency from information and intelligence technologies, and undermining the current operational concepts for deterrence.

Recapitalization of R&D defense budgets would allow Northeast Asian countries to develop more effective asymmetric military solutions to cope with the more powerful weapons now emerging, such as hypersonic missiles, unmanned vehicles, and autonomous robots.

A new paradigm is needed to prepare for the wars of the future. The pursuit of new types and generations of military technology is not enough, by itself, nor is the conceptual reappraisal of fighting tactics: the two must be seamlessly interwoven.

Large platforms are losing their ascendancy for future wars. In land operations, main battle tanks (MBTs) and tactical artillery guns may no longer dominate ground warfare. Instead, light tanks, infantry fighting vehicles, and mobile artillery seem likely to be the leading actors. Unmanned aerial vehicles (UAVs) will also play a crucial tactical role for information, surveillance, target acquisition, and reconnaissance (ISTAR) missions, greatly improving the battlefield awareness of commanders.

Moreover, the future battlefield, rather than being several independent domains, will instead be a multiple and complex environment. Decisive land warfare in future battlefields will also require air, maritime, space, and cyber dominance. This will extend the range, accuracy, and precision of strike operations, and give early warning to support hardware security on land.

² Sam Tangredi, 'Fighting when the network dies,' *United States Naval Institute Proceedings*, March, 2023, pp. 32-37.

³ See Office of National Security, *The Yoon Suk Yeol Administration's National Security Strategy: Global Pivotal State for Freedom, Peace and Prosperity* (Seoul: The Office of National Security, Republic of Korea, June 2023), chapter II.

Some existing doctrines and operational concepts will need to be radically revised to accommodate emerging military technologies and the new type of battlefield environments. All-domain warfare must encompass and integrate littoral marine regimental operations, expeditionary advanced base operations, distributed maritime operations, manned-and-unmanned team (MUM-T) operations, and situational awareness ISTAR operations.⁴ Moreover, a major battlefield is not only about combat logistics: a supply chain must also be maintained, and ideally with just-in-time support.

III. The Diminishing Importance of Platform-Centric Competition

The security environment of Northeast Asia is at a crossroads. Platform-based military competition has long relied upon MBTs, large-caliber self-propelled artillery guns, flattop aircraft carriers, large surface combatant vessels, long-endurance submarines, stealth aircraft, short/medium-range ballistic missiles, and air defense systems. But several disruptive factors are now driving competition to develop potentially revolutionary technologies.

Globalization has distributed the burden of groundbreaking research across many countries and entities, with fundamental innovations resulting in rapid progress in dual-purpose civil-military technologies.⁵ As well as being much cheaper than relying upon dedicated military R&D, dual-purpose technologies are generally much more convenient to use.

Future battlefield operations and tactics will use GPS, ISTAR, and Position, Navigation, and Target/Time (PNT) technologies to create a Joint Domain Command-and-Control (JDC2) capability. Conventional ballistic and cruise missiles, MUM-T systems, and mid-range hypersonic missiles will all be coordinated, expanding the coverage angle of sensors, the number of targets, and the precision of the strikes. To be militarily effective, these new technologies will need real-time data processing and dissemination, and theater-level ISTAR integration, with systems managed autonomously by Artificial Intelligence (AI).

The most promising emergent dual-purpose technologies are focused on sensors, new materials, and space-based applications including GaN radar, integrated C4ISR, situational awareness, precision-guided weapons, microsystems, biomaterials, directed-energy weapons, improved precision sensors, hypersonic weapons, electronic and cyber-warfare, and space-based ISTAR.

AESA radar with autonomous control capability is being fitted to advanced strategic and operational fighters and to stealth UAVs. This enables precision strikes from long range, without necessarily

⁴ Olivia Savage, Carlo Munoz, and Oishee Majumdar, 'Shoulder-to-Shoulder,' *Jane's Defence Weekly*, 15 February 2023, pp. 20-25.

⁵ Marc Selinger, 'US DoD's Office of Strategic Capital eyes range of investor,' *Jane's Defence Weekly*, 29 March 2023, p. 6.

revealing a military presence. Thus, the Chinese J-20 stealth fighter has long-range target detection and can track more than 50 targets.⁶

In MUM-T operations, UAVs are now becoming much more accurate: the US MQ-4 Global Hawk, MQ-25 Stingray, and RQ-4 Triton UAVs can already coordinate with existing manned fighters. And China's Y-9 can operate as a maritime air surveillance aircraft, while integrated with the TB-001 and BZK-005 UAVs.

Hypersonic propulsion and kinetic-energy short-range air-defense systems are under development. For example, the Chinese PL-series air-to-air missiles range out to 400km.⁷ This is part of China's developing A2/AD strategy using phased array radar and X-band frequency over-the-horizon radar, enabling DF-21/26 anti-ship/surface ballistic missiles to target US Navy Carrier Strike Groups between the first and second island chains.

IV. Adoption of 4IR Technologies for Future Wars

Northeast Asian countries' preparedness for future wars will likely depend upon 4th Industrial Revolution (4IR) technologies such as Big Data Processing, AI, Machine Learning, Virtual Reality, and Augmented Reality. These technologies offer much wider benefits than defense modernization, however, so the realization of emerging military technologies requires establishing close relationships between military/defense institutions and industrial/academic ones.⁸

Most 4IR technologies are produced by civilian companies, or by universities and research institutes. Although incubating such technologies is a high-risk investment, the flexibility offered by such next-generation platforms and systems provides better medium and long-term prospects than simply increasing firepower.⁹

⁶ Michael Dahm, 'Lessons from the changing geometry of PLA Navy carrier ops,' *United States Naval Institute Proceedings*, January 2023, pp. 18-23; Sukjoon Yoon, 'How to Respond to the New North Korean Threat From UAVs,' *38 North*, January 27, 2023.

⁷ Scott Savitz, 'Aerial Minefields can put the miss in missile,' *United States Naval Institute Proceedings*, December 2022, pp. 42-45.

⁸ Gerald Cowan, 'Digital Future,' *Jane's Defence Weekly*, 25 January 2023, pp. 20-25.

⁹ Carlo Munoz, 'Pentagon, US Navy seeking advanced capabilities in micro-electronics,' *Jane's Defence Weekly*, 18 January 2023, p. 5.

The adoption of 4IR technologies has, however, given rise to some concerns about verification, testing, and accountability.¹⁰ Even with 24/7 ISTAR, better battlefield management systems, and all-domain command and control systems, new algorithms will not provide a perfect awareness of theater and battlefield situations: commanders will still be surprised by unpredictable events.

Machines may advise and direct humans, but expert systems will always have flaws.¹¹ AI is a useful tool for generating operational plans and scenarios, but its utility depends upon the quality of the tactical scenarios it has been trained on. 4IR technologies are unproven, thus far, as practical analytical tools for operational monitoring. Consensus military opinion strongly recommends against the use of AI for predicting military outcomes until civilian AI applications of comparable complexity have been more comprehensively assessed: the risks are currently too great¹².

Despite such concerns, the major nations of the West are taking the lead in developing next-generation systems. Exactly what constitutes a 'next generation' is contentious, and sometimes this is just a buzzword, but the real utility of 4IR technologies is now widely recognized. Next-generation platforms are defined by the adoption of a new set of technologies and performance attributes. Sixth-generation fighters are a good example, such as the Future Combat Air System of France, Germany, and Spain, and the Global Combat Air Program of the UK, Italy, and Japan.

Such next-generation systems and programs seek to enhance the capabilities of previous generations by delivering advanced combat performance, additive capacities, and more convenient enablers; they make use of new materials, integrated networking, and autonomous AI. How these next-generation systems will ultimately perform is unclear, but many nations have already committed significant resources to developing 4IR military technologies.

V. Northeast Asia: Arms Race or Arms Control?

Emerging military technologies are providing next-generation weapons and systems which are being deployed in Northeast Asia. So, will this increase the tempo of the ongoing arms race or will it lead to arms control?

¹⁰ David E. Sanger, 'Killer robots become a military nightmare,' *The New York Times International Edition*, May 8, 2023, p. 4.

¹¹ Anthony Zinni, Mie Augier, and Sean F.X. Barrett, 'Innovation: People Are More Important than Technology,' *United States Naval Institute Proceedings*, August 2022, pp. 42-48; Harold James, 'Technology for me, not for thee,' *Korea JoongAng Daily*, May 5-7, 2023, p. 7.

¹² David E. Sanger, 'Killer robots become a military nightmare,' *The New York Times International Edition*, May 8, 2023, p. 4; Lina M. Khan, 'America needs to regulate A.I.,' *ibid*, May 8, 2023, p. 9.

If the new technologies encourage the production of additional weapons and systems to replace obsolescent ones, then a continuing arms race may be inevitable and irreversible. The shift from manned platforms to unmanned and autonomous vehicles will significantly increase lethality. The US, China, and some other Northeast Asia countries are already conducting training exercises involving UAVs, MUM-T operations, and combined integrated units.

On the other hand, high-end military technologies may encourage militaries to reduce the number and scale of their operational and tactical units, given the high cost of the new technologies, and also the increasing pressure from demographic changes with fewer young men available for military service.

4IR technologies are also resulting in a shift away from heavily armed platforms, such as MBTs, heavy fighters and bombers, and large naval combatants such as destroyers, amphibious assault ships, and submarines. The future will belong to smaller lighter platforms with long-range capabilities and high lethality. Unmanned vehicles may also help reduce the possibility of minor conflicts and confrontations leading to all-out war: if no actual humans have been killed in a skirmish, then it should be politically easy to de-escalate.¹³

With the deployment of emerging military technologies, the necessary recapitalization of defense budgets will surely mean a reduction in the scale and number of existing large platforms, and also, probably, a reduction in military personnel. We may hope that the resulting lower profile of defense forces will enable the adoption of less belligerent defense policies towards adversaries, opening up a space for arms control treaties to be negotiated.

VI. Implications for South Korean Defense Policy

The South Korean military has long concentrated on countering and deterring North Korean military provocations. Despite the continuing conventional and nuclear threat from North Korea, South Korean defense and security strategy now needs a broader focus. In the future, the military will rely upon more cutting-edge scientific technologies, with fewer and better-trained personnel.

1. New military technologies and the South Korean defense strategy

Former US president Donald Trump's 'America First' principle cast US military alliances in explicitly transactional terms and this prompted NATO to seek greater strategic autonomy in maintaining European military security. South Korea has likewise recognized the need for strategic defense reforms, for example by acquiring F-35s and developing Hyunmoo-4 ballistic missiles and maritime maneuvering helicopters.

¹³ Peter Coy, 'For one of A.I.'s greatest dangers, look to the military,' *The New York Times International Edition*, May 22, 2023, p. 12.

Concern about China is also driving South Korea's adoption of revolutionary new technologies. The US has long focused on counter-terrorism operations in the Middle East and South Asia, allowing China to emerge as a militarily credible threat to the US and its allies. South Korea's defense budget for 2023 and its 2023-2027 defense acquisition plans reflect this new reality. During 2019-23, defense R&D increased by 12.2% while spending on weapon systems development only increased by 4.5%. President Yoon's government has accelerated this trend toward refocusing the defense budget to acquire new emerging technologies.¹⁴

North Korean military threats have expanded well beyond the legacy threat of conventional military attack. Despite sanctions, North Korea has managed to develop both nuclear weapons and the means to deliver them, though its detailed capabilities remain unclear. Besides UAVs, MBTs, and the KN-25 600mm super-large artillery gun, North Korea has many types of missiles, including an SLBM, (the Pukkuksong-3, tested in a North Korean lake); the solid-fuel Hwasong-18 ICBM; solid-fuel tactical ballistic missiles (the KN-23, apparently adapted from the Russian Iskandar-M, and the KN-24, apparently similar to the US ATACMS); and the recently tested Hwasong-8 long-range cruise missile.

South Korea is already adopting sophisticated dual-use technologies for its defense.¹⁵ The ROK Air Force is developing the KF-21 4.5 generation stealth fighter, and also space-based satellite ISTAR capabilities. The ROK Navy intends to build an aircraft carrier for a naval variant of the KF-21, and also the KSS-III batch- II conventional submarines. The ROK Army, by contrast, relies upon advanced, but still old-style scenario-based MBTs and artillery.

2. Changing Times

The changing security environment of Northeast Asia requires a new approach for South Korean defense and military strategies. South Korea's Smart Technology-based Strong Defense Strategy focuses on mid-term R&D projects.¹⁶ The 2023-2027 defense acquisition plan recapitalizes South Korea's defense budget to develop a new concept of combined/joint coalition operations between the ROK and the US.

This will encompass next-generation platforms, including KF-21 4.5 generation stealth fighters, 105mm mortar-equipped combat vehicles, KSS-III batch- II submarines, and long-range precision-guided hypersonic missiles. Also, sophisticated ISR sensors resembling the US Army AN/TPQ-53 radar, a Korean C-RAM (similar to the Israeli Iron Dome), and integrated All Domain C2 networks capable of being adapted for theaters beyond the Korean Peninsula. Defense Innovation 4.0 requires a 4.5%

¹⁴ Michael Lee, 'Korea: a rising global defense supplier,' *Korea JoongAng Daily*, May 2, 2023, p. 1 & 3.

¹⁵ Michael Lee, 'DAPA deputy highlights punctual, tailored defense industry,' *Korea JoongAng Daily*, May 11, 2023, p. 5.

¹⁶ Michael Lee, 'Korea demonstrates defense tech prowess with expansive weapons arsenal,' *Korea JoongAng Daily*, May 3, 2023,

increase for the 2023 budget, to 55.23 trillion won (\$US 42.4 billion), and the five-year plan will total 315.2 trillion won (\$US 271.8 billion).¹⁷

Besides new technology, new doctrines, operational concepts, and tactical manuals for combined operations between the ROK and USFK are needed.¹⁸ For example, an ROK Strategic Command should be established, subordinate to ROK JCS and the current CFC ROK-US structure, to prepare to counter North Korean nuclear and missile threats.¹⁹ A Combined Forces Combat Development Command has been established, subordinate to the current ROK-US CFC structure, to prepare for overseas expeditionary joint military operations beyond the Korean Peninsula, as agreed at the Biden-Moon Summit of April 2021.

This command will expand integrated Combined Component Operational Command beyond the Korean Peninsula theater-level, to encompass unit-level components from all the services. The ROK-US alliance also needs to build an integrated JADC2 network incorporating the ROK's C2 and ISR, which will need long-range in-depth ISR sensors.

Existing doctrines and tactical manuals are based on legacy military doctrines and outdated force structures. These need to be reformed to align with new US force structures and operations concepts, such as the US Marine Corp's Littoral Regiment, the US Army's Multi-Domain Task Force, and the US Navy's Ghost Fleet. The ROK Air Force has already reorganized its combat development group into an air and space combat research group so that it can share a Common Operational Picture with the US Space Force. (The ROK Army and the ROK Navy are also getting more involved with space, for example, the Cheonri-a satellite now monitors the surrounding seas of the Korean Peninsula.) One project which particularly needs to be ready for all-domain operations is the LPX- II light aircraft carrier currently being developed for the ROK Navy: it must be integrated into a new combined defense posture with the US Navy's distributed maritime operations.

For seven decades the ROK-US alliance has focused on dealing with conventional military threats from North Korea, but significant changes are now necessary to deal with the changing character of the threats. The ROK military needs to be recapitalized, and must also be more closely integrated with USFK²⁰. The ROK-US alliance has suffered a period of relative neglect but now needs to move on.

¹⁷ Sohn Dong-Joo, Choi Hyun-Mok, 'Korean arms companies are on the front lines of defense,' *Korea JoongAng Daily*, May 4, 2023, p. 5.

¹⁸ Michael Lee, 'Hardliner named vice chair of new committee,' *Korea JoongAng Daily*, May 11, 2023, p. 2.

¹⁹ Paragraph 7, The White House, *Washington Declaration*, April 26, 2023, <https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/26/washington-declaration-2/>

²⁰ See Office of National Security, *The Yoon Suk Yeol Administration's National Security Strategy: Global Pivotal State for Freedom, Peace and Prosperity*, chapter V.

VII. Conclusions: Some Takeaways for South Korean Defense Strategy

The Northeast Asian security environment is changing: emerging dual-purpose technologies are certain to be disruptive, and may well be transformative. The feasibility and flexibility of adopting 4IR technologies is now an essential consideration in preparing for a future war. Northeast Asia has several world-class militaries brushing up against one another, and the potential for confrontations is growing.

The status quo has been destabilized by emerging military technologies, some of which will likely erode the military advantage of the stronger players relative to the weaker ones. It is also possible that emerging military technologies may enhance the confidence of some countries which have been reluctant to stand against China, encouraging closer interconnections with allies and partners for collective security.

These technologies do remove the need to define defense postures and operational plans for all-out war: new doctrines and operations need to be developed and adapted, taking into account the next-generation platforms which will be involved in a future war.

South Korea's Defense Innovation 4.0 initiative is focusing on how to adapt dual-use 4IR technologies to retrofit existing weapons and systems, but its five-year defense acquisition plan for 2023-27 also includes R&D of more radical possibilities.

South Korea is not seeking an arms race with North Korea or with any other country and would prefer to work toward arms control. Yet it still seems most likely that the emerging technologies will disrupt and destabilize the Northeast Asian security environment.

This is a transitional time, however, with 4IR technologies as yet unverified for military applications, neither for ongoing operations nor for future war preparedness. Some expect 4IR technologies to dominate future warfare, and to be significantly more effective with fewer human casualties; others see them playing a purely supplementary role to existing platforms and force structures. Only time will tell.



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