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Study on Acquisition Strategies for Advanced Weapon Systems Utilizing Artificial Intelligence: From the Perspective of Technological Obsolescence

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Abstract: With the advancements and widespread application of Fourth Industrial Revolution (4IR) technologies—including artificial intelligence (AI), big data, the Internet of Things (IoT), and Autonomous Transportation Systems—these scientific and technological developments are influencing not only civilian industries but also military science and technology sectors. (1) Background/Purpose: South Korea's military acquisition process still lags behind, reflecting outdated standards that fail to align with the rapid advancements in military science and technology. The current weapon acquisition process may take considerable time to integrate advanced weapon systems, leading to technological obsolescence. This research examines the current state and challenges of South Korea's weapon acquisition system, reviews acquisition strategies of allied countries, and proposes strategies for the South Korean military to adopt advanced technologies such as AI in weapon systems. (2) Study Design/Methodology/Approach: This study employs case analysis, examining relevant legislation, organizational practices, and comparative cases from South Korea, the United States, the United Kingdom, Australia, Sweden, Germany, China, and Japan. Literature review was conducted using prior research results, official government documents, internet sources, and mass media materials. (3) Findings: Advanced nations have recognized the necessity of rapid acquisition systems and are implementing related legislation and organizational reforms, while South Korea's rapid acquisition system—including the Rapid Prototype Acquisition Program introduced in 2020—has achieved limited practical results. Newly acquired weapon systems may still face technological obsolescence. (4) Originality/Value: This study proposes two strategic recommendations: operating a rapid acquisition system that considers the pace of military science and technology advancement, and rapidly acquiring AI-applied advanced weapon systems through evolutionary Required Operational Capability (ROC) concepts. These reforms would strengthen national defense and serve as new economic growth drivers for the South Korean economy.

Keywords: advanced weapon systems; AI acquisition strategy; technological obsolescence; rapid acquisition; Fourth Industrial Revolution; Required Operational Capability (ROC); defense industry; JCIDS; South Korea military; Middle Tier Acquisition

1. Introduction

1.1. Research Background

The advancement of Fourth Industrial Revolution (4IR) technologies—such as Artificial Intelligence (AI), Internet of Things (IoT), and Autonomous Transportation Systems (ATS)—is being broadly applied to military science and technology, facilitating the research, development, and deployment of advanced weapon systems including drones, UAVs, and unmanned weapon systems. The deployment of these advanced weapon systems will fundamentally transform the future battlefield environment and warfare concepts. In particular, the emergence of On-Device AI is expected to bring unprecedented innovation to the acquisition and operation of advanced weapon systems. However, South Korea's weapon system acquisition process does not adequately reflect this advanced weapon system acquisition environment, and in reality, it fails to align with acquisition policies that consider the pace of advancement in cutting-edge military science and technology including 4IR technologies.

In contrast, major military advanced nations such as the United States and the United Kingdom are pursuing visible efforts to effectively incorporate cutting-edge military science and technology into weapon systems and battlefield operational concepts in order to proactively respond to the rapidly developing military science and technology driven by 4IR technologies. The US has introduced the Middle Tier Acquisition (MTA) system as a shortened acquisition system for advanced weapon systems, alongside the evolutionary acquisition system and Advanced Concept Technology Demonstration (ACTD). The UK operates the IRIS (Innovation and Research InSight) fund targeting private companies and research institutes to rapidly apply innovative civilian advanced technologies to military weapon systems.

However, South Korea's weapon system acquisition procedures do not keep pace with the rapid advancement of 4IR technologies, and the country has failed to establish a system for rapid acquisition and deployment of advanced weapon systems based on cutting-edge military science and technology. The Ministry of National Defense has specified ACTD provisions and urgent/rapid force requirements in the 'Guidelines on National Defense Capability Development' (MOD Directive No. 2921), but these have not achieved meaningful results.

An analysis of South Korea's weapon system acquisition reveals that most systems—whether domestically developed (T-50 trainer: 16 years 2 months; K-21 IFV: 17 years 7 months) or procured from abroad (F-15K fighter: 11 years; AEW aircraft: 26 years)—took more than 10 years to acquire and deploy. As a result, even newly acquired weapon systems face the risk of technological obsolescence. Since 2010, only 33 cases were designated as urgent force requirements, and only 8% of those were actually acquired and deployed, demonstrating the need for policy improvements to enable rapid acquisition of advanced weapon systems.

Applying general weapon system acquisition processes to advanced weapon systems incorporating rapidly advancing technologies such as AI, big data, ATS, and ART (Advanced Robot Technology) will inevitably lead to technological obsolescence—even for newly acquired systems. This will negatively impact national security by deploying weapon systems with relatively lower technology levels compared to allied forces' advanced systems.

The issue of rapid acquisition and deployment of advanced weapon systems applying 4IR technologies is not only important from a military and national security perspective but also from a national economic perspective. As demonstrated by the US, UK, and France, weapon acquisition policies significantly influence national economic policies. The global defense industry market reached approximately USD 2.443 trillion at the end of 2023. South Korea's defense industry currently ranks eighth globally, holding approximately 3% of the global defense market (approximately USD 7.33 billion, about 0.51% of South Korea's real GDP of KRW 1,995.6 trillion in 2023). If advanced weapon system development can expand South Korea's defense industry market share to 5% (approximately fifth place globally), the industry could grow to an estimated USD 122.15 billion—equivalent to 0.85% of South Korea's 2023 GDP—thus contributing positively to the South Korean economy.

1.2. Research Purpose

The research purpose is threefold: first, to analyze the environment related to weapon system acquisition, including the Fourth Industrial Revolution, military science and technology, and weapon system development; second, to examine the problems in South Korea's weapon system acquisition system through investigation and analysis of relevant regulations and cases, and to draw implications from allied nations' rapid acquisition systems; and third, to present strategic recommendations for rapid acquisition of advanced weapon systems applying cutting-edge military science and technology.

From 2022's Global Defense Market Yearbook published by KRIT, international arms trade for 2017–2021 totaled 27,204 TIV, a 4.6% decrease from 28,514 TIV for 2012–2016. However, weapon sales of the world's top 100 defense companies grew from USD 524 billion in 2019 to USD 531 billion in 2020 (1.3% growth), and the financial value of global arms trade in 2022 was estimated at a minimum of USD 138 billion (approximately KRW 190 trillion). South Korea ranked 8th among the world's top 10 arms exporters for 2017–2021 with a 2.8% share. In 2024, South Korea's defense exports are expected to surpass USD 20 billion for the first time, potentially reaching fifth place globally.

The defense industry is a high-value-added industry with significant impacts on employment creation and scientific-technological advancement. If South Korea can consistently increase its defense industry capabilities to reach the status of a top 5 global defense exporter, it would create considerable economic benefits, serving as a new growth driver for the Korean economy.

1.3. Research Methodology

This study applies case analysis techniques to derive rapid acquisition strategies for South Korea's advanced weapon systems. The research employs literature review encompassing prior research on the 4IR, South Korea's weapon system acquisition processes and defense industry, allied nations' rapid acquisition strategies, as well as internet and mass media materials. Current status and factual investigations related to South Korea's weapon system acquisition systems were conducted using materials provided by the Ministry of National Defense, Defense Acquisition Program Administration (DAPA), and Korea Defense Industry Association, with case investigations conducted on publicly available data and relevant legislation.

2. Literature Review and Environmental Analysis

2.1. The Fourth Industrial Revolution and Changes in Warfare Patterns

The rapid development and spread of Fourth Industrial Revolution (4IR) technologies—including Artificial Intelligence (AI), Internet of Things (IoT), Big Data, Autonomous Transportation Systems (ATS), and Advanced Robot Technology (ART)—are causing numerous changes and innovations across all areas of human society including politics, economy, society, and culture. Historically, as shown in Table 1, the transformation of civilization and technological advancement have directly influenced changes in warfare patterns. Therefore, the advancement of 4IR technologies is also expected to cause significant changes in future warfare patterns.

Table 1. Transformation of Civilization and Changes in Warfare Patterns.

Civilization Stage	Agricultural Society	Industrial Society	Information Society	Hyper-Intelligent Society
Warfare Pattern	Physical combat / Hand-to-hand	Mechanical / Chemical warfare	Information / Knowledge warfare	Data / Intelligence warfare
Battlefield Space	1D (Ground)	3D (Land, Sea, Air)	5D (3D + Space, Cyber)	5D (3D + Space, GPS)
Command Structure	Commander-centered	Vertical hierarchical	Horizontal network	Hyper-space network
Force Structure	Manpower-intensive	Asset-intensive	Information-intensive	Intelligence-intensive

Source: Ministry of National Defense (2003), 'Vision and Strategies for Korean Military Innovation for Information/Knowledge-Based Defense Capability Building'

The advancement of 4IR technologies will promote the formation of Ubiquitous Network Battle-space (UNB)—a hyper-connected, hyper-intelligent battlefield. UNB refers to a state in which a network-centric operational environment is established where all combat elements communicate, voluntarily cooperate and collaborate, achieving simultaneity and integration of spaces, weapon systems, and means in the battlefield (Choi, 2017). The formation of UNB will enable simultaneous and integrated operation of all combat elements within the same battlefield, increasing operational speed and enabling rapid decisive operations.

Furthermore, 4IR technologies are expected to create new warfare paradigms as a driving force of new civilization development. First, through Military Technical Revolution (MTR) combining 4IR technologies with existing weapon systems, weapon systems' destructive power, precision, and intelligence will be enhanced. Second, through the Revolution in Military Affairs (RMA), which develops integrated combat systems capable of operating multiple weapon systems in the same battlefield, UNB will be established, leading to innovations across military sectors including command structures, unit structures, force structures, combat doctrine, and logistics support systems. Third, 4IR technologies will cause a Revolution in Security Affairs (RSA) at the global level, transcending MTR and RMA by changing concepts, objectives, and scope of warfare.

In response to these changes, nations are competitively developing advanced weapon systems by integrating 4IR technologies into military science and establishing rapid acquisition systems. The Republic of Korea Army has prepared 'Army Vision 2050,' conceptualizing future army postures incorporating 4IR technologies, and is promoting weapon system innovations to realize the future battlefield environment. The Army's envisioned advanced weapon systems are characterized by: (1) all weapon systems hyper-connected on AI platforms, interacting within battlefield platforms; (2) individual combatants augmented to Trans-Super Soldiers through future science and technology; (3) all newly deployed weapon systems capable of autonomous judgment and proactive action via own sensors; and (4) operational support systems capable of independent and sustained missions while minimizing additional support requirements.

Key technologies for Army Vision 2050 Game Changers include: Brain-Computer Interface (BCI) and biological/physical enhancement technologies for Super Soldiers; combat robot technologies including humanoid robots, bio-inspired robots, and swarm drones; energy weapon technologies including lasers and railguns; hypersonic technologies including hypersonic cruise missiles and hypersonic glide vehicles; Non-Lethal (Soft-Kill) weapon technologies; unmanned autonomous vehicles including dronebots, UAVs, and multi-copters; hyper-connected network technologies including AI-based intelligent command decision systems; and energy supply technologies including space solar power, wireless power transmission, and nuclear batteries.

2.2. The Fourth Industrial Revolution and Weapon System Acquisition

J.F.C. Fuller, a British military officer of the Second Industrial Revolution era 100 years ago, stated that 'what determines the outcome of war is not military strategy or leadership but weapon systems, which account for 90% of victory or defeat' (Cheon et al., 2019). Looking at human history, there appears to be a correlation among the intangible elements of military science and technology and military strategy and the tangible element of weapon systems.

Generally, the development of weapon systems originates from military strategy—how to fight. Military strategy and battlefield operational concepts create new requirements for weapon systems, and weapon system development proceeds accordingly. This can be explained by the 'Demand-Pull Theory,' which holds that new product development and innovation must be grounded in customer needs or demand.

Table 2. Demand-Pull Theory vs. Technology-Push Theory.

Criterion	Demand-Pull Theory	Technology-Push Theory
Driver of Innovation	Military strategy and operational requirements drive weapon system development	Technological advancement drives weapon system innovation
Process	Requirements identification → Technology development → Weapon system development	Technology development → Application identification → Weapon system development
Risk	Risk of technology obsolescence when acquisition takes too long	Risk of developing systems with unclear operational requirements
4IR Suitability	Lower suitability in rapidly evolving 4IR environment	Higher suitability; technology-led development aligns with rapid advancement

However, in the 4IR era where technological development is extremely rapid, applying the Demand-Pull Theory to weapon system development may result in technological obsolescence. For military weapon systems requiring massive national budgets and performance levels commensurate with or exceeding those of allied nations' equivalent systems, the 'Technology-Push Theory' may be a more rational alternative—where technology takes the lead in weapon system development, success, and desirable innovation.

Analysis of South Korea's recent weapon system acquisition reveals that the country's planning approach heavily relies on demand-pull, with most recently developed weapon systems arising from responses to North Korean threats, changes in defense policy (military strategy), or defects/obsolescence in current weapon systems.

Table 3. Causes of Major Weapon System Requirements in the South Korean Military.

Weapon System	Cause of Requirement Generation	Category
Short-range anti-tank rocket launcher	Countering North Korea's Seon'gun-ho tank	Response to North Korean Threat
Air-to-ground guided missile	Countering North Korea's long-range artillery	Response to North Korean Threat
Guided rocket (Bigeun)	Countering North Korea's air-cushion vessels	Response to North Korean Threat
Transport aircraft performance upgrade	Preemptive strike strategy (decapitation operation)	Defense Policy Change
Counter-terrorism machine gun	Counter-terrorism capability enhancement (Anti-terrorism Special Act)	Defense Policy Change
New 40mm high-speed grenade machine gun	Current weapon (K-4 machine gun) obsolescence / excessive weight	Current Weapon Defect/Obsolescence
Next-gen light machine gun, new 7.62mm machine gun	Current weapons (K-3, M60 machine gun) obsolescence / insufficient range and firepower	Current Weapon Defect/Obsolescence

The development and deployment of advanced weapon systems means securing appropriate combat power to dominate the battlefield while maintaining a stable level of military readiness capable of protecting the nation and its people in the event of enemy aggression. South Korea's wartime operational plans are fundamentally defensive in nature. Therefore, securing overwhelming combat power through the development and deployment of advanced weapon systems is the most efficient means of deterring war—causing the enemy to abandon its will to fight before war actually begins. This represents the optimal application of the ancient strategic principle of 'subduing the enemy without fighting' (不戰屈人之兵).

The development and deployment of advanced weapon systems applying 4IR technologies has implications not only for military strength but also for the national economy. Korea's export industry, built since the 1960s, drove the country's remarkable economic growth. However, since the 1990s, rising labor costs and competition from low-wage emerging economies have eroded South Korea's competitive advantage. The defense industry, combining advanced science and technology, represents a high-value-added industry that can serve as a new economic growth engine.

Table 4. Major Arms Export/Import Countries (2019–2023).

Rank	Exporting Country	Export Share	Importing Country	Import Share
1	United States	42.0%	India	9.8%
2	Russia	11.0%	Saudi Arabia	8.4%
3	France	11.0%	Qatar	7.6%
4	China	5.8%	Ukraine	4.9%
5	Germany	5.6%	Pakistan	4.3%
6	Italy	4.3%	Japan	4.1%
7	United Kingdom	3.7%	Egypt	4.0%
8	Spain	2.7%	Australia	3.7%
9	Israel	2.4%	South Korea	3.1%
10	South Korea	2.0%	China	2.9%

Source: 2024 SIPRI Yearbook.

If South Korea can expand its defense export share to 10% of the world market (approximately 5th globally), its defense industry exports would reach approximately USD 14 billion (approximately KRW 193.2 trillion), equivalent to approximately 2.1% of South Korea's total exports in 2022. This demonstrates that the defense industry could serve as a significant new economic growth driver for a South Korean economy that has entered a low-growth phase.

3. Case Analysis

3.1. South Korea's Weapon System Acquisition Cases

3.1.1. South Korea's Weapon System Acquisition System

South Korea's defense capability building is based on the Planning, Programming, Budgeting, Execution, Evaluation, and Supplementation System (PPBEES), grounded in Defense Business Act (Act No. 20190) and the Guidelines on National Defense Capability Development (MOD Directive No. 2921). PPBEES is an integrated defense resource management system that comprehensively and systematically seeks the best methods for building, operating, and maintaining military power to achieve defense objectives, thereby enabling more efficient allocation and management of limited defense resources.

Weapon system requirements are classified by time horizon: Long-term Force Requirement (F+8 to F+17 years), Mid-term Force Requirement (F+3 to F+7 years), Urgent Force Requirement (F to F+2 years), and Rapid Force Requirement (F+1 to F+5 years). In general, most weapon systems are reflected as mid- or long-term requirements, taking 3 to 17 years from requirement determination to acquisition and deployment.

The weapon system acquisition process flows from 'Preliminary Research → Basic Strategy Establishment → Exploratory Development → System Development → Test and Evaluation → Initial Production/Deployment → Follow-on Production/Deployment.' The preliminary research phase comprehensively investigates and analyzes the feasibility of research and development, optimal deployment timing, appropriate quantity, defense science and technology level to be applied, and cost-effectiveness.

3.1.2. Operational Status and Problems of South Korea's Weapon System Acquisition System

The greatest problem in South Korea's weapon system acquisition system is that the time required to secure weapon systems is excessively long. The longer the period from requirement determination to acquisition and deployment, the greater the probability of technological obsolescence at the time of deployment.

Table 5. Acquisition Timeline for Major Weapon Systems.

Category	Weapon System	Req. Decision	R&D Period	Deployment	Total Duration
R&D	K-9 Self-propelled Howitzer	May 1992	Dec 1992 – Oct 1998	Dec 1999	7 yrs 7 mos
R&D	T-50 Trainer Aircraft	Nov 1989	Dec 1992 – Jan 2006	Jan 2006	16 yrs 2 mos
R&D	K-21 IFV	May 1992	Dec 1999 – Jun 2007	Dec 2009	17 yrs 7 mos
Purchase (Tech Transfer)	Type 214 Submarine	1997	2000–2007	2007–2018	~10 yrs
Purchase (Overseas)	F-15K Fighter	1994	—	2005–2012	~11 yrs
Purchase (Overseas)	AEW Aircraft	1985	—	2011–2012	~26 yrs

As shown in Table 5, the acquisition timeline for major weapon systems ranged from a minimum of 7 years 7 months (K-9) to a maximum of 26 years (AEW aircraft), with most systems taking over 10 years. Even newly acquired and deployed weapon systems cannot exclude the possibility of technological obsolescence.

3.1.3. South Korea's Rapid Weapon System Acquisition System

Under current South Korean military acquisition legislation and practice, newly acquired weapon systems are generally decided as mid- or long-term force requirements. To overcome this limitation, urgent force requirements can be designated in cases such as: armed conflict, overseas deployment, enemy infiltration or provocation, terrorism, or when military utility of new technologies has been verified through pilot application.

Table 6. Urgent Force Requirement Acquisition Process.

Urgent Requirement Submission	Each service, Joint Chiefs of Staff
↓	
Urgent Requirement Decision	Urgent Requirement Decision Committee
↓	
Rapid Acquisition Project Plan Establishment	DAPA, Services
↓	
R&D (Exploratory & System Development conducted in parallel for rapid acquisition)	R&D Company (DAPA Contracted Company)
↓	
Integrated Test and Evaluation	Service Test & Evaluation Departments
↓	
Production and Deployment	MOD, DAPA, Contractor, Services

(Deployment within 2 years)	
↓	
Operations and Maintenance	Services

However, even among weapon systems designated as urgent requirements, only 8% were actually acquired and deployed. As shown in Table 7, from 2010 to 2016, a total of 33 weapon system types were designated as urgent requirements (averaging 5 types per year), but only 3 were actually acquired and deployed.

Table 7. Annual Status of Urgent Force Requirements in the South Korean Military (Post-2010).

Category	Total	2010	2011	2012	2013	2014	2016
Urgent Requirements	33 types	12 types	5 types	4 types	3 types	8 types	1 type
Remarks	—	Cheonan/Yeonpyeong	NW Islands	Long-range artillery	NK nuclear test	Full-scale war	Terrorism

In August 2020, DAPA established the 'Rapid Prototype Acquisition Program Management Guidelines' and created a Rapid Acquisition Project Team under the Future Force Project Headquarters, introducing a new rapid acquisition pilot program. The target areas for rapid acquisition R&D are 14 technology fields of 4IR-based technologies, including:

- ① AI/Intelligence ② Hyper-connectivity (next-gen communication, network, IoT) ③ Cloud ④ Virtual/Augmented Reality ⑤ Individual Combat System/Wearable ⑥ CPS/Precision Control ⑦ Advanced Biotech ⑧ Advanced Cyber/Blockchain ⑨ Future Protection ⑩ Big Data ⑪ Autonomous Unmanned/Robotics ⑫ Drones (Unmanned Aircraft) ⑬ Advanced Propulsion/Energy ⑭ Advanced Materials/Sensors/Processing (stealth, intelligent sensors, quantum, 3D printing)

In 2021, rapid acquisition R&D procedures were newly established. However, since the acquisition procedures for target weapon systems follow existing acquisition procedures, meaningful results have not yet been achieved.

Table 8. Rapid Prototype Acquisition Program Target Projects.

Category	Target Projects	Service
Drones	Small reconnaissance/strike hybrid drone, kamikaze UAV, rifle-aiming shooting drone, long-range small UAV	Army
Drones	Vertical take-off coastal surveillance drone (rotary wing)	Navy/Air Force
Drones	Vertical take-off surveillance/reconnaissance drone (fixed wing)	Army, Marine Corps
Unmanned Vehicles	Multi-purpose unmanned vehicle	Army
Anti-Drone	Portable anti-drone gun, RADAR-integrated anti-drone solution	Navy/Air Force, Marine Corps
Combat Command System	Commercial smartphone-based small unit combat command system	Army
Wearable Equipment	Wearable underwater search equipment	Navy

Source: Jang Won-jun (2021), 'Leading Defense Industry Promotion Strategy through Rapid Prototype Acquisition Program Activation'

3.2. Foreign Military Cases (Focusing on Rapid Acquisition Systems)

3.2.1. United States

The US military's requirements planning system is the Joint Capabilities Integration and Development System (JCIDS), introduced in June 2003. As shown in Table 9, the JCIDS acquisition and deployment process is divided into three main categories:

Table 9. U.S. JCIDS Acquisition Procedure Categories.

Category	Requirement Timeline	JCIDS Document	JCIDS Decision Timeline
Normal Situation	Future requirement (>2 years)	ICD, CDD	97 days, 103 days
Ongoing Contingency	Urgent requirement (<2 years)	JUON	15 days
Anticipated Contingency	Emergent requirement (<2 years)	JBON	31 days

The US amended the National Defense Authorization Act (NDAA) in 2015 and revised the Other Transaction Authority (OTA) in 2016 to innovate its weapon system acquisition. The MTA (Middle Tier Acquisition) system was established, allowing private companies to develop and test prototypes within 2–5 years before delivery to the military. MTA is subdivided into Rapid Prototyping (developing prototypes using innovative technology within 5 years under actual operational conditions) and Rapid Fielding (commencing R&D or performance improvements within 6 months of requirement decision and completing acquisition within 5 years using proven technology).

For rapid acquisition organization, the US established the Joint Rapid Acquisition Cell (JRAC) and Senior Integration Group (SIC). In 2018, Army Futures Command was newly established, reducing the requirements decision process from 5 years to 1 year and establishing a Defense Innovation Unit to rapidly apply excellent civilian technologies to defense. Obama's PCAST formalized the Advanced Manufacturing Partnership (AMP) program in June 2011, and Trump's Executive Order 13806 in July 2017 promoted broad application of 4IR technologies to both civilian and military sectors.

US rapid acquisition prioritizes speed of acquisition over completeness of technology or performance. Even if target weapon systems do not fully meet ROC or required performance, if the weapon system's performance is at an acceptable level for mission accomplishment, it is acquired and deployed, with follow-on performance improvements planned.

3.2.2. United Kingdom

The UK's weapon system acquisition system manages the entire lifecycle from requirement decision to disposal through the 'Total Life Cycle System Management (TLCSM)' concept. The Equipment Capability Customer (ECC) handles requirements submission, while the Defence Equipment and Support (DE&S) and Chief Scientific Adviser (CSA) handle R&D. The Equipment Plan (EP) covering the next 10 years is prepared based on the Defence Vision and Defence Strategic Guidance.

The UK's rapid acquisition system is the Urgent Operational Requirements (UOR) system. UOR refers to requirements for equipment and materials needed by the military to overcome operational capability limitations or force gaps in ongoing or imminent operations. UOR approval conditions include: (1) acquisition of capabilities for specific operations; (2) acquisition of equipment to overcome newly identified force gaps; (3) acceleration of ongoing programs; (4) bridging force gaps until currently budgeted programs become operational; and (5) programs for which budget was not pre-allocated.

For rapid acquisition, UOR-approved weapon systems accept approximately 80% of required operational capabilities and are acquired primarily through direct purchase. The UK's UOR acquisition process follows: Requirement Identification → Acquisition Method Identification and Approval → Acquisition → Deployment (IOC achievement) → Operations (FOC achievement) → Evaluation (decision on program continuation within 12 months of IOC). This system is similar to applying evolutionary ROC—deploying at the Initial Operational Capability (IOC) standard first, then reaching Full Operational Capability (FOC) in the operational phase.

3.2.3. Other Countries

Australia's rapid acquisition system is the Rapid Prototyping, Development and Evaluation (RPDE) program—a mechanism where the military and industry-academia collaborate to strengthen and accelerate military combat capabilities. Since RPDE's introduction in 2005, over 250 organizations have participated and more than 140 programs have been conducted, achieving successful prototype development.

Sweden does not operate a separate rapid acquisition system because its acquisition approach prioritizes speed and budget savings from the outset. Sweden's acquisition priority order is: overseas or domestic purchase, performance improvement of existing systems, joint international R&D, and domestic independent R&D. By maximizing use of already-released or commercially mature systems, Sweden naturally maintains relatively short acquisition timelines.

Germany has been developing various innovation policies since 2006, establishing Working Groups for Industry 4.0 in 2012 and launching 'The New High-Tech Strategy Innovation for Germany' in 2014. Germany's Industry 4.0 strategy aims to build industrial ecosystems driven by 4IR technologies, pursuing optimized manufacturing systems integrating high-performance industrial facilities, IoT, and Cyber-Physical Systems (CPS).

China's 4IR response strategy is encapsulated in 'Made in China 2025,' aiming to achieve hardware innovation and soft infrastructure construction through the Internet Plus strategy to improve manufacturing innovation capabilities. Key strategic industries include advanced robotics, electric vehicles, information technology, new materials, biopharmaceuticals, aerospace, marine engineering, agricultural machinery, and power equipment.

Japan's 4IR response strategy is government-led, aimed at escaping the long-term economic stagnation and securing new growth drivers. Japan announced a 'New Industrial Structure Vision' selecting 7 strategic promotion areas: data utilization environments, human resource development and employment flexibility, innovation technology acceleration, financial function strengthening, industrial structure transformation, 4IR spillovers to SMEs and regional economies, and advancement of 4IR economic and social systems.

4. Strategic Suggestions

Military science and technology is advancing at an unprecedented rate due to 4IR technologies, and the advancement of weapon systems applying cutting-edge military science and technology is proceeding competitively with massive policy support from national governments. South Korea's weapon system acquisition system still remains in the past, experiencing difficulties in rapid acquisition and facing concerns about technological obsolescence even for advanced weapon systems.

4.1. Operating a Rapid Acquisition System Considering the Pace of Military Science and Technology Advancement

The acquisition of advanced weapon systems incorporating rapidly advancing military science and technology—such as AI, Big Data, IoT, ATS, and AR—using past weapon system acquisition systems may result in advanced weapon systems that are inadequate for actual operational use due to technological obsolescence, even if newly acquired and deployed. Therefore, it is necessary to operate a rapid acquisition system for advanced weapon systems that considers the pace of military science and technology advancement.

DAPA introduced the 'Rapid Prototype Acquisition Program' in 2020 with an initial budget of KRW 30 billion. This program purchases commercial products applying 4IR technologies (AI, drones, unmanned weapon systems) or conducts military pilot operations, then connects these to military requirements for rapid follow-on acquisition and deployment. The program benchmarks the US rapid acquisition system and aims to drastically reduce acquisition and deployment timelines compared to the existing 10–15+ year acquisition process. However, this program has not achieved meaningful results due to institutional limitations and early-stage constraints.

The following seven strategic measures are proposed for improving South Korea's advanced weapon system rapid acquisition system:

1. Legal foundation establishment: Revising or enacting new legislation related to advanced weapon system rapid acquisition. The current basis is the Defense Business Act and Guidelines on National Defense Capability Development. The current 'Rapid Prototype Acquisition Program' should be elevated from a pilot program to an institutionalized regular system.
2. Personnel and organizational reinforcement: Establishing dedicated rapid acquisition personnel and organizations. Currently, there are no dedicated rapid acquisition personnel and organizations for advanced weapon systems. Related legislation should explicitly codify provisions regarding rapid acquisition personnel and organizations.
3. Adequate budget securing: Ensuring flexible and sufficient budgets for advanced weapon system rapid acquisition. Legal provisions should be established to enable reallocation of reserve funds when needed, preventing budget shortfalls from constraining rapid acquisition.

4. Activation of the current 'Rapid Prototype Acquisition Program': Expanding the program by encouraging more companies to participate, offering incentives, and providing priority rights for follow-on production and deployment projects for companies meeting certain criteria.
5. Expanding the scope of target projects: Currently limited to purchase projects; application to advanced weapon system purchase projects and some R&D projects should be permitted. For R&D projects, rapid prototype acquisition should only apply when technology maturity level (TRL 6–7 or above) has been verified.
6. Strengthening linkage with service requirements: Ensuring that from the requirements submission stage, the period from submission to acquisition and deployment is ideally within 3 years. For advanced weapon systems, if this exceeds 3 years, there is high probability of failure to deploy weapon systems with appropriate technology levels at the required time.
7. PPBEES system improvement: The current PPBEES system's physical limitations make rapid acquisition difficult despite legal and institutional improvements. A new planning management system dedicated to advanced weapon system rapid acquisition should be established and institutionalized at an equivalent level to the current PPBEES system.

4.2. Rapid Acquisition of AI-Applied Advanced Weapon Systems through Evolutionary ROC

The core of institutionalizing and establishing the rapid acquisition system for advanced weapon systems is the ability to acquire and deploy weapon systems with appropriate technology levels and performance demanded by the services, at appropriate costs, at the time required by the services. Therefore, the trade-off between the technology level applied to weapon systems and acquisition costs must be carefully considered from the requirements submission stage.

Required Operational Capability (ROC) refers to the performance (technology level) and capability that satisfies the operational concept of weapon systems required by the service to achieve military strategy objectives. ROC determined at the requirements submission stage is the most critical and important element determining the cost, timeline, and performance of the weapon system acquisition program. However, ROC that does not align with reality, excessive or insufficient ROC requirements, or outdated ROC requirements that fail to consider technology advancement trends are frequent causes of acquisition disruption or public distrust.

The evolutionary ROC concept addresses this by phasing the ROC applied to weapon systems over time—rather than spending enormous costs and extended periods developing and deploying a perfect weapon system at once—thereby deploying weapon systems that meet requirements at the appropriate time. This is particularly well-suited for advanced technology weapon systems.

For AI-applied advanced weapon systems, there are physical limitations in achieving required target performance from the initial application of AI models to unmanned weapon systems. This is because even if AI models were developed through training data during the development process, their performance may be relatively lower than training performance under actual battlefield conditions. AI models will continuously improve performance through self-learning during actual operational deployment, and data accumulated during operations will cause performance to improve dramatically at certain points. Therefore, for AI-applied unmanned weapon systems, the ROC required by the service should be phased using the evolutionary ROC concept so that the final target performance can be achieved at a specific time, enabling acquisition of weapon systems that fulfill service-established ROC at the appropriate time.

5. Conclusions and Implications

5.1. Summary and Conclusions

The Fourth Industrial Revolution is having a profound impact on all areas of modern society, with technological advancement proceeding at an unprecedented rate. This has led advanced nations to competitively establish government-led response measures. The 4IR is also significantly influencing military sectors, affecting the rapid advancement of military science and technology and the acquisition and deployment of advanced weapon systems.

Nations are proactively implementing rapid acquisition systems to prevent technological obsolescence concerns arising from the very fast pace of military science and technology advancement. South Korea introduced the 'Rapid Prototype Acquisition Program' in 2020 and has institutional arrangements for 'urgent force requirements' and 'rapid force requirements,' but their practical effectiveness remains very limited.

To institutionally establish rapid acquisition and deployment of advanced weapon systems, South Korea must: first, prioritize relevant legislation; second, reinforce dedicated rapid acquisition personnel and organizations; third, secure adequate budgets; and fourth, activate and expand the current 'Rapid Prototype Acquisition Program.' The scope of target projects should be expanded, linkage with service requirements strengthened, and PPBEES improved or replaced with a dedicated planning management system for advanced weapon system rapid acquisition.

For rapid acquisition of advanced weapon systems, applying phased acquisition methods such as evolutionary ROC is also necessary. ROC set at an excessively high level may result in prohibitive costs, extended timelines, or acquisition failures. Therefore, appropriate ROC levels must be set or ROC should be phased from the requirements submission stage—particularly for 4IR technology-based advanced weapon systems, where evolutionary ROC should be applied with practical acquisition methods that prevent technological obsolescence.

5.2. Implications

This case study confirmed the necessity of a rapid acquisition system for advanced weapon systems applying 4IR technologies, and demonstrated that the activation of rapid acquisition systems can have significant positive impacts on South Korea's national security and economic growth. Nations are competitively pursuing 4IR response efforts under government leadership, establishing and vigorously promoting relevant policies, and implementing rapid acquisition systems for advanced weapon systems. South Korea also recognizes this necessity and has introduced the 2020 'Rapid Prototype Acquisition Program,' but has not achieved visible results due to institutional limitations.

The acquisition of advanced weapon systems is essential not only for national security through military strength enhancement but also for economic growth, considering the defense industry's impact on the national economy. The activation of rapid acquisition programs and defense industry cultivation could potentially serve as new growth drivers for South Korea's low-growth economy.

5.3. Research Limitations and Future Directions

This case study confirmed the necessity of a rapid acquisition system for advanced weapon systems applying 4IR technologies. However, since most research-related baseline data pertains to classified military information due to the nature of the research subject, there were limitations in collecting and analyzing sufficient data. Additionally, data was selectively investigated from South Korea, the US, UK, and a limited number of other countries where data investigation was feasible.

Future research on South Korea's acquisition strategies for advanced weapon systems applying AI and other cutting-edge technologies should conduct more comprehensive investigation and analysis of acquisition systems not only in South Korea but also in military advanced nations including the US, to derive more substantive research results.

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