Recent developments in science and technology, as represented by the dramatic advancement of Information and Communications Technology (ICT), has impacted a variety of areas, triggering significant and revolutionary changes in many areas such as economy, society, and lifestyle.

The military sphere is no exception. Developed countries, including the United States, consider that transformations driven by advances in ICT can dramatically improve combat and other capabilities, and therefore, continue to pursue a variety of ICT research and policies.

For example, if information on enemy forces collected by using information-gathering systems, including reconnaissance satellites and unmanned aircraft, is shared on a network, command and control can be exercised immediately, even from remote headquarters, and offensive power can be directed swiftly, precisely, and flexibly against targets.

Additionally, new ICT technology has been developed in recent years. For instance, in August 2016, China launched a satellite called “Mozi” to perform the world’s first quantum cryptographic communications\(^1\) testing. Then in January 2017, it was said that they succeeded in using Mozi for long-distance quantum cryptographic communication between China and Australia. Going forward, new technologies such as quantum cryptography communications could potentially be applied to the military field in various countries in the future.

Furthermore, there is the possibility that a revolution in military logistics will occur due to the 3D printing technology, for example by allowing the procurement of parts that does not rely on inventory. For instance, in August 2017, the U.S. Navy announced that they carried out a demonstration experiment on mobile 3D printer equipment capable of manufacturing replacement parts\(^2\) in forward-deployed regions.

Major countries with sophisticated and modernized military forces, place emphasis on improving the destructive capabilities of weapons, precision guidance technology, information-related technology including C4ISR, unmanned technology (e.g., drones),\(^3\) artificial intelligence (AI) and big data analysis,\(^4\) and hypersonic technology\(^5\) to be able to carry out more precise and effective attacks. Recently, reports have been published of successful tests of railguns\(^6\) and high energy laser weapons\(^7\) that are expected to provide effective repower compared to existing weapons, such as artillery, in terms of their cost per ring, range, precision, promptness, and other aspects. Furthermore, there have been reports about the development of high speed strike weapons (HSSW) that can strike even long-range targets with conventional weapons, quickly and with pinpoint accuracy.\(^8\)

Recent research of the Defense Advanced Research Projects Agency (DARPA) of the U.S. Department of Defense (DoD) has pointed out a variety of advanced research and development in small unmanned aircraft

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1. Quantum cryptographic communication is a method of communication that relies on quantum cryptographic technology, an encryption technology that makes use of quantum properties, and it is said that third parties cannot decode it.
2. Associated equipment that includes 3D printers is stored in a container, allowing some parts to be manufactured immediately and on the spot.
3. Drones for military use such as unmanned aerial vehicle (UAV), unmanned ground vehicle (UGV), and unmanned maritime vehicle (UMV) have been developed (UMVs may be classified into unmanned surface vehicle (USV) and unmanned underwater vehicle (UUV)). It is suggested that these drones could shift from human-operated types to fully autonomous types, as known as Lethal Autonomous Weapons Systems (LAWS). Furthermore, within the framework of the United Nations Convention on Certain Conventional Weapons (CCW), discussions are taking place on the operation of systems that automatically kill enemies without human judgment from the perspectives of their characteristics, human intervention and international law.
4. For example, in the United States, DARPA and the Air Force are engaged in joint research and development of the Hypersonic Air-breathing Weapon Concept (HAWC), aiming to apply the technology to hypersonic missiles, etc. in the future. HAWC uses the technology of scramjet engine, which enables hypersonic flight by taking in air at hypersonic speed and burning it without reducing the speed to below the speed of sound. Furthermore, Russia is developing Zircon, an anti-ship hypersonic cruise missile, which has been attracting attention for its performance and nasal vessel it will be deployed on.
5. A railgun is a weapon that shoots bullets by using the magnetic field generated from electric energy instead of gunpowder. The U.S. Forces are developing a railgun with a range of about 370 km, or about ten times that of the existing 5-inch (127 mm) ammunition. A single railgun shot reportedly costs 1/20th to 1/60th the price of a missile.
6. The U.S. Forces are developing hypersonic cruise missiles capable of providing strong high-attitude air defense capabilities against small ships and drones, and firing tests have been carried out. It is considered that these high energy laser weapon systems will be miniaturized, with a possibility for placing the weapons on light mobility vehicles. In addition, tests have been conducted on integrating the high energy liquid laser area defense system (HELLADS) with the ground-based laser weapon system, since 2017. Tests have also been carried out to bring down unmanned aircraft by using lasers in efforts to put the technology to practical use.
7. Said to fly at lower orbital altitudes than ballistic missiles with the aim of greatly reducing the time required for conventional weapons attack.
Trends Concerning Defense Production and Technological Bases

Recently, Western countries in particular have continued to face difficulties when they try to increase defense budgets significantly. On the other hand, the sophistication of military science and technology and the greater complexity of equipment have escalated development and production costs and have raised unit prices for equipment procurement. Under these circumstances, many countries are taking on a variety of initiatives in order to maintain and enhance their national defense production and technological bases.

Western countries have set a target to increase competitiveness through realignment of their defense industry, based on the aforementioned situation related to national defense budgets. The United States has experienced repeated mergers and integrations among domestic corporations, while Europe has experienced cross-border mergers and integrations of the defense industry, especially in Germany, France, the United Kingdom, and Italy.

In response to the escalation of development and production costs, Western countries are promoting joint development and production and technological cooperation related to equipment among their allies and partners. This move aims for (1) splitting development and production costs, (2) expanding demands in all countries participating in joint development and production, (3) mutual complement of technologies, and (4) raising domestic technology levels by obtaining the latest technology.

For example, the joint development and production of the F-35 fighter jet led by the United States is the largest joint program. At present, there is anticipated demand for around 3,200 aircraft. This project will have impacts on the defense production and technological bases of the countries involved, through the operation, sustainment and maintenance stages of the aircraft.

Additionally, there is an increasing number of cases where governments are providing funding for national defense-related research and development conducted by the private sector. In the United States, for example, approximately US$3.17 billion in research and development funding was requested for FY 2018 to DARPA whose mission is to make investments in breakthrough technologies that will contribute to national security. The defense authorities have long provided substantial funding for the research conducted by companies and universities. The EU has also promoted a gradual process on the framework to fund research related to defense technology, against the backdrop of the consistent decline in national defense research expenditure.

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9 DARPA has announced plans to carry out flight tests in 2019 with the aim of testing the airborne launch and recovery of unmanned aircraft.
10 The Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV) (“Sea Hunter”) is capable of navigating several thousand kilometers for months without crewmembers on board through constant remote supervision by humans. In August 2016, this vessel allegedly completed its initial sea trials ahead of its deployment by the U.S. Navy slated before the end of 2018.
11 In May 2017, DARPA announced the development of the spaceplane, “XS-1,” capable of launching satellites quickly and at low cost.
12 It has been reported in the media that the report released by the Combating Terrorism Center of the United States Military Academy has pointed out the possibility of improved performance in unmanned aircraft used by terrorist organizations, including increased loading capacity and boosted flight range.
13 It has been reported that the DoD launched a 700 million dollar project as a measure against drone attacks by terrorist organizations such as ISIL.
14 There are nine countries involved in the joint development and production of the F-35 fighter jets, which are Australia, Canada, Denmark, Italy, the Netherlands, Norway, Turkey, the United Kingdom, and the United States. Countries acquiring them include Israel, the ROK, and Japan, and the defense production and technological base of these countries is involved in their production and sustainment.
15 DARPA is the DoD agency. Approximately 100 program managers, who are hired for limited stints, generally three to five years, oversee around 250 research and development programs. It does not have its own research and development facilities.
by member states over the past 10 years. In 2017, the EU commenced Preparatory Action on Common Security and Defence Policy (CSDP) - related research in which it will provide €90 million over three years to more than 12 national defense research programs, with the European Defense Agency as the implementing body of this framework.

Countries have exported equipment overseas since the Cold War era, and even today, many countries are taking measures to promote exports.

Exports of equipment to the Asia-Pacific region have increased in recent years. This has been underpinned by economic growth in the region as well as the growing influence of China, the existence of territorial disputes, and responses to the enhancement of military buildup in neighboring countries. Countries such as China and the ROK have expanded exports of affordable equipment due to the development of the infrastructure required for production of equipment with the past imports of equipment and the improvement of capabilities in science and technology.

Importing countries adopt offset policies in order to keep a good balance between improving defense capabilities through imports and developing domestic defense production and technological bases, including setting requirements that domestic companies would be involved in parts manufacturing as a condition for procurement of equipment and services from abroad.

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16 The EU has launched a funding program called “Horizon 2020” for research and innovation to which it has committed 80 billion Euros over the seven-year period from 2014 to 2020. However, the provision of funds is limited to research for civilian or dual-use technology. In the United Kingdom, the Defence Science and Technology Laboratory (DSTL) has a budget of £6 million in FY2017 and regularly solicits conceptual demonstration research topics in order to fund research with a novel, high risk and high potential earning rate to develop capabilities for U.K. defense and security.

17 The definition of offset in defense trade encompasses a range of industrial and commercial benefits such as co-production, licensed production, subcontracting, technology transfer, purchasing, and credit assistance, technology transfer, assistance in purchase and payment, to “Offsets in Defense Trade Version Twenty-First Study” by the U.S. Department of Commerce Bureau of Industry and Security.