포스트 코로나 시대의
국제방산 협력방안 연구

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ACRONYMS AND ABBREVIATIONS

AESA Active Electronic Scan Array

AMRAAM Advanced Medium Range Air to Air Missile

ASRAAM Advanced Short Range Air to Air Missile

AU Austrailia

BE Belgium

CA Canada

CAP Combat Air Patrol

CAS Close Air Support

CDP Concept Demonstration Phase

CSA Chief Scientific Advisor

C4 Command, Control, Communication and Computer

C4ISTAR Command, Control, Communications, Computers, Information, Surveillance, Targeting, Acquisition and Reconnaissance

DAPA Defense Acquisition Procurement Administration

DE Data Exchange

DMSB Dual Mode Seeker Brimstone

DNO Defence Nuclear Organization

DSIS Defence and Security Industrial Strategy

DSPCR The Defence and Security Public Contracts Regulations

DoD Department of Defense

DK Denmark

FCAS Future Combat Aviation Systems

FMS Foreign Military Sales

FSAF Forward Surface to Air Family of missile systems

GAO Government Accountability Office

GBP Great British Pound

GPA Agreement on Government Procurement

GDP Gross Domestic Product

GE Germany

G2G Government to Government

IEPG Independent European Program Group

IOT&E Initial Operational Test and Evaluation

ISR Intelligence, Surveillance and Reconnaissance

ISS Institue for Strategic Studies

ISS In-Service Support

IT Italy

JA Japan

MMCM Maritime Mine Counter Measures

MOD Ministry of Defence

MOU Memorandum of Understanding

NAO National Audit Office

NATO North Atlantic Treaty Organization

NL Netherland

OCCAR Organization for joint Armament Co-operation

PAAMS Principal Anti-Air Missile System

PAUC Program Acquisition Unit Cost

PSFD Production, Sustainment and Follow on Development

R&D Research and Development

RAF Royal Air Force

S&T Science and Technology

SDD System Development and Demonstration

SSRO Single Source Regulation Office

T&E Testing and Evaluation

TAA Technical Assistance Agreement

UK United Kingdom

UKIP United Kingdom Independence Party

US United States of America

1. Introduction

The world before COVID-19 was relatively stable in the US-centered order system after the Cold War, and the economy also enjoyed a boom. However, the situation has changed rapidly since COVID-19. The deepening U.S.-China conflict, Britain's Brexit, and Lysia's invasion of Ukraine are making the international situation tense, and economic pressure on high prices is amplifying these problems. There is also a trend of change that has continued since before COVID-19. There are growing voices calling for peace to extend human security and quality of life, claiming climate change as a substantial threat, and coexistence with nature. Then, what is the most important characteristic of the international situation in the post-COVID-19 era?

Korea's defense Industrial policy has been clearly distinguished at home and abroad, and the government has recognized the exclusive status of some companies, such as designating defense industries and designating defense companies, and has implemented a national security-first domestic policy for the past 40 years. And the defense policy in the foreign sector was focused on exports. Therefore, most of the policies focused on laying the foundation for exports and operated a consultative body that could discuss market development groups, conferences, MOUs, and defense industry issues. Furthermore, as an incentive for technology development for export, policy projects and systems were improved, such as the development and development of weapons systems and support for testing and evaluation for export.

However, in the post-COVID-19 era, despite the achievements so far, it is necessary to change these defense industry policies. The biggest industrial feature after COVID-19 will be the arrival of the era of the 4th industrial revolution. The development of artificial

intelligence and the increase in drone use may change the concept of war, and it can be seen that the conditions for game changers to be born are being created like guns and traps in the previous industrial revolution era.

This paper aims to renew the meaning and purpose of international cooperation measures by focusing on the UK's defense industrial policy and international joint development cases, and to check whether there is any part that can be linked to the domestic defense industry promotion policy. It is trying to seek international cooperation measures considering even ways to foster the domestic defense industry. The purpose of this paper is to find Korea's international cooperation plan through defense industry policies and technology-oriented cooperation cases linked to the international situation.

2. International Relations in the Post-Corona Era

2.1 China threat in the western perspective

Chinese threats have been steadily raised in various perspectives of Western-centered international relations. China's threat theory focused on China's challenge to the international system, analyzing China's rise centering on the relationship between hegemony pursuit and violence of powerful countries. However, in the real international community, China has shown a cooperative and peace-oriented attitude along with the expansion of its own national power, and these differences between theory and reality have raised fundamental problems in the adequacy of China's threat theory.

In more detail, the Western world emphasizes the logic that national power expansion based on the premise that only powers

acting with the responsibility to the international community can be treated as powers entails corresponding responsibilities (Deng Yong, 2001:359-360) and that they enjoy privileges or status as powers, but also maintain and protect the international system Responsibility as a powerhouse is a basic principle that stipulates the obligation to contribute to the maintenance and development of the world order (Yongjin Jang and Greg Austin, 2001:4). In the West, it is recognized that a responsible power can be established through three stages of development. The third stage of development to become a responsible power can be divided into compliance with the first stage of international law, resolution of international problems through diplomatic compromise, contribution to the international community through the second stage of civilization development, respect for human rights, and democratic rule (Rosemary Foot, 2001).

From the Western point of view, China must play a three-step role in order to become a responsible power in a true sense, and it emphasizes that it must accept the multilateral approach that constitutes the background of the Western concept of a responsible power. The multilateral approach focuses on strengthening the binding power of the international system to the state, and the main focus is on recognizing the state control of the international system through coercion if the state violates the norms and principles of the international system. Therefore, China's acceptance of multilateral approaches means that in the process of expanding participation and activities in the international system, China must comply with the norms and principles stipulated by the national system and acknowledge some degree of sovereignty interference by the international system (Johnston, 1999).

The West argues that in order for China to become a truly responsible country by accepting English school and constructivism

approaches, it is necessary to change China's national interest or worldview at a more fundamental level. In other words, if China participates in the international system and socializes through continuous interaction, it can be transformed into a truly responsible state when changing its interests and worldviews in line with the norms and values pursued by the international system (Wendt, 1999). The most important concept in the socialization process is learning. In the West, China sees the process of ultimately accepting the norms and values of the international system as learning and argues that China can become a responsible country when achieving fundamental changes within the country and cooperating more actively with the international system (Levy,1994)

In this way, the West connects China's rise with the theme of responsibility of the international community and emphasizes that China must show responsible external behavior in order to be respected as a true power in the international community. However, in the West, China's fundamental change-institutional change and constructivist change are required as prerequisites for China's development as a responsible power, so it can be seen that the responsible power theory raised by the West aims to change China according to Western standards.

Chinese scholars systematically refute the theory of threatening China and emphasize the integrity of China's theory of responsibility. In the case of Tang Shipping, through an analysis of China's realist tendencies, emphasizes that China is not a challenging force in the international order, but a guardian force of the world order. While acknowledging China's realist tendency, which is presented as the basis for China's threat theory, he refutes China's threat theory through the distinction between offensive realism and defensive realism (Tang and Peter, 2002:1-5). In other

words, the possibility of challenging China's realist worldview and China's world order accordingly is due to its understanding of Chinese realism as offensive realism, and in fact, Chinese realism is based on defensive realism, contrary to their views (Deng Yong, 1999:47-72).

Tang seeks the distinction between offensive realism and defensive realism in the perception of the security dilemma. In other words, offensive realism recognizes that the national security promotion can only be achieved by strengthening the national power and establishing an alliance and therefore does not consider the security dilemma(John, 1990:5-56). On the other hand, defensive realism acknowledges the existence of the security dilemma and believes that the security dilemma acts as one of the main causes of national security anxiety. Therefore, defensive realists recognize the expansion of national power and the establishment of alliances as major factors in promoting national security but suggest that security cooperation between countries is another factor in promoting national security (Robert Jervis, 1978:189-214). As an extension of this logic, Tang argues that Chinese threats negatively grasp China based on offensive realism, but in practice, Chinese realism is based on defensive realism, which is rather a theoretical basis for promoting China's security through external security cooperation (Tang and Peter, 2002).

Tang also defines the main theories of international politics as offensive realism, defensive realism, and neoliberalism, adding explanation of neoliberalism. In other words, neoliberals argue that national security can be guaranteed not only by security cooperation between countries but also by the security system. The core theme of neoliberalism is the role of the state system to the state. International systems are primarily responsible for regulating and coordinating state activities in the international community

based on global norms and principles, promoting information exchange, monitoring mutual activities, and imposing multilateral or unilateral sanctions on countries that violate international system norms and principles (Keohane, 1984). Therefore, neoliberals emphasize state management by the international system and insist on national security by international system management. Tang defines China's propensity for a responsible state as a form of adding neoliberal propensity based on security realism (Tang and Peter, 2002).

From China's point of view, it can be emphasized that the West has no responsibility or debt to the Western-centered international community in modern history, while the West has some responsibility for China. In particular, China interprets historical responsibilities or obligations more comprehensively and incorporates them into securing its own national interests. In other words, China mentioned Western invasion and misuse of China for 100 years after the Opium War in 1842, stressing that the West should be responsible for past actions and that the West should not interfere with China's internal issues as an extension of its responsibility (Gerald Chan, 2014).

Regarding historical responsibility, China emphasizes participation in the formation of international norms and standards as a powerhouse in the international community. China emphasizes that it has never participated in the formation of international norms and standards since modern times and that international norms and standards have always been applied unfavorably to China, suggesting participation in international norms and standards as a condition of responsibility (Liping, 2001). In addition, China is incorporating its internal problems into the rights and responsibilities of powerhouses. For example, China recognizes that it is the right and responsibility to exercise as a powerhouse in the

international community that it must maintain its internal stability even by using force (Deng Yong, 2001). China's position argues for the logic of a responsible power from the standpoint of promoting its own interests.

In early 2021, the British government released a new defense report, the Integrated Review of Security Defense Development and Foreign Policy. The report shows their predictions and views on international relations during the post-COVID-19 era. Four major changes are expected, including geopolitical changes, organizational competition, rapid technological changes, and the emergence of transnational tasks.

Geopolitical changes include China's growing international power, the increasing importance of the Indo-Pacific region to global prosperity and security, and the leap of a new mid-sized country. This shows once again the importance of Asia that Britain feels. Even if Britain does not represent all Europe, they describe China as a systematic competitor in the post-Corona era. But they remain vigilant about China. Even if they interact with China, they must protect the negative impact on security and cooperate on transnational tasks such as climate cooperation, confirming that they have the nuance to fulfill their duties as a responsible power.

In addition, in the post-COVID-19 era, preparations are needed as the international order is increasingly competitive and fragmented, and global cooperation is expected to shrink, making it more difficult to protect its own interests and values.

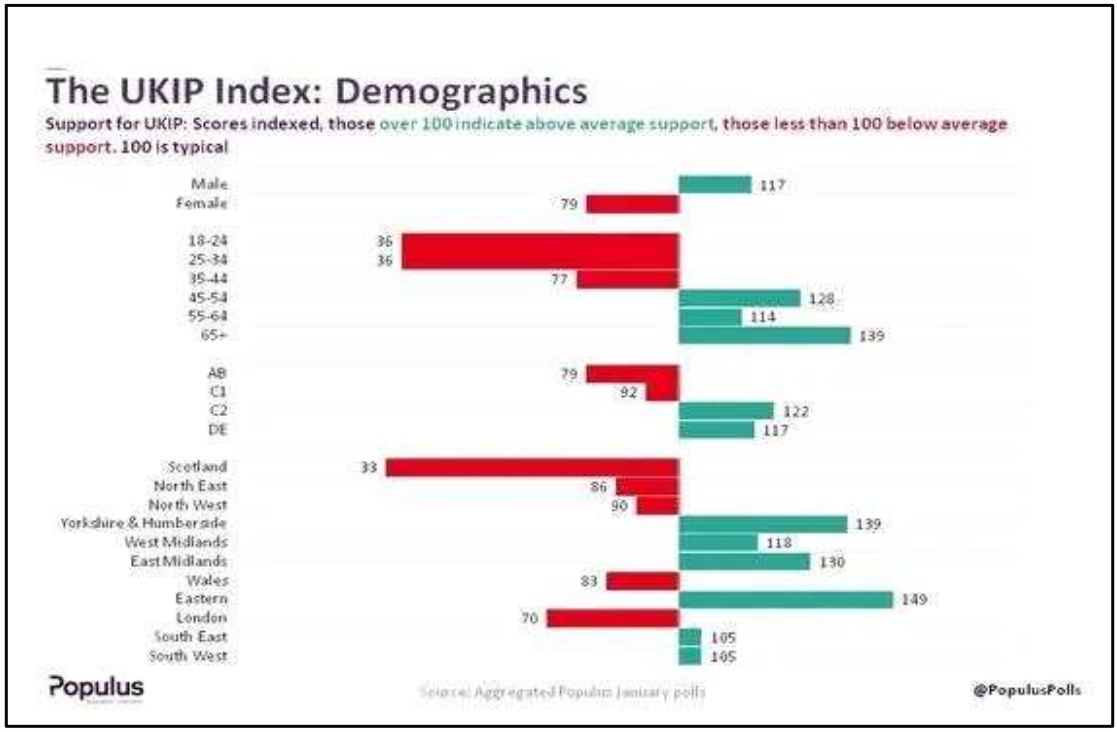
2.2 The origins of Brexit: left behind

Who are left behind? Analysis of this group is essential to understand not only the UK's withdrawal from the EU but also the

political, economic, and social problems facing the UK since 1990. Already in the 21st century, Ford and Goodwin (2014) analyzed the rapidly growing growth of the British Independence Party and concluded that the "leavers" were the ones who strongly supported Britain's exit from the EU. According to them, "left behind" is defined as blue-collar workers who have been marginalized by the middleization of the Labor Party since the 1980s, have low education levels, and have been economically hit by the wave of globalization. In the voter analysis conducted after the Brexit vote, the correlation between "leftovers" and leaving the EU is strong.

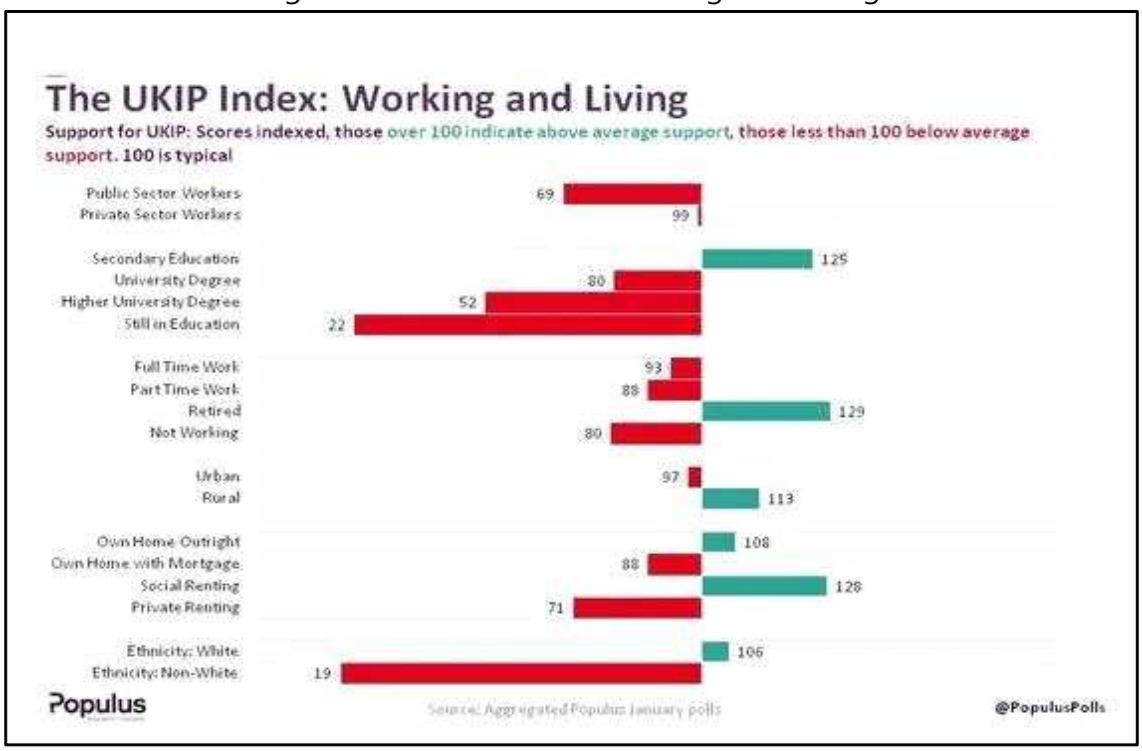
Figure 1 & 2 below show the education, age, and socio-economic background of major UKIP supporters analyzed by Populus, a British polling agency, in April 2015. Considering the correlation between UKIP supporters and Brexit withdrawal, the characteristics of major Brexit supporters can be estimated in more detail. In terms of education, it is a class that has only received secondary education. And there was a marked trend in support of Brexit among those aged 45-54, 55-64, 65 and older and retired voters. In addition, the socio-economic class shows that there is a strong anti-European perception of C2 (professional and technical workers) and D and E (including semi-skilled and unskilled workers, unemployed and the lowest class). Geographical factors are also important. Among England, Scotland, Wales, and Northern Ireland, public opinion of withdrawal is high across England except in London. In particular, public opinion on withdrawal is prominent in the traditional industrial areas of Eastern England and the West Midlands. In the residential environment, Brexit supporters tend to live mainly in rental houses or row houses provided by local governments. Finally, according to gender analysis, relatively men want to leave the EU compared to women.

<Figure 1: The UKIP Idex: Demographics>



(HuffPost, 2015)

<Figure 2: The UKIP Idex: Working and Living>

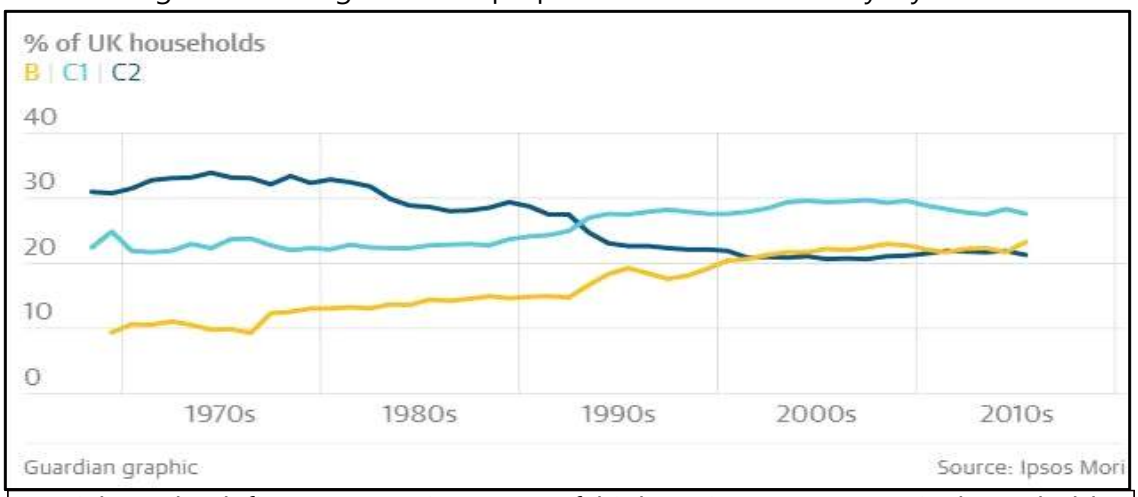


(HuffPost, 2015)

What caused the British working class, especially the blue color, to be 'left behind' in British mainstream society and politics? The UK

can also be found in the differentiation of the working class as it entered the post-industrial society experienced. as shown in figure 3 below Since the 1970s, practically the British working class has been called white color, and the population of mental workers in the category B or at least C1 or higher has increased, while the population of blue color C2 has gradually decreased.

<Figure 3: Changes in the proportion of British society by class>

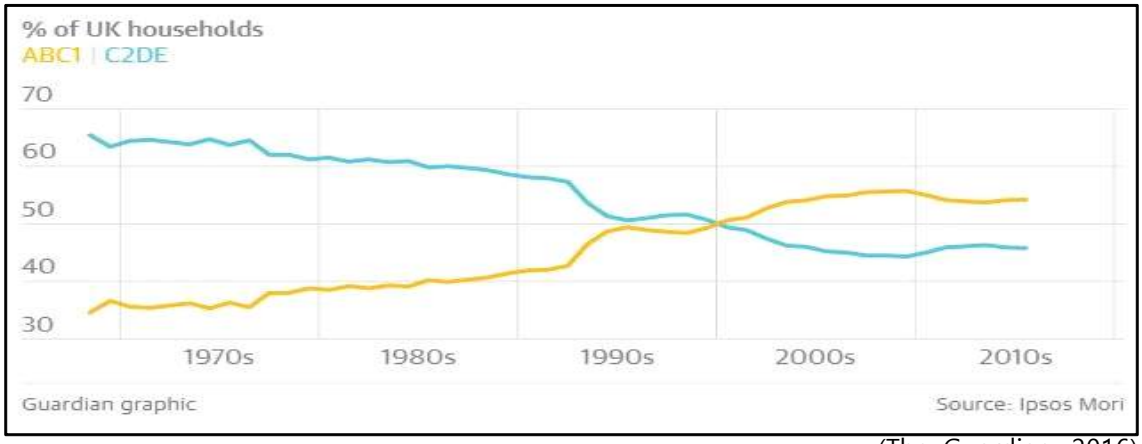


Social grade defines occupation type of highest income earner in household:
A - Higher managerial, administrative and professional.
B - Intermediate managerial, administrative and professional
C1 - Supervisory, clerical and junior managerial, administrative and professional
C2 - Skilled manual workers
D - Semi-skilled and unskilled manual workers
E - State pensioners, casual and lowest grade workers, unemployed with state benefits only

(The Guardian, 2016)

In addition, if A, which can be regarded as the uppermost layer, is grouped together with B and C1, and D and E included in the lower layer are grouped together with C2, the layers will be divided into distinct 'X' shapes. As shown in figure 4 below, it is more pronounced due to the continuous rise of the ABC1 layer and the steady decrease of C2DE. This phenomenon is reflected in the change in the character of voters in the process of re-election in the general elections since the 1960s.

<Figure 4: Changes in the proportion of British society by class group>



(The Guardian, 2016)

Ford and Goodwin (2014: 114-117) summarize this class differentiation as follows. At the time of the establishment of the Labour Party's Government led by Harold Wilson in 1964, more than one-half of the working classes were blue-collar, and more than 70 percent had no formal education. In addition, more than 40 percent were members of the union, and 30 percent were residents of rental houses. By comparison, when Tony Blair took office in 1997, the percentage of blue-color workers was just one-third of the electorate. It was reduced by 20 percent, union members only exceeded 20 percent of the total supporters. The number of people living in rental housing also fell to 14 percent and 70 percent of the voters were homeowners. In particular. The professional middle class accounted for a third of the electorate and 20 percent graduated from the university In the end, Blair's victory could be concluded entirely because the New Labour, like office workers, civil servants, teachers, and nurses, chose the Labour Party. In other words, the Labour Party in the 1990s turned its attention to the newly emerging middle-class voters in Britain rather than the blue color, which was reduced to a minority to win the general election, which can be seen as a change in the Labour Party's identity.

The decline in the social influence of trade unions can be cited as the reason why the Labour Party's reform was successful. Trade unions in heavy industries such as mining, steel and machinery, which once had a powerful fighting power to embarrass the central government, had long since collapsed in the 1980s after Thatcher forced privatization (Ford & Goodwin, 2014: 115). More precisely, the change in the industrial structure weakened the heavy industry itself, which was the background of a strong union. For example, during the 1985 coal mining union strike, the number of miners in the United Kingdom reached 170,000 and the number including the clerical staff involved reached 221,000. However, just a decade later, by 1995, about 90% of coal miners had lost their jobs (Beaty et al., 2007:1654), and the UK's industrial structure, in which blue-color unions were no longer influential within the Labour Party, has been established.

The deepening of the post-industrial social structure and the entrenchment of neoliberalism have shaken the lives of blue-collar workers themselves from the roots, but the British Labour Party has turned more attention to white-collar, a large number of voters who have fallen behind traditional supporters and become so-called middle-class. Tony Blair and Gordon Brown's Labour parties abandoned their class-based left-wing identity and embraced the neo-liberal system, which has already become the world's trend, while emphasizing universal and moral values as an identity element that defines "Britishness." This value-centered citizenship has been defined as an identity that will bind the entire British people and the newly introduced EU citizens into British territory amid domestic and international changes in the launch of the EU and the transfer of political power to local governments. However, this change in Labour's identity has led to a rift in identity with the English, represented by the Left behind.

2.3 Change in UK defence industrial policy caused by Brexit

This Brexit eventually affected the defense industry strategy. First of all, the separation of procurement policies from the European Union has enabled separate independent law enforcement. The government says that decisions made by the European Court of Justice (CJEU) since December 31, 2020, when the UK left the EU, will not be made to domestic courts and tribunals in the UK. Since 31 December 2020, the DSPCR has become an independent regulation of the United Kingdom that has completely deviated from the European Defense Equipment Contract Guidelines. The minister of state, Earl Howe, said the changes were made to give UK and Gibraltar-based companies the right to access the market.

In December 2020, the British government published a green paper called Transforming Public Procurement. The document was a starting point for converting a complex regulatory framework into a single framework that could be applied to all contracts. DSPCR 2011 was included in the list of regulations to be explicitly replaced. However, the document complements certain sectors, including the defense sector.

DSIS says the timing of Britain's departure from the European Union is an opportunity to reorganize the DSPCR. DSIS allows these amendments to simplify the procurement process and increase the acquisition speed, so that new technologies can be actively introduced into the defense industry.

It also heralded a major change in the procurement policy of the defense market in the UK. In 2021, MOD adopted a new approach from DSIS (Defense Security Industry Strategy) to acquiring national defense. This replaced the "global competition by default" policy, which had been the basis of the acquisition system since 2012, with

a "more flexible and more sophisticated approach". The UK Defence Department will ensure that competition is in place and will consider other approaches. Like other central ministries, the acquisition program will include social value. The social value means that the following contents are included.

- It helps communities manage and recover from the impact of COVID-19.
- Address economic inequality by creating new businesses, new jobs, and new technologies • Increase supply chain resilience and capacity
- Fight climate change.
- Equal opportunities achieved by reducing the disability employment gap and addressing labor inequality
- Improve health and well-being, including physical and mental health of contract workers
- Improve community integration, including impact on employees, suppliers and communities through contract delivery to support strong and integrated communities

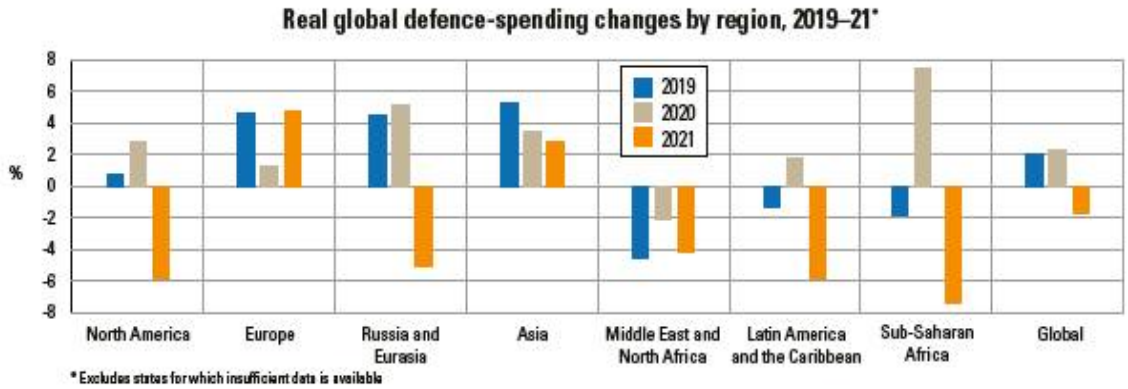
The above-mentioned parts will lead to the effect of giving more British identity and economic benefits to the Left Behind in the UK, which was the cause of Brexit. In 2020, the government introduced a social value model to all government departments. The new social value model, mandated for procurement of all public contract regulations, is used by central government agencies to consider the additional social benefits that can be achieved when implementing contracts. At least 10% of the bid evaluation weights should be allocated to social value targets. This social value policy is expected to spread rapidly to the defense industry.

3. the Global Defense Market

3.1 Trends in world defense spending

Global defense spending in 2021 was $1.92 trillion, up 3.4% from 2020. However, soaring inflation in all regions meant that this was a 1.8% drop on a real basis. This is because if inflation continues to rise, the cost of factor input will increase, putting pressure on the defense budget, while soldiers may demand higher wages to keep pace with rising living costs

<Figure 5: Changes in real defense spending by region in 2019-2021>

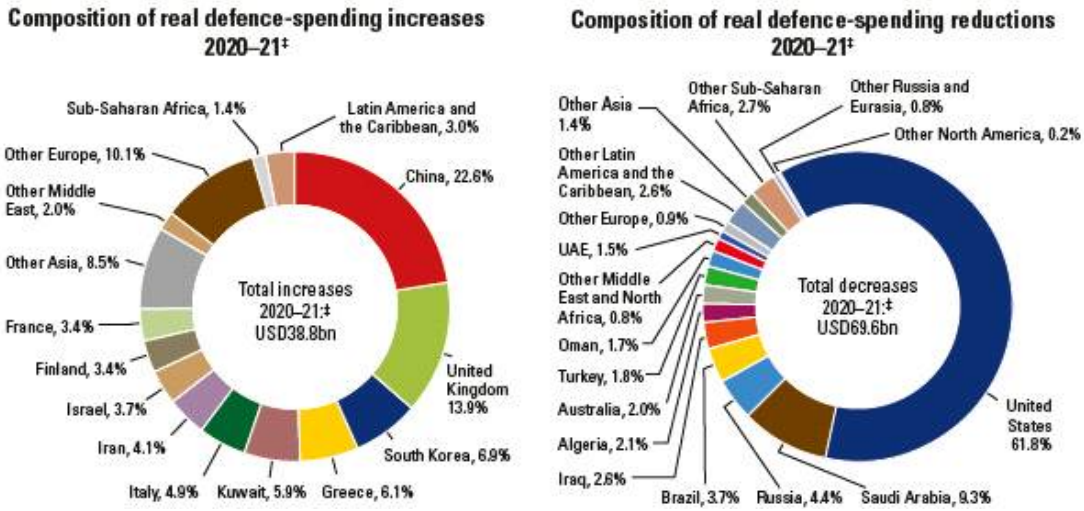


(Military Balance 2022)

In 2020, the United States was a major driver of global defense spending growth. However, the U.S. defense budget authority fell from $775 billion in 2020 to $754 billion in 2021. Inflation rose from 3.1% to 6.4% in 2021, reducing the budget by 6% on a real basis.

High inflation rates have dampened real spending in Latin America, sub-Saharan Africa, the Middle East and North Africa, Russia and Eurasia, although nominal increases have been evident in most regions. In fact, Latin America's spending is the same as in 2009. Meanwhile, economic constraints in sub-Saharan Africa have continued to reduce defense spending. In fact, spending in this region in 2021 is the same as in 2012.

<Figure 6: Regional/Country Defense Expenditure Plan for 2021>



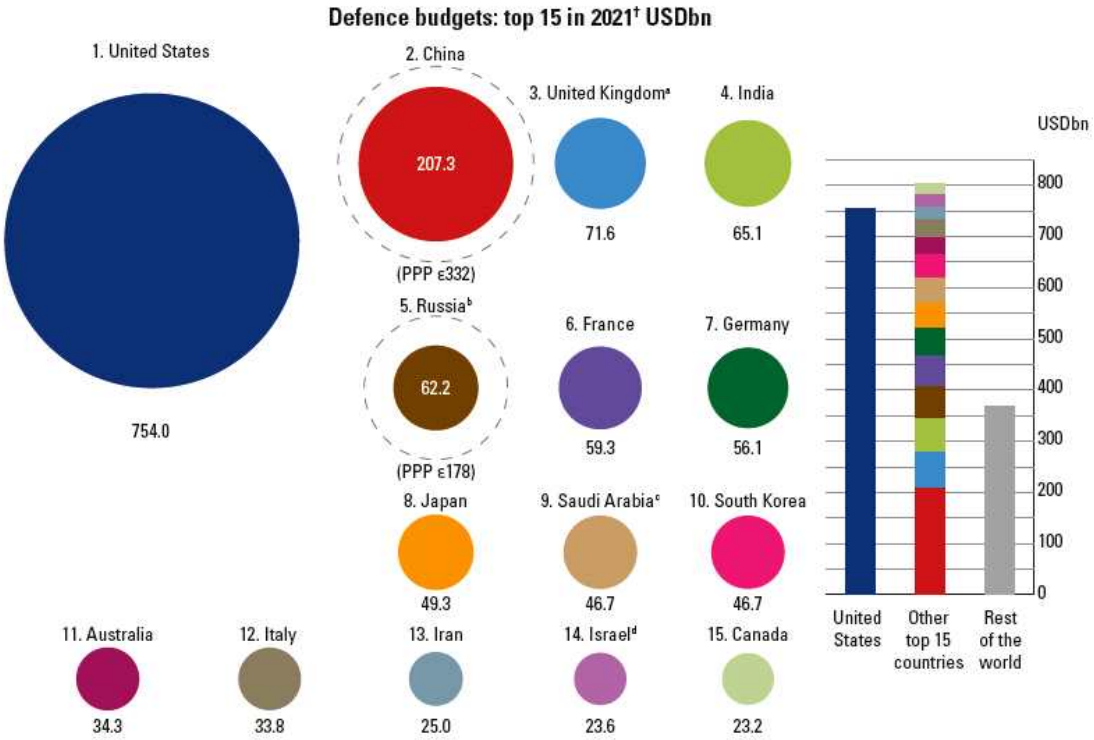
(Military Balance 2022)

While defense spending in the Middle East is nominally relatively stable, inflation has averaged 6.9% per year (over 30% in some countries), with a substantial reduction of 3.6% per year over the four years to 2021.

Asia's defense budget has proved resilient despite limited financial conditions, and there is little evidence that the planned defense investment has been thwarted by the coronavirus epidemic. Regional spending growth slowed to 3.4% and 2.8% in 2020 and 2021, respectively, down from 5.3% in 2019 on a real basis, but only a few countries implemented cuts and others decided to curb spending plans. China, which has a defense budget of $207 billion in 2021, accounted for 43% of the region's total expenditure. Total regional spending in 2021 is $488 billion, more than double the $226 billion spent in 2008.

In 2021, defense spending in Europe is up 4.8 percent on a real basis, higher than in any other region. This marked the seventh consecutive year of real growth. The 2021 increase, combined with spending declines in other regions, means that European spending has hovered between 16.5% and 17% annually since 2014, accounting for 18.7% of the world's total.

<Figure 7: Defense Budgets: Top15 in 2021>



(Military Balance 2022)

3.2 Market trends in weapon systems by field

Land

The proliferation of more precise and long-range fire support capabilities can continue to complicate ground maneuvers at tactical and operational levels. Some troops are increasing investment in both exercise and non-movement defense systems and countermeasures, but relative costs limit availability in a short period of time, which risks the army being overwhelmed by cheaper attack systems (drones or drones).

Maritime

The importance and challenges of underwater combat space continue to grow, as do investments in underground capabilities. This was highlighted by the AUKUS partnership in September 2021, in which Australia, the United Kingdom and the United States will

work together to develop a nuclear-powered attack submarine (SSN) for the Australian Navy. Meanwhile, the UK also announced a contract in September for the initial design work for the next generation of SSNs. And Germany confirmed the order of 5 Poseidon maritime patrol aircraft P-8A in June.

Germany and Italy are likely to join a group of countries that procure more than 10,000 tons of major water battleships, and the next generation of British and American destroyers may also be in the distributed system in the UK. Meanwhile, the UK is pursuing cheaper Type-31 and Type-32 designs, while France, Greece, Italy and Spain are leading the European Patrol Corvette program.

Aerospace

Relatively inexpensive armed unmanned aerial vehicles (UAVs) are being adopted to complement more. Manned-unmanned teaming, and more broadly, unmanned systems, are emerging as a way to supplement the number of combat aircraft fleets and reduce the potential consumption rate of manned platforms in high-level cooperative environments.

China and Turkey are emerging as leaders in dealing with this market. As a result, more efforts are being made to develop detection and engagement systems to defeat armed UAVs. Research and development of unmanned combat aircraft (UCAV) is underway in several countries, and India has begun flight testing of the Ghatak UCAV project as part of its latest initiative. Russia and China are also testing UCAV aircraft.

The weaponization of the universe continues in parallel with efforts to reduce or manage it. China, Russia, and the U.S. are developing a variety of space response systems, and intermediate powers are also strengthening their space capabilities. France conducted its first satellite defense exercise AsterX since the creation of the Space

Command in 2019. In March 2021, Britain and Germany established Space Command in April and July 2021, respectively.

Drivers of unmanned aerial vehicles proliferation and Trends

Economic cost reduction

The U.S. Department of Defense (DoD) explained that unmanned systems, including unmanned aerial vehicles, not only reduce human workload, improve military mission performance, and reduce the overall risk of civilians and soldiers on the battlefield, but also reduce costs in all respects. David H. Dunn described unmanned aerial vehicles as a revolutionary technology, citing their low cost in terms of the acquisition, operation, and training. In addition to this, some studies have suggested that unmanned aerial vehicles are low cost (Avery Plaw & Mattew S. Fricker, 2012; Daniel Brunstetter & Mergan Braun, 2011)

The drone's performance has yet to catch up with the manned aircraft. However, unmanned aerial vehicles have replaced much of the missions that manned aircraft have performed and are expected to replace more missions in the future. In this respect, the comparison of the acquisition and operation costs of unmanned aerial vehicles and manned aircraft is limited but meaningful. One of the most recent comparisons between unmanned aerial vehicles and manned aircraft in terms of the acquisition cost of weapons systems is the F-35 and XQ-58 (222) Valkyrie (Amy Zegart, 2018). To date, unmanned aerial vehicles such as XQ-58(222) Valkyrie have not been able to completely replace manned aircraft such as F-35, but XQ-58(222) Valkyrie is expected to replace some of the F-35 missions, such as serving as a wingman (Mike Hanlon, 2017). The price per F-35A is $94 million, and the F-35B is $122 million (Nick Zazulia, 2018). On the other hand, the XQ-58 (222) Valkyrie is

priced at only 2 to 3 million dollars per unit (Kelly Hodgkins, 2019).

Given the operating costs of the F-16C and unmanned aerial vehicle MQ-9A Reaper, the four F-16C and four MQ-9A Reaper fleets cost $85.9 million and $36.9 million, respectively, when they perform 7,300 hours of combat air patrol (CAP) missions annually (James Hasik, 2012). The drone's ability to support close air (CAS) is sufficiently proven in battlefields in Libya with the MQ-9A Reaper, an attack drone (Colin Clark, 2017).

Emphasis on life and political cost reduction

The use of unmanned aerial vehicles has eased the domestic political burden of military operations, and political risks and costs have decreased as the international community has also responded insensitively (David H. Dunn, 2013). Drone attacks also significantly reduce friendly casualties as well as relatively soften international criticism of airstrikes (Avery Plaw & Matthew S. Fricker, 2012).

Unmanned planes that enable military operations without guaranteeing the lives of soldiers are raising concerns that they will lower the standard for military use. From 2011 to 2014, the U.S. public's support for the use of unmanned aerial vehicles was around 65%, raising the possibility of easing legislative restrictions on the use of military force (Michael C. Horowitz, Sarah E. Kreps & Mattew Fuhrmann, 2016). In fact, the American people were insensitive to the war using unmanned aerial vehicles. The American public was not particularly dissatisfied with hundreds of air strikes using MQ-1 Predators and MQ-9 Reapers (Michael C. Horowitz, Sarah E. Kreps & Mattew Fuhrmann, 2016). President Barack Obama, aware of the negative public opinion about the war in Afghanistan, actively used drones to achieve practical results quickly (Avery Plaw & Matthew S. Fricker, 2012). In addition, civilian casualties can be

reduced as commanders on the battlefield become more accurately aware of the situation through reconnaissance of unmanned aerial vehicles (Samuel J. Brannen, 2014).

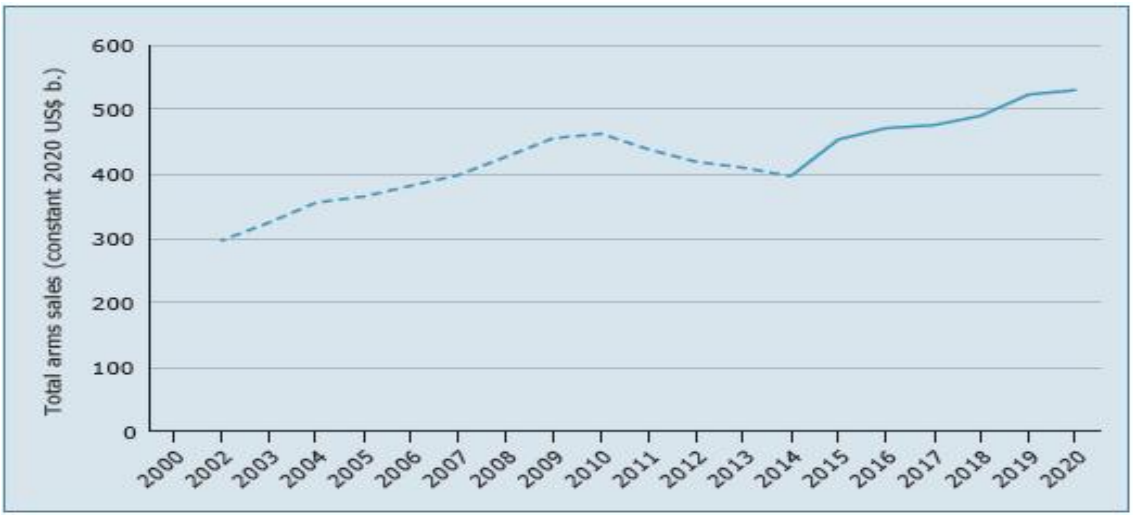
UAVs are less burdensome not only in domestic politics but also in international politics. Not only is the level of criticism relatively low for air strikes using unmanned aerial vehicles in the international community (Samuel J. Brannen, 2014), but unmanned aerial vehicle reconnaissance is characterized by slow response because it is difficult to immediately identify the subject of the flight. As mentioned in the introduction, unmanned aerial vehicles suspected of being North Korea's work were found several times in the front area in 2014, but the South Korean government could not conclude that it was North Korea's provocation, and North Korea strongly denied the charges. In 2019, there were several mutual invasion of unmanned aerial vehicles at the border between India and Pakistan, but the two sides dismissed the incident as denying their respective charges. The drone's invasion of airspace, which is difficult to immediately find clear evidence of provocations, gives the provocative country room to use the tactical of pointing out tactics, so there is little burden on the immediate spread of conflict. However, countries that have been invaded by unmanned aerial vehicles have greater distrust of suspected countries and recognize them as a threat and prepare for them.

3.3 Trends in the arms trade market

Arms sales

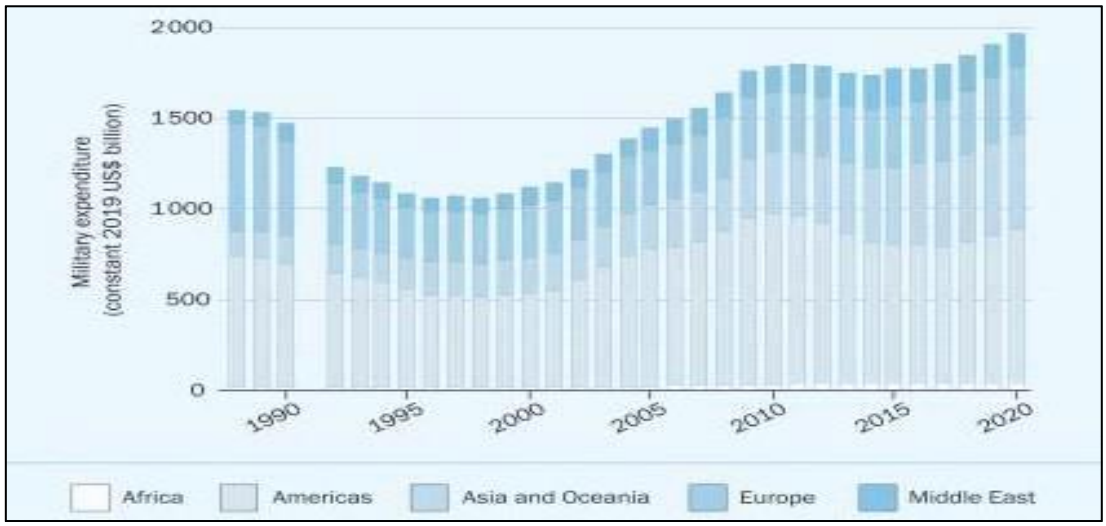
In 2020, arms sales of major global defense companies (SIPRI TOP 100) were $531 billion, up 1.3% from the previous year. Despite the smallest increase in the past three years, it has been showing a continuous increase since 2015, which is also related to the increase in global defense spending.

<Figure 8: SIPRI Top 100 Arms Sales>



(Sipri Top 100 2021)

<Figure 9: the nominal expenditure on world defense(1988-2020)>



(source: Sipri Top 100 2021)

Trends in arms exports

In 2017-21, nearly half of the U.S. arms exports (58%) were exported to the Middle East. On the other hand, Russia's arms exports fell 26% compared to the previous period, and its share of the world's total exports decreased from 24% in 2012-16 to 19% in 2016-20.

Western Europe's top five arms exporters - France, Germany, Britain,

Spain and Italy together accounted for 24 percent, up from 21.2 percent in 2012-16. In the case of Korea, arms exports increased 177 percent compared to 2012-16. Asia and Oceania accounted for 63% of Korea's arms exports and 24% of Europe's from 2017 to 21. Korea has also further developed arms export relations with other regions, especially the Middle East.

<Table 1: Major arms exporters in 2017-21 >

	Exporter	Share of global arms exports (%)		Per cent change from 2012–16 to 2017–21[a]	Main recipients (share of exporter's total exports, %), 2017–21					
		2017–21	2012–16		1st		2nd		3rd	
1	United States	39	32	14	Saudi Arabia	(23)	Australia	(9.4)	South Korea	(6.8)
2	Russia	19	24	−26	India	(28)	China	(21)	Egypt	(13)
3	France	11	6.4	59	India	(29)	Qatar	(16)	Egypt	(11)
4	China	4.6	6.4	−31	Pakistan	(47)	Bangladesh	(16)	Thailand	(5.0)
5	Germany	4.5	5.4	−19	South Korea	(25)	Egypt	(14)	USA	(6.1)
6	Italy	3.1	2.5	16	Egypt	(28)	Turkey	(15)	Qatar	(9.0)
7	United Kingdom	2.9	4.7	−41	Oman	(19)	Saudi Arabia	(19)	USA	(19)
8	South Korea	2.8	1.0	177	Philippines	(16)	Indonesia	(14)	UK	(14)
9	Spain	2.5	2.2	10	Australia	(51)	Turkey	(13)	Belgium	(8.6)
10	Israel	2.4	2.5	−5.6	India	(37)	Azerbaijan	(13)	Viet Nam	(11)

(Sipri Fact Sheet, 2022 March)

Trends in arms imports

The top five arms importers are India, Saudi Arabia, Egypt, Australia and China, accounting for 37.9 percent of all arms imports, with the top 10 countries accounting for 55 percent of all arms imports. Asia and Oceania accounted for 43% of the world's total arms imports in 2017-21, the regions that received the most major arms supplies. Next, the Middle East accounted for 32 per cent. In terms of regional changes, arms imports in the Middle East and Europe increased (2.8% and 19%, respectively). Arms inflows to three other regions - Africa, the Americas, Asia and Oceania - declined (34%, 36%, and 4.7%, respectively).

<Table 2: Major arms importers in 2017-21>

	Importer	Share of global arms imports (%)		Per cent change from 2012–16 to 2017–21[a]	Main suppliers (share of importer's total imports, %), 2017–21					
		2017–21	2012–16		1st		2nd		3rd	
1	India	11	14	–21	Russia	(46)	France	(27)	USA	(12)
2	Saudi Arabia	11	8.2	27	USA	(82)	France	(5.1)	UK	(5.0)
3	Egypt	5.7	3.2	73	Russia	(41)	France	(21)	Italy	(15)
4	Australia	5.4	3.2	62	USA	(67)	Spain	(24)	Switzerland	(3.3)
5	China	4.8	4.4	4.1	Russia	(81)	France	(9.1)	Ukraine	(5.9)
6	Qatar	4.6	1.3	227	USA	(46)	France	(36)	Italy	(6.1)
7	South Korea	4.1	2.3	71	USA	(63)	Germany	(27)	France	(7.8)
8	Pakistan	3.0	3.2	–11	China	(72)	Sweden	(6.4)	Russia	(5.6)
9	UAE	2.8	4.5	–41	USA	(61)	France	(6.2)	Russia	(5.3)
10	Japan	2.6	1.0	152	USA	(98)	UK	(1.7)	Sweden	(0.7)

(source: Sipri Fact Sheet, 2022 March)

3.4 Development trends of weapon systems for export

U.S.

Lockheed Martin: F-35 Simulator (MRT LITE) Modification Development: Hardware change to implement the same software function in 90% reduced space (within 10 square feet) and fully modular configuration to meet customer's portable requirements in a few hours. It is expected to take 18 months to develop with F-35 program customers.

Boeing - Block-II Chinook Helicopter Modification Development: Improved lifting capability through rotor blade improvement, enhanced viability, and additional hoverable digital automatic flight control systems and radars * In June 21, the RAF placed an order of more than $580 million on delivery of 14 Chinook helicopters in 26 years 26.

Europe

Dassault Aviation: Rafale Fighter Modification Development: Improved satellite communications and data links, upgraded to helmet-mounted displays, integrated with a 22,000 pound AASM

air-to-ground missile, and signed a $19 billion supply contract with the UAE in December 21 with a package deal of $12 million. In January 22, Indonesia officially announced the introduction of 42 Rafale units and signed the first six supply contracts.

BAE Systems: Typhoon Fighter Performance Improvements: Strengthen defense systems and data links, apply precision-guided ammunition, apply touchscreen displays to cockpit, respond to sensors and improve data processing capabilities, and sign contracts with Eurofighter consortiums such as Germany, Italy and Spain.

Theales: Ground Master 200 Multi Misson: Next-generation mid-range ground radar improves processing power, including tracking and classification of 4D AESA radar technology, and in February 19, it was developed as an evolutionary development after signing nine major supply contracts with the Netherlands and plans to work with Norwegian Ritek to integrate battery radar.

China

CAIG (Chengdu Aircraft Industry Group): Sky Saker is a derivative of Wing Lung (armed drone) developed for export. With surveillance and air-to-ground weapons (BA-7 air-to-ground missiles, YZ-212 laser guided bombs, 50kg small guided bombs, etc.), Wing Lung has sold various modified derivatives (six Wing Long II, WJ-1) to Saudi, Egypt, Libya, and the United Arab Emirates for $1 million.

Russia

Rosoronexport: T-90S Tank Performance Improvement: Lightweight version development for export market is completed and negotiations are underway to supply T-90MS tanks to India. The

Su-57E is being introduced to export markets early in the production cycle. In August 21, the Russian government approved the export of the SU-57, and China wants to purchase the J-20 stealth aircraft in its own country.

4. Defence industrial Policy and the Status of the Defence Industry in the United Kingdom

4.1 Security environment in the U.K.

The security environment is deteriorating. The proliferation of CBRN weapons, advanced conventional weapons and new military technologies will increase the risk and intensity of the conflict and pose significant challenges to strategic stability. The benefits of advanced features can be eroded by low-tech threats that are inexpensive and easily available, such as drones and instant explosive devices. Russia will be more active in the wider European region, and Iran and North Korea will continue to destabilize their region. They are also concerned about China's military modernization and its growing international influence in the Indian Pacific region and beyond.

4.2 Defense industrial policy and security strategy

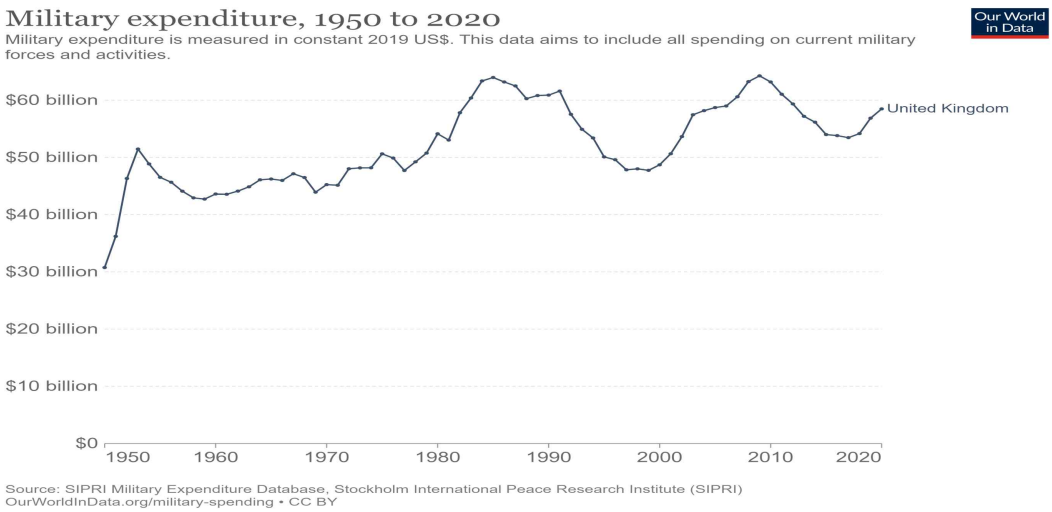
In March 2021, the British government announced an integrated review (IR) of security, defense, development and foreign policy, titled "Global Britain in a Competitive Age." Britain after the end of the Cold War. Shortly thereafter, a Defense Command document, Defense of Competition, detailed plans for military modernization, including significant cuts in personnel and platform inventories, especially in the British and Royal Army. Supports the cost of investing in the Air Force (RAF), new equipment programs and new

technologies. This transition from outdated 'sunset' to 'sunrise' features will include networking, data utilization, artificial intelligence, directed energy weapons, robots and autonomous systems. The plan includes a reconnaissance satellite constellation for the new UK Space Command. To support all this, the government previously announced in November 2020 that it would increase its defense budget by (216.5 billion ($22.8 billion) over a four-year period.

4.3. The British defence budget

In the past decade, the UK has reduced its defense budget seven times, and various defense projects have also been reduced or canceled. The British government has consistently cut back on defense spending to make up for the growing fiscal deficit. However, the British government has achieved NATO guidelines of spending 2% of GDP by slightly increasing defense spending over the past four years.

<Figure 10: British Military Expenditure (1950-2020)>



(Our World in data, SIPRI Military Expenditure Database)

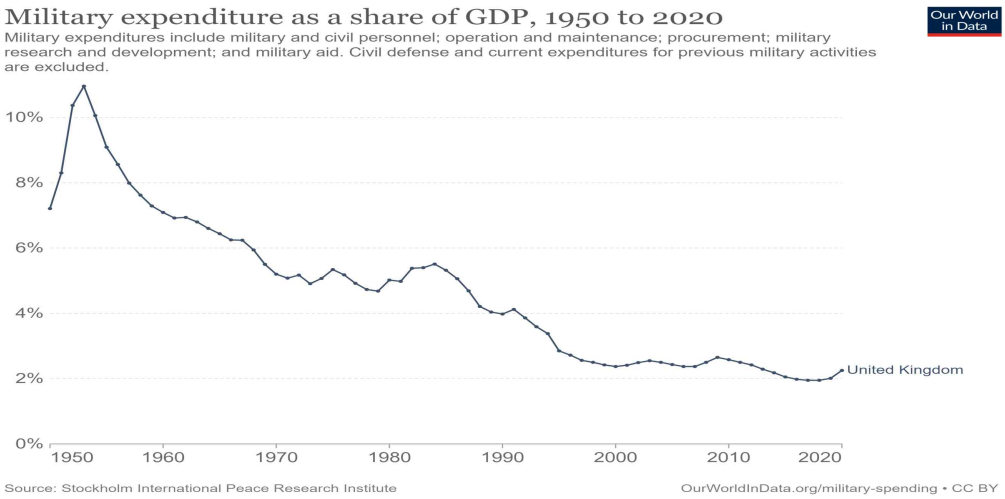
<Table 3: British Military Expenditure/- as a share of GDP (1950-2020)>

($billion, %)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
military expenditure	61.04	59.35	57.17	56.15	54.00	53.81	53.45	54.16	56.86	58.48
military_expenditure_share_GDP	2.5	2.42	2.29	2.18	2.05	1.98	1.95	1.95	2.01	2.25

(Our World in data, SIPRI Military Expenditure Database)

<Figure 11: Military Expenditure as a share of GDP (1950-2020)>

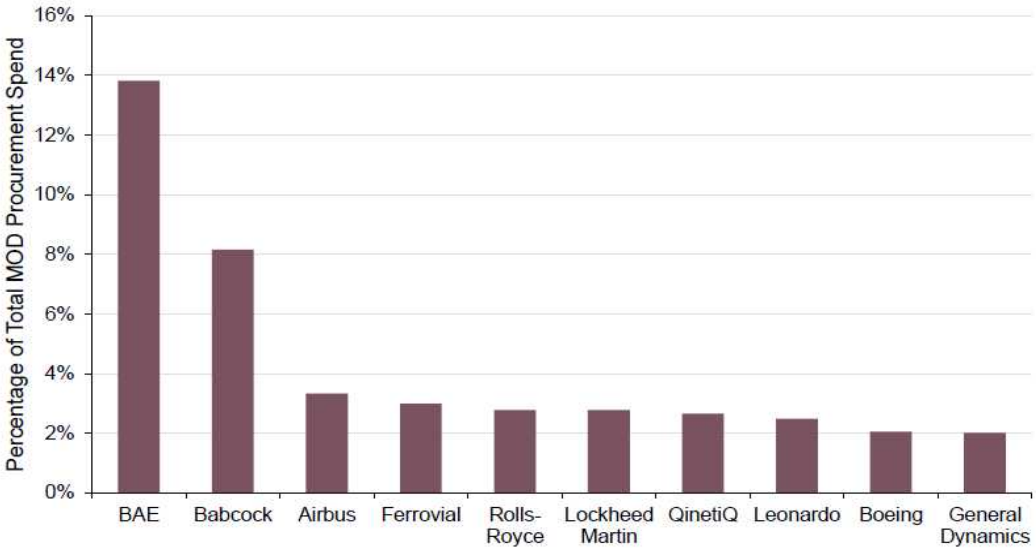


(Our World in data, SIPRI Military Expenditure Database)

4.4 The British defence industry

The UK generates more than 22 billion GBP a year in revenue in the defence industry, employing approximately 140,000 employees directly and an additional 120,000 indirectly. The direct contribution of the defense industry to gross domestic product (GDP) in 2018 includes exports worth 14 billion GBP. The UK is Europe's largest defense market, with BAE Systems dominating the domestic fighter and naval market. The Defense Ministry's main equipment supply contract is biased toward a small number of defense companies, and about half of the total equipment acquired is supplied by 18 companies.

<Figure 12: MOD Spending Ratio for Top 10 Suppliers in 2020/21>



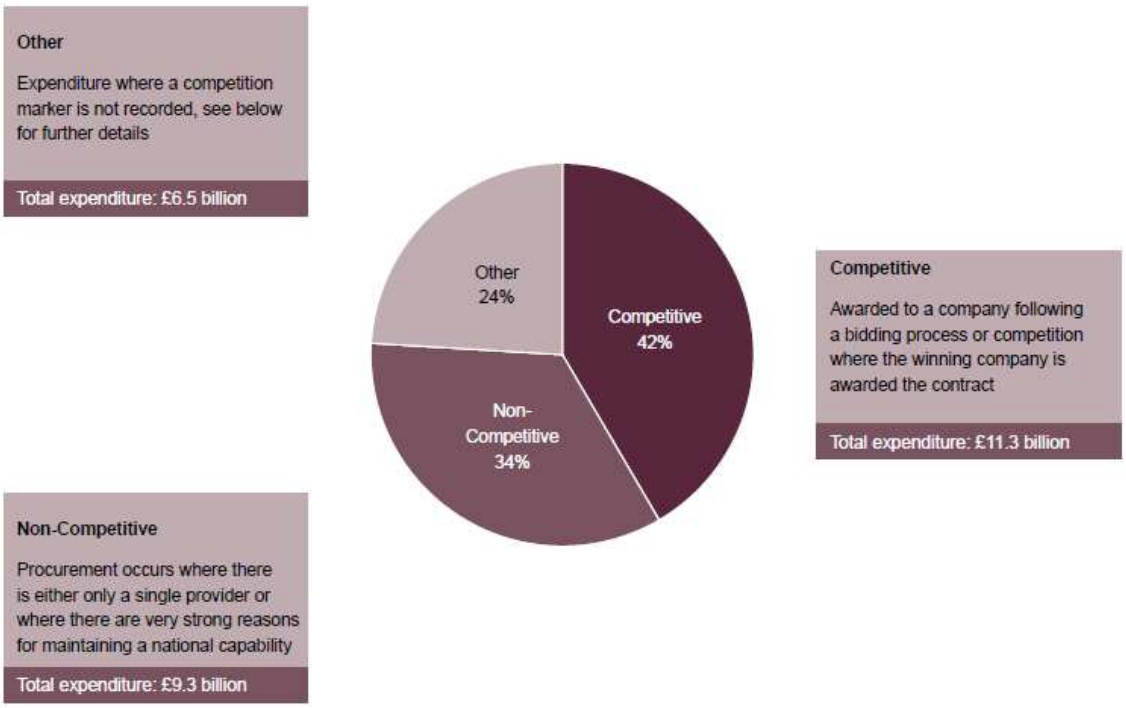
(DBS Finance, UKHO and Dstl data sources)

Many U.S.-based companies are also building strong positions in the U.K. General Dynamics plays an important role in the ground sector, and Lockheed Martin plays an important role in the nuclear sector. In addition to major companies, the Aerospace Industries Association (ADS), a British trade organization, has strong capabilities in defense supply chains in lower fields, representing about 1,000 defense-related organizations.

Founded in 2014, the Single Source Regulation Office (SSRO) regulates the procurement of 'single source' munitions, work and services by the British government. In 2020/21, MOD Core Department paid a total of 27.2 billion GBP to UK and foreign owned organizations (including defense suppliers and intermediate agencies). This is a nominal increase of 0.6 billion GBP from 2019/20. Of all MOD core departmental expenditures in 2020/21, 42% were spent on organizations under the competitive bidding process. This is down from 44% of annual expenditure through competitive sourcing in 2019/20. However, spending recorded through means without competitive markers increased by 1 percentage point over the same period. These statistics mean that much of the defense procurement is financed through a single

source contract despite the defense industry's competitiveness-enhancing policy of "basically global competition" that has continued since 2012, and are also proof of how difficult it is to create competition in the defense sector.

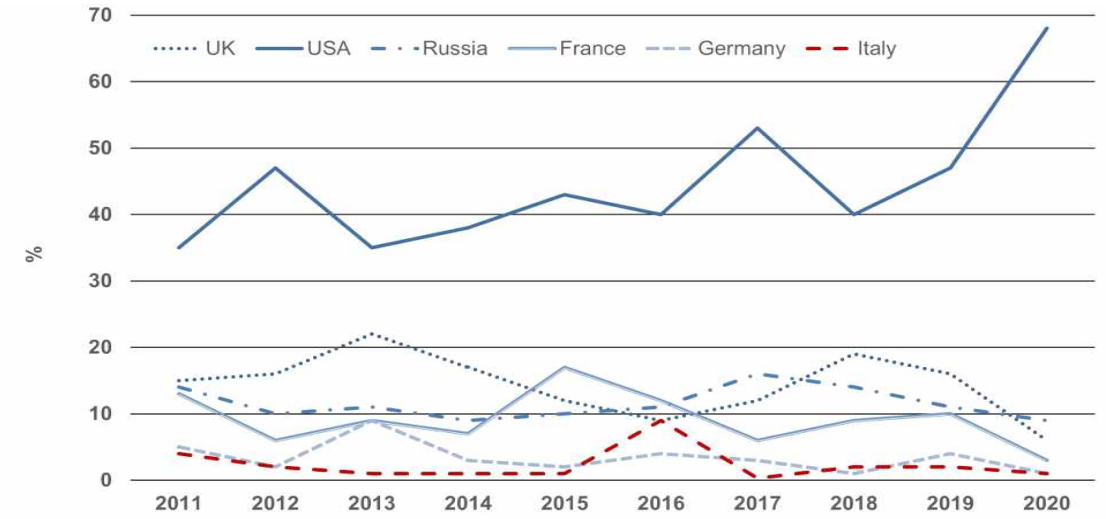
<Figure 13: Direct MOD Core Department Payments by Type of Contract in 2020/21 (VAT Exclusive)>



(MOD trade, industry and contracts 2021)

According to the UK's own defense export statistics, it is the second largest exporter of defense in the world after the United States over the past decade. In 2020, the UK won a defense order of 7.9 billion GBP compared to the previous year (11 billion GBP), and the UK's share in the global defense export market was estimated to be 6% in 2020. Britain's biggest export markets for defense were Europe, North America, and the Middle East. In 2020, the U.S. achieved an estimated market share of 68%, Russia 9%, Britain 6%, and France 3%.

<Figure 14: Defense exports: Estimated UK and competitor market share (2011 to 2020)>



(UK defence and security export statistics: 2020 – GOV.UK)

4.5. British Defence Acquisition and Procurement System

The Ministry of Defense(MOD) oversees the acquisition of defense, but the agency that manages and performs acquisition is the Defense Equipment and Support Agency (DE&S). The UK defence acquisition process is as follows. First, the Ministry of Defence headquarters sets limits on acquisition and wide-ranging needs. This is usually done based on Strategic Defense and Security Reviews (SDSR). Second, each military command (Army, Navy, Air Force, Joint Forces) establishes the required disturbances to achieve its own goals. Third, DE&S advises on how to meet the requirements of the military command and coordinates opinions to reach an agreement. DE&S is responsible for signing contracts with defense companies and managing their businesses.

Defense Equipment and Support (DE&S) Agency is responsible for the equipment and support of the British Army. The government converted DE&S into a customized trading corporation on April 1, 2014. This means that it is currently an independent administrative

corporation of the Ministry of National Defense. The DE&S transition is one of the major reforms currently underway within the Ministry of Defence to address important issues in the defense procurement system. Initially, the British government promoted the method of operating government-owned-contractors. However, due to the proposal of only one company in the competitive bidding, proper competition was not achieved, and it became difficult to promote the government-owned-contracting operation method. Instead, the Ministry of National Defense made DE&S a separate specialized institution and granted autonomy such as annual salary and welfare to secure and maintain professional manpower.

The Defense and Security Public Contracts 2011 (DSPCR), a regulation related to the acquisition of British national defense, was controlled by European Union (EU) Defense Security Guidelines No. 19981.EC. However, since 31 December 2020, the DSPCR has become an independent British regulation completely outside of the European Defense Equipment Contract Guidelines. The minister of state, Earl Howe, said the changes were made to give UK and Gibraltar-based companies the right to access the market. DSPCR is the EU Retained EU law by EU Withdrawal Act 2018 section 2. The DSPCR has created two amendments to work effectively when the UK leaves the European Union.

· The Defence and Security Public Contracts (Amendments) (EU exit) Regulations 2019
· The Defence and Security Public Contracts (Amendments) (EU exit) Regulations 2020

In December 2020, the British government published a green paper called Transforming Public Procurement. The document was a starting point for converting a complex regulatory framework into a single framework that could be applied to all contracts. DSPCR 2011 was included in the list of regulations to be explicitly replaced. And the Defense and Security Industrial Strategy (DSIS)

says that the timing of Britain's departure from the European Union is an opportunity to reorganize the DSPCR.

DSIS says that these amendments can simplify the procurement process and increase the acquisition speed, so that new technologies can be actively introduced into the defense industry. However, the strategy statement said the government is aware of concerns about placing the defense and security industries in a regulatory framework and will have exemptions to allow these contracts to be considered. The exemption from international cooperation will reflect the ministry's unique international cooperation project.

DSPCR allows the following contracts to be applied as an exception. Where the regulations apply, the UK is considered to be contrary to the essential interests of national security, and the Government is required to enter into contracts with other governments or to enter into basic agreements in relation to:

1) Defense supplies or sensitive equipment

2) Projects and services directly related to national defense materials, etc

3) projects and services promoted for military purposes

4) Sensitive businesses and services (if the contract is related to information collection activities, if the contract is a G2G development and acquisition project involving both parties or multiple persons, if the contract is concluded in accordance with the specific procedural rules of the international organization, etc.)

4.6 Defense science technology strategy

The Ministry of Defence (MOD) announced the 2020 Science and Technology Strategy. They are strategies to understand that science and technology (S&T) are important components of power development and to effectively approach making the right decisions in the power development process for future benefits. This strategy can protect and prioritize S&T research.

An important aspect of the MOD (Ministry of Defense) approach is a clear distinction between S&T and R&D. S&T generates activation technologies and system building blocks required for R&D. R&D then integrates and matures these building blocks into operational capabilities. In the field of defense, Chief Scientific Advisors (CSAs) provide leadership in S&T, and the Chief of Staff of the Defense promotes R&D, and the CSA provides consistency, direction, and is conducted according to legal, ethical, and strict standards.

This strategy will take an efficient strategic approach to R&D so that S&T can create a space for pursuing truly new and disruptive features while continuing to deliver valuable incremental innovations. They use both top-down and bottom-up approaches to find valuable innovative things.

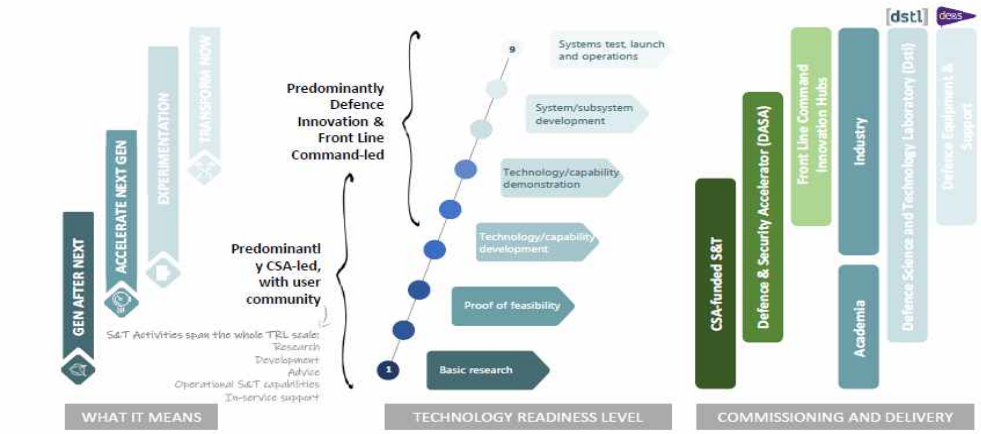
<Figure 15: Ministry of Defence's Approach to Science and Technology Innovation>

(Science and Technology Strategy 2020 – GOV.UK)

The Integrated Operating Concept 2025 (IOpC25) contains physical components of future combat operational concepts, which can provide opportunities for delivering innovative solutions. The Department of Defence CSA identified five competency challenges that could provide decisive opportunities in the future. The ability to perform surveillance and reconnaissance (ISR) in all environments, multi-domain command & control (C4) ability to execute joint operations, develop UK ability to compete against enemies below existing collision threshold, develop high-performance systems or new weapons, and free movement in rejected electronic environments.

Defense forecasting and S&T research have produced Dual Mode Seeker Brimstone (DMSB) missiles over the years, focusing on next-generation capabilities, which have been used decisively in operational deployments in Afghanistan and the Middle East. The CSA is the Director of Science and Occupation at MOD and oversees active professional development programs. At least 1.2 percent of the defense budget is directly invested in science and technology. Ensure that all S&Ts performed within defense are strategy-driven rather than demand-driven, and that the S&T research portfolio is within the context of a broad defense R&D ecosystem with a complex network of stakeholders and delivery agents. S&T is used and performed at all stages of R&D.

<Figure 16: Schematic of the British Defence R&D ecosystem>



(Science and Technology Strategy 2020 – GOV.UK)

4.7 Equipment plan

Navy Command

The Naval Command is responsible for the delivery of water vessels, marine helicopters and submarines. And major submarine construction programs are funded and provided by the Defense Atomic Energy Agency. The Navy Command plans to spend 38.1 billion GBP on equipment plans over the next 10 years, compared with 30.6 billion GBP at the end of the previous planning period.

The Navy's new investment focuses on improving the fleet's sustainability, criticality and availability, and providing a more modern, advanced and automated navy. The criticality of the water fleet will be increased by upgrading the Type 45 destroyer's air defense capability, Sea Viper, to combat increasing and evolving threats. The Navy is also investing in new lightweight torpedoes in our vessels and aircraft to replace our current Stingray weapons and will purchase high-performance vessels for missile transport to replace our current Harpoon missile system, which will be unavailable in 2023. With additional investment, Merlin helicopters could extend their service from 2029 to 2040, and the Navy could have the world's best autonomous mine-hunting capability to replace legacy platforms.

The biggest investment in the navy is made in the form of shipbuilding pipelines. It is a strategic and long-term investment to increase the capability and size of the Royal Navy's water fleet and to develop three fleet solid support ships, multiple maritime surveillance capabilities, multiple support ships and Type 31 and Type 32 frigates. This will provide quantity and certainty to our national shipbuilders and encourage British industry to invest to provide world-class productivity.

The availability of frigates will also improve over the next few years by extending the life of the three most recently refitted ships, and two of our oldest type 23 frigates will be out of service. UK will also launch the UK-designed state-of-the-art Type 26 anti-submarine frigates with Canada and Australia.

Army Command

The Army Command has the following responsibilities:

Armoured combat vehicles, ground air defense systems, artillery systems, protective and support vehicles, battlefield helicopters, specific unmanned aerial systems, military combat systems, and communications and information systems in the land environment.

The Army Command plans to spend 41.3 billion pounds on equipment plans over the next 10 years, compared with 32.6 billion pounds at the end of the previous plan.

The Army's new investment focuses on making the Army more agile, integrated and deadly. The Army is reorganizing itself around the Brigade Combat Corps (BCT) and establishing special ground operational capabilities through a new Ranger Battalion, allowing the Army to respond more quickly to operational demands.

To this end, the Army is expanding its Boxer program to equip two

armoured BCTs and upgrading 148 Challenger II tanks to one of the deadliest and most viable tanks. The rest of the Challenger fleet was retired. The upgrade to the Army's existing Challenger 2 main tank will include a digitized turret and a more capable 120mm turret. Improved munitions based on improved gloves and other viability, upgraded sights, and a soft bore gun with improved viability. In addition, new investments.

Army equipment increases the capability and capacity of ground air defense and long-range precision shooting, modernizes land-based electronic warfare and signal intelligence capabilities, increases cyber and electromagnetic capabilities, and improves intelligence, surveillance and reconnaissance (ISR) capabilities. and Upgrade

Increase the number of batteries in mini unmanned aerial systems under tactical UAS, watchdogs, and project aquila. These investments will improve the Army's ability to provide. It also enables ground air defense, improved understanding of the operating environment, and targeted future deep fire capabilities.

The AH-64 Apache attack helicopter will be upgraded to state-of-the-art technology by 2025. Investments in new and modern medium lift helicopters in the mid-2020s will enable the integration of different fleets of Army medium lift helicopters in four platform types.

Some legacy platforms that have already been extended beyond the planned lifetime will be retired. In doing so, the Army was able to make plans to invest in shortening service periods. It improved the performance of boxer armored vehicles and increased the number of the entire fleet. We will no longer upgrade the Warrior, but we will continue to use it as the Army transitions to Boxer-based BCT, and the UK now expects this BCT to occur by the middle of the decade. The Army will also retire the oldest CH-47 Chinook

helicopter and purchase a new model of operationally proven U.S. aircraft.

Air Command

The Air Force Command is responsible for combat air, including high-speed jets and weapons, ISRs, remote-controlled aircraft, strategic and tactical air transport, aerial refueling aircraft, aerial platform protection, training aircraft, space and training systems.And it includes compounds like augmented reality and virtual reality.

The Air Force Command has core R&D funding and Future Combat Aviation Systems(FCAS) Technology Initiative funding, but new investments for the acquisition phase of the program are put on hold.

Separately by Combat Air Directorate at headquarters as part of its strategic program. Both budgets are supervised and managed by the responsible senior owner of the headquarters. Funding for additional purchases of the new A400M Atlas and F35B Lightning II is not included in the Air Force Command's planned expenditure and will be conducted centrally. The Air Force Command plans to spend 36.2 billion on equipment plans over the next 10 years, compared with 34.7 billion at the end of the previous plan.

The new investment focuses on making the RAF one of the world's most technologically innovative, productive and deadly air forces. New funds are supporting Radar 2.

The UK will run a program that will provide typhoon with powerful Active Electronic Scan Array (AESA) radars to ensure that this feature will work successfully in the most challenging future. The UK will strengthen its military flight training system with additional investments in synthetic training, which will guide more capable

pilots quickly and efficiently. Next-generation aerial command and control aircraft, E7 Wedgetail, will replace E-3D Sentry.

The Air Command will scrap equipment that is increasingly limited in utility in digital and future operating environments. These include streamlining old fleets and retiring to improve efficiency. The Air Command will scrap equipment that is increasingly limited in utility in digital and future operating environments. These include streamlining old fleets and retiring to improve efficiency. Typhoon Tranche 1 and Hawk T1 by 2025. The Air Force Command will also retire BAE 146 by 2022 and C130 Hercules by 2023.

UK Strategic Command

The British Strategic Command is responsible for command, control, communications, computers, information, surveillance, targeting, acquisition and reconnaissance systems and capabilities (C4ISTAR) in both operational and business environments. The British Strategic Command plans to spend 35 billion on equipment plans over the next 10 years, compared with 28.8 billion at the end of the previous planning period.

New investments from the UK Strategic Command are focused on improving cross-domain integration and developing our digital and cyber capabilities. The Department has decided to increase investment in information capabilities, including the use of automation for massive amounts of information analysis. The Ministry of National Defense increased investment in our cyber capabilities and logistics transformation, and supported our troops to create a better and more efficient military. Additional investment in defense synthetic companies and better network modeling and simulation capabilities will enable more efficient and better quality training, experimentation, and mission rehearsals. The increased

pipeline of funding for the British Special Forces will ensure that they continue to have the equipment and capabilities necessary to carry out the most difficult operations.

Defence Nuclear Organization

The Defence Nuclear Organization (DNO) procures and destroys all submarines in the United Kingdom through the Submarine India Agency; and nuclear warheads and Trident missiles for the UK's nuclear deterrent. DNO plans to spend 58.1 billion GBP on equipment planning over the next 10 years, compared to 43.9 billion GBP at the end of the previous planning period.

DNO's new investment focuses on modernizing Britain's nuclear warheads to ensure that we maintain effective deterrence throughout our Dreadnought class mission, and works closely with the United States to ensure that our new sovereign warheads are compatible with the Mk7 Aeroshell and Trident strategic weapons systems.

Strategic Programmes

Strategic Programmes is a set of equipment programmes, led by a team within head office. They are responsible for the procurement of Defence’s complex weapons portfolio, test and evaluation and training services. In addition to this, the Combat Air Director holds the new funding for the next phase of the Future Combat Air System programme.

The combined Strategic and Combat Air Programmes currently plan to spend around £21.5 billion GBP in the equipment plan over the next ten years compared to £11.6 billion GBP at the end of the previous planning period. The increase is largely attributable to the

new investment in the concept and assessment phase of the Future Combat Air System.

Investments have also been made to develop future testing and evaluation (T&E) capabilities for new weapons, artificial intelligence and synthesis, digital and space-based systems. These are the areas the UK has begun to consider under the T&E Futures program, which plans to invest more than 60 million found over the next four years. Overall, British investment will bring these next-generation technologies into the hands of our workforce and develop a pipeline of future capabilities for future troops

UK are also investing in the concept and evaluation phase of future combat aviation systems. Funding for the next phase of the Future Combat Aviation System Acquisition Program is to define concepts for Britain's next-generation core platform, selectively piloted systems and autonomous systems, preserving Britain's operational advantage for a long time in the future. This program will leverage our unique industrial foundation to create a sixth-generation combat aviation company centered around the UK.

5. An Analysis of International Defense Cooperation Cases

5.1 The concept of international defense cooperation

Terms similar to international cooperation in acquiring and procuring weapons systems are called "International cooperation in the defense industry" and "International arms cooperation." In the Evaluation of Security Support for the U.S. and the Prospect of Defense Cooperation between Korea and the U.S., 'International Cooperation in the Defense Industry' is defined as follows. International cooperation in the defense industry is said to be joint technology exchanges in research, development, production, and

military support, and beneficial cooperation in the procurement and defense industries in order to reduce defense budgets and improve joint operations by standardizing and increasing interoperability. The annual report of the United States Defense Ministers' Conference defines the United States' International Arms Cooperation as follows. It is necessary to cooperate in developing and deploying military equipment through fair cost sharing to ensure efficiency and interoperability of conventional military equipment used by the U.S. and its allies.

The definition of international defense industry cooperation includes the subject of cooperation, the object and method of pursuing common interests, and the weapon system as the object of cooperation. In these definitions, the expected benefits of pursuing the following international cooperation are shown. First, as international cooperation is achieved between allies in political interests, it acts as a means to solidify political solidarity between allies. Second, it is an effort to achieve a reduction in the defense budget through mutual cost sharing through economic benefits. Third, in an operational aspect, interoperability can be increased through standardization of military equipment between allies.

The definition of international cooperation in acquiring and procuring weapons systems may be used in the same way as the definition of international cooperation in the defense industry. This is because the weapon system can be said to be a product of the defense industry, so 'international cooperation in the weapon system' is only the difference from seeing the defense industry as the subject of cooperation.

5.2 International cooperation in acquisition and procurement of arms systems

The types of international cooperation for the acquisition of weapons systems should be classified according to the acquisition method. The classification of acquisition methods can be classified according to the degree of R&D and the life stage of the weapon system in which cooperation takes place. As shown in <Table 4>, Laurel and Lowell classified the forms of international cooperation in acquiring and procuring weapons systems into three types: reciprocal trade, cooperative production, and code development. In other words, mutual trade simply buys and sells R&D weapons systems in the form of finished products between the countries of cooperation, and the representative example is the US AMRAAM and ASRAAM mutual cooperation transaction of the three European countries.

<Table 4: Three Types of Collaborative Programs>

Program Type	Description
Reciprocal trade: two way street or family of weapons	• Each government agrees to Purchase weapons or weapons systems developed and produced by defence contractors in the partner country. “Two Way Street” approach encourages the evolution of a balanced tranastlantic arms trade. Under “Family of Weapons” concept, the partner countries each develop and produce complementary weapons systems. Example: AMRAAM(U.S.) ⇔ ASRAAM(U.K., GE)
Cooperative production: Licensed or Joint production	• Defense contractors from two or more partner countries produce weapons systems developed by firms from one of the partner countries. Under joint production, original developer produces system with its foreign partners Participanting governments reconcile acqusition schedules. Production shares usually proportional to tax revenues contributed. Transfers of military sensitive technologies and the third party sales must be approved by the home government of the original developer. Example: F-104(BE, CA, GE, IT, JA, NL, US) F-16(BE, DK, NL, US)

Co-development	• Defense contractors from partner countries jointly develop and produce weapon systems; marketing and after-sales servicing of the systems may or may not be joint. Participainting governments reconcile military requirements as well as acquisition schedules to a greater extent than under cooperative production. As under cooperative production, both R&D and production shares chosen according to relative tax shares rather than economic efficiency criteria. Example: Jaguar(FR, UK), X-31(GE, US)

(Lorell & Lowell, 1995)

AMRAAM is a medium-range, medium- and large-to-air missile developed in the United States, and ASRAAM is a short-range, anti-aircraft, air-to-air missile developed in the United Kingdom and Germany.

Although cooperative production has been researched and developed, a representative example is the F-16 fighter jet in the form of cooperation between the partner countries at the production stage. This was researched and developed in the United States, and NATO countries, Korea, and Japan produced cooperative products. Joint development refers to the cooperation between the partner countries at the entire stage from R&D to production of the weapon system, that is, at all stages of design, development, and production. A representative example of joint production is the Jaguar project jointly developed by France and the United Kingdom.

5.3 Motivation for international defense industrial cooperation

International defense industry cooperation can occur if collaboration or coordination is required between the parties. Cooperation is interpreted in the active sense of achieving common interests, and mediation can be defined and interpreted in the passive sense of avoiding common damage. In other words, when an independent

act is undesirable in determining whether each actor will cooperate jointly or independently in performing an act, or when the next-best outcome is predicted, it may not proceed to an independent act and may proceed to cooperation. The dilemma of common hatred and the dilemma of common interest in game theory can be seen as largely useful as a framework for analyzing the motivation of international cooperation.

Cooperation consists of two main factors. The first cooperation is that each actor's actions have a specific purpose. However, at this time, the purpose of the actors subject to cooperation does not have to be the same, and reasonable and rational actions of the actors in the field can be assumed. In other words, if the relationship of cooperation does not end in a single act, but in a situation where repetition or repeatability is predicted, it can be assumed that cooperation will react as cooperation and betrayal as betrayal. Second, under reasonable circumstances, cooperation can provide benefits and rewards to actors. These interests cannot be the same for each country, but they can be said to be reciprocal.

The fact that R&D of advanced weapons systems by the state increases costs and only requires relatively small production facilities to meet domestic demand, thus increasing production costs per unit of weapons provides an incentive for international cooperation in the defense industry. According to this motivation, the U.S., Japan, and Europe are participating in various reciprocal trade, cooperative production, and joint development plans involving two or more countries, Britain, France, Germany, and Italy.

International defense industry cooperation in Europe is being promoted with a particular emphasis on economic interests. Among the economic benefits, the sharing of R&D costs and the interests of the industry are regarded as motivation for promotion. First,

international defense cooperation saved R&D and production costs, allowing cooperative countries to share expensive R&D expenditures, and integrating orders from their countries to achieve economies of scale through mass production. For example, if two countries produce a constant number of bombers that require a certain development cost, an equal percentage of joint ventures can reduce unit production costs to economies of scale resulting from doubling production while halving development costs. Second, international cooperation has brought industrial benefits to partner countries. Cooperative countries can maintain domestic industries at the level of high-tech equipment such as aerospace, and cooperation also allows them to form competitive large industries to compete in large markets such as the United States.

In relation to international cooperation in the acquisition and procurement of weapons systems, adverse functions may occur, regardless of whether or not the cooperating parties have predicted or not. This can lead to inefficiency in negotiations between the governments, bureaucrats, and the military of cooperative parties, in addition to lobbying from various stakeholders. In other words, international cooperation can be based on inefficiency, political understanding, and negotiation criteria rather than comparative advantage. For this reason, there are cases in which international cooperation took a higher cost and development period than domestic R&D, but international cooperation will continue as long as the participating countries determine that cooperation is worth pursuing.

Lorell and Lowell show the logic of approval and opposition to international cooperation projects from the perspective of the United States in <Table 5>. When the U.S. participates in international cooperation by dividing the motives of international cooperation into economic, operational, and political aspects, there

are logic in favor of and against international cooperation from the standpoint of reciprocal trade, cooperative production, and joint development, respectively.

Economically, all three types of international defense industrial cooperation are likely to expand the market size of a given weapon system. Therefore, arms system producers have benefits from economies of scale, and as a result, the country can reduce its defense budget. All three forms of international cooperation can theoretically reduce costs due to international specialization of

<Table 5: Pros and Cons of Collaborative Programs >

Objective	Type of Program		
	Reciprocal	Cooperative Production	Codevelopment
Economic	Pro: Specialization by U.S. and Partners increases size of market and reduces costs.	Pro: Specialization of production, Lager market reduce costs while U.S. still able to maintain R&D and some production capability.	Pro: Shared costs of R&D and production, larger market reduce costs, allowing U.S. to maintain wider range of R&D and production capabilities.
	Con: U.S. loses R&D and Production capabilities for weapons.	Con: Duplication of production, small size, and inexperience of partners raise costs of U.S.	Con: Uninternational transfer of Technology may harm more advanced U.S. industry. Greater risk of cost growth and schedule slippage.
Operational	Pro: U.S. and Partners share common equipment.	Pro: U.S. and partners share common equipment.	Pro: U.S. and partners share common equipment.
	Con: U.S. requirements comprimised; independent U.S. capability diminished.	Con: Significant differences between models produced by partners.	Con: U.S. requirements compromised; independent U.S. capability diminished. Significant differences between models produced by partners.

Political	Pro: Partners strengthen political ties through military reliance. Common equipment encourages shared training and doctrine.	Pro: U.S. able to influence partners' defense postures. Common equipment encourages shared trainning and doctrine.	Pro: Better than partners developing independent R&D capability. Common equipment encourages shared training and doctrine.
	Con: Compromised requirements, loss of independent capability strain political ties.	Con: Disagreements over program management strain political ties.	Con: Compromised requirements, disagreements over program management strain political ties.

(Lorell & Lowell, 1995)

design, development, and production rather than national projects, but may lose R&D or production capacity for technologies or systems that are not specialized in the country. Incomplete specialization can lead to excessive overlapping investment in R&D and production workplaces, and also allow international cooperation to transfer unwanted technologies to foreign competitors.

International defense industrial cooperation can result in operational or military standardization of equipment and increased interoperability among the partner countries, and consequently improve joint operational performance. Although mutual trade, cooperative production, and joint production can all theoretically achieve the sharing of weapons systems and equipment, in practice, compromising national military needs may not increase the standardization or interoperability of equipment.

Politically, international defense industrial cooperation in the acquisition and procurement of weapons systems can strengthen political cohesion through joint training and joint doctrinal systems. Although it is a problem that is less raised by advocates of international cooperation as a political motive for international defense industrial cooperation, countries with political superiority can exert influence on the defense policies or defense capabilities

of countries with relatively low levels of international cooperation. However, compromising national requirements through international cooperation or inconsistencies in project initiatives and management may lead to tension in political relations between the partner countries.

In the past Cold War era, the United States seemed to emphasize operational or political dimensions more than economic aspects, at least externally, in the motivation for international cooperation in acquiring and procuring weapons systems. For example, the U.S.-Japan Defense Cooperation Guidelines, which were compromised in 1978, focused on extensive joint defense plans and training for combat operations, intelligence, and military leaders. Recently, however, the United States has been using international cooperation with NATO countries to acquire and procure weapons systems as a means of rational use of the limited national R&D budget. In this way, policymakers have the hope of effectively building an overall military structure with a small budget. The cuts in defense budgets in the 1980s and 1990s have allowed the Allies to share more defense costs and also highlight the importance of joint research and development with the Allies. In addition, the advanced and complexity of military technology in the security environment after the 1990s is an excessive burden on the United States to independently develop a new weapons system.

In Europe, economic and political motives for international cooperation have always had an advantage over operational motives. Britain is ostensibly emphasizing its operational reasons for international joint development rather than other countries. The most important economic motivation for international cooperation projects among European countries is not the rationality of the budget through joint research and development. The main economic motivation for cooperation among European countries

was to maintain a defense industry base for increasing national security and industrial core technology and economic benefits.

In the 1950s, international defense industry cooperation drew considerable attention when Britain, France, and Germany, developed countries in terms of military power, were burdened with purely national research and development to develop modern weapons systems. For example, Germany fully utilized the Treaty of Cooperation with France to improve Germany's overall defense industry capabilities. By linking the German and French defense industries with each other, Germany was able to secure French technology and research and development experience. Cooperation was also used as a means of achieving diplomatic objectives. For example, early international cooperation between Germany and France kept Germany tied to France in defense procurement. However, it was not possible to prevent overlapping investment in R&D and production of such cooperative projects, so it was not induced to rational allocation of resources and tasks.

Afterwards, leading European countries began to pursue a wide range of European cooperatives as a means of responding to U.S. arms market dominance. The Independent European Program Group (IEPG) is not part of NATO and was established in 1976 as an alternative to preventing its subordination to the United States in defense procurement. In 1985, this IEPG was selected as a 'multinational forum for defense procurement cooperation in Europe'. A report published by the IEPG in 1988 describes how European defense industries can respond to the same kind of U.S. defense industry competitiveness (Covington, Brendley, & Chenoweth, 1987)

As such, there is a big difference in goals in international cooperation between the United States and Europe. While European

countries focused on securing technology, maintaining employment, and establishing an overall defense base, the United States emphasized the rationality of military R&D and the interoperability of equipment.

5.4 An analysis of international defense industrial cooperation cases

Earlier, the three goals or motives of international cooperation were examined in the theoretical framework of the analysis of international cooperation in the weapons system. Therefore, each case needs to analyze and evaluate whether the expected profits have actually been achieved in terms of economic, political, and operational aspects. If an arms system international cooperation project is economically successful, it may bring operational and political success, but success in one aspect will not guarantee the other.

What should be noted in the case analysis of the international defense industry cooperation project is what factors have prevented the cooperation project from being successful. Conflicts of goals or motivations among the partner countries are the most fundamental factors that hinder success. It can be said that the reason for the difference between the expected profit and the actual profit is due to the following three conflicts.

First, due to military conflicts, there may be conflicts across military demands such as the required capabilities of the weapon system subject to cooperation or the timing of electrification.

Second, economic conflict occurs in connection with the distribution of national interests, such as ownership of technology in the establishment, development, and production of weapons systems, whether or not production lines are installed, and the location of

assembly sites.

Finally, due to political reasons, there is a need to solve pending issues between the partner countries, or actual profits may vary depending on political factors within the country.

In addition to the three aspects, nationalism, avoidance of technology transfer, competition between participating companies, and different organizational organizations and work practices of each country intensify conflicts among partner countries. In addition, racial, ethnic, religious, and historical biases can act as obstacles.

5.4.1 Jaguar codevelopment program

The increase in costs in France in the Jaguar project exceeds the total cost of all other tactical aircraft projects in France. And this cost is almost 2.5 times the total cost of the Mirage-F1 project in France during that period. By 1972, Jaguar aircraft fuselage had experienced a cost increase of 600%, while engines experienced a cost increase of 300%.

<Table 6: Cost Growth in Fench Codevelopment Efforts (1965-1970)>

Program	Cost Growth(%)
Atlantic	17.2
Transall	37.4
Jaguar	309.2

(Lorell & Lowell, 1995)

This cost overrun caused serious obstacles to France's ongoing domestic business. During this period, France's overall military aircraft development was still concentrated in areas of low technology such as conventional transport, patrol aircraft, trainers, helicopters, and tactical missiles. France's high-tech and high-priority acquisition projects were all being developed as national projects.

Perhaps the key motivation for France's early international joint development was not cost-cutting or budget-saving. At this time, detailed cost research on joint development projects was not conducted before or after the joint development project.

In addition, the British and French Jaguar planes have different functions and capabilities. Initially, it began as a dual-purpose aircraft that could be used as a trainer and tactical support aircraft, but Britain valued high combat performance, and France required aircraft with advanced training capabilities with navigation systems. As a result, the fuselage became larger because the French accepted some of the demands, and the engine was more expensive than the British requirements, in other words, the French required. Business risks occurred due to operational inconsistencies. Eventually, this project was finally carried out separately in each country, such as aviation and electronic equipment and subsystems, and France re-promoted a separate trainer jet project.

France's initial experience of joint development has various implications for countries attempting to cooperate. First, France was unrealistic in the initial evaluation of the project due to a lack of interest in the cost factor in the joint development project, and as a result, the cost increase was significant. The new weapons system development project is more likely to increase costs due to the risk of technology and is more sensitive to seemingly trivial technical problems than the project only related to production. Laurel and Lowell saw that France chose Britain as its partner, which is expected to be costly due to political considerations, even though the country's operational capabilities in weapons systems cannot be matched for political reasons (Lorel & Lowell, 1995). Jaguar's case is an example that shows that if international joint development is promoted for political reasons and partner countries are selected without sufficient preliminary review and coordination, operational

and economic risks are likely to occur in the project process.

5.4.2 F-16 cooperative production

F-16 cooperative production is recorded as one of the most ambitious efforts ever attempted in international defense cooperation (Lorel & Lowell, 1995). The project was accomplished by matching the wishes of the participating countries. Almost at the same time that the U.S. Air Force decided to launch a lightweight fighter business, four NATO countries, Belgium, Denmark, the Netherlands and Norway, formed a consortium to replace their aging fighter F-104S fighter jets. After France, Sweden, and the United States competed with each other and actively promoted and marketed the four-nation consortium, the four European countries selected the F-16 as an alternative. One of the most important reasons for choosing the F-16 model is considered to be the guarantee of cooperative production.

Contractors from four European countries, including the United States, simultaneously produced aircraft fuselage, engines, and aircraft electronics from assembly lines owned by each country through negotiations. Belgium, the Netherlands, and the United States were responsible for the final assembly process of the aircraft. Despite this complexity, the aircraft was not only produced on time and placed on the base, but the business was also able to achieve third-party sales. In addition, the increase in the cost of the project and the total cost of the project were not large. Although there was a slight increase in cost, it was less than that of major other countries' own projects. <Table 7> shows the cost increase estimate for F-16 international cooperation until 1980.

<Table 7: Estimated Cost Growth in the F-16 Multinational Program (through 1980)>

Phase	No. of Aircraft	Baseline Cost (1975 $million)	Est. Cost Growth (Percent)
development	8	578.6	+28.3
Procurement	650	3,798.2	+13.3
Total Program	658	4,376.8	+15.3

(Lorell & Lowell, 1995)

From the perspective of the U.S. Air Force, participation in F-16 cooperative production was an approximately 5% addition to the total cost of 650 units initially produced for the U.S. Air Force. The benefits of economies of scale could offset the cost of defective parts produced in Europe.

On the economic front, the F-16 licensing project shows that international cooperation can be somewhat successful. However, it has the following characteristics that are difficult to repeat this success. First, the F-16 project was almost identical to all five participating countries in terms of business schedules and aircraft performance, which was a rare occurrence. European countries had stock of old F-104S that required replacement, but the U.S. Air Force was able to compromise these issues by making minor changes to the schedule. The concept of concurrent development and production was used to shorten the schedule. Second, production in Europe caused a certain problem, but it was possible to minimize a certain risk because it maintained a complete production system in the United States. Although Europe delayed schedules for key fuselage, engines, and aerospace components, maintenance of the U.S. production system effectively covered these areas. The third F-16 was an aircraft designed and developed by the United States and was a U.S.-led project. The related technology was well known, and the leading country of the project was clear. Technology transfer was overseen by U.S. contractors, who helped overcome difficulties related to overseas production.

5.4.3 Euro-fighter 2000 (Typhoon)

In some cases, specialization fails. In the Euro-fighter 2000 project, the UK, Germany, Italy, and Spain all participated in the development of important subsystems and components. In addition, in most international cooperation projects, all participating countries have their own assembly plants in Korea. The ability to install and develop such overlapping assembly processes is inefficient and increases management costs, resulting in an overall increase in cost.

The typhoon was conceived as a collaborative project with Germany, Italy, and Spain in the 1980s during the Cold War. As of December 2010, about 70 typhoons were operated by air-to-air fighter jets, mainly to protect the airspace around the British and Falkland Islands.

In 2004, the Ministry of National Defense decided to withdraw Jaguar aircraft. In the same year, it was decided to spend 백만119 million to upgrade its initial typoon to replace the Jaguar's ground offensive capability. This upgrade was successfully introduced in July 2008. In 2009, the company decided to retire Tornado F3, another air defense fighter, early to save money. As a result, typhoon aircraft were prioritized to take over the air defense mission carried out by Tornado F3. The Pentagon can now deploy a handful of Typhoon multi-role aircraft, but in most cases, such as Afghanistan, the tornado GR4 remains the Pentagon's preferred ground attack aircraft. The Ministry of Defence has spent about 48 million on emergency upgrades to the tornado GR4 to play a role in Afghanistan since June 2009. The new Typoon aircraft gradually improved its multi-role capability with laser-guided Paveway IV bombs and Storm Shadow cruise missiles. The typhoon is expected to be a suitable aircraft for both ground and air defense.

The Strategic Defense and Security Review said, "Our fast jet fleet

will consist of two modern and highly capable multi-role fighters, Typhoon and Joint Strike Fighter. This combination will provide flexibility and aggression to address a variety of new and existing threats, while dramatically improving cost efficiency and efficiency." The Defense Ministry has yet to decide how many high-speed jets the RAF will ultimately operate, but the announcement marks the continuation of the trend of the number of high-speed jet fleets falling to 12 in 2010. This number will be reduced to eight squadrons as Harrier aircraft are retired and tornado aircraft are reduced. The ministry also plans to retire 53 of the oldest typhoons by 2019, followed by 107 aircraft by 2030.

The development cost of Typhoon is 6.7 billion GBP, more than doubling from what was first approved in 1987. This cost is fixed regardless of the number of aircraft purchased by the Department of Defense. The production cost of the Typhoon was 13.5 billion GBP, which was within the original approval of 1996, but the Ministry of Defence purchased 160 fighter jets, 72 (30% reduction) less than the original planned 232 when the investment decision was made. Considering development and production costs, the unit price of each aircraft ordered was increased by 75%.

According to a report by the National Audit Office(NAO), the current unit production cost of aircraft (excluding the cost of the cooperative development phase) is similar to that of similar types of aircraft. Part of the increase in project costs can be explained by the fact that the production phase of the project has begun unrealistically. In other words, investment was decided based on excessive optimism.

Of the 3.5billion GBP cost increase, 2.2billion GBP was mainly due to problems caused by inefficient commercial and management collaboration, obligations to international partners, complexity of

technologies under development, and strict collaborative work sharing requirements. The Department did not anticipate the possibility that these measures would incur additional costs for the project.

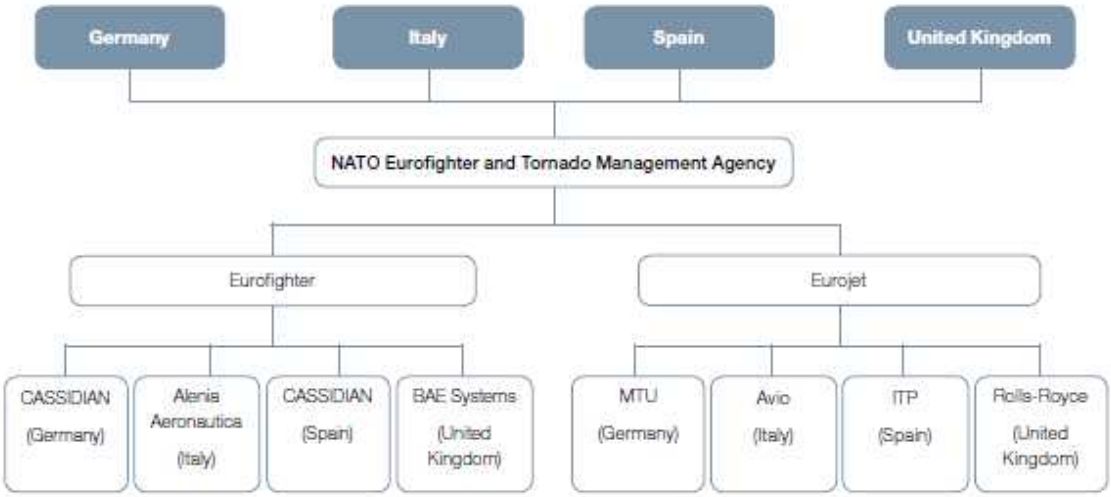
The UK Government now have a better grasp of the cost of the Typoon project. By the time the fighter jets cease service, according to the current plan, the ministry estimates that it will spend about 337 billion on this capability. The British Board of Audit and Inspection judged that it was establishing a better plan for future costs.

The cost of aircraft support was the same across the board, but increased per aircraft. The number of aircraft purchased was reduced by a third, and on a similar basis, the cost of support units per aircraft increased by about a third. The risk remains because the aircraft will operate over the next 20 years, with 84 percent of the estimated support costs still under contract. The proportion of commitments not yet signed underscores the importance of departments generating robust data to make future investment decisions and negotiate with international partners and industries

Decision-making problem

The NATO Eurofighter and Tornado Management Agency coordinates projects on behalf of partner countries and manages industry contractual relationships, but decision-making remains in partner countries (Figure 17). For example, in order to proceed with the upgrade, such decisions must be made under the agreement of all countries. Although there is a proposed time scale for deciding to work 40 days, it can be difficult for countries to stick to this.

<Figure 17: Collaborative arrangements>



(National Audit Office, 2011)

The main objective of cooperation was to reduce the cost of each partner country designing, producing, and supporting new highly complex and technologically advanced aircraft. Although there has been some success in achieving these goals, the partner countries' goals for the project have been completely inconsistent and slow to make decisions. For example, a major decision required agreement from all four partner countries. It took up to seven years to agree and deliver some major upgrades. The problem was particularly dangerous for the UK because RAF (Royal Air Force) flies more time in Typoon than in other partner countries and RAF is more likely to use full multi-role capabilities in the future. Performance in the project procurement phase shows that cooperative contracts cause serious problems if the Ministry of Defence upgrades and supports fighter jets quickly and cost-effectively unless partner countries find new ways to cooperate. In the end, it was concluded that collaborative decision-making was inefficient.

<Figure 18: The time taken to agree key ground attack upgrades>

Upgrade	Details	First request to industry	Delivery	Forecast cost (£m)
Ground attack capability for Tranche 1 aircraft	United Kingdom-only change All nations had to agree use of test aircraft and equipment	June 2004	Solution declared combat ready by RAF in July 2008	119
Ground attack capability for Tranche 2 aircraft (stage one)	One year for industry to provide acceptable proposal Stage one will be delivered in two phases, with capability of first phase still to be fully defined	April 2005	Forecasted delivery from June 2012	445

(National Audit Office, 2011)

The Department has appointed the Chief Executive Officer of Typhoon, Chairman of the Program Committee, which brings together those responsible for providing all the components of the functions that Typhoon must have in order to function effectively. These components are education, equipment, manpower, infrastructure, doctrines and concepts, organization, information, and logistics. The introduction of the programming committee has gone a step further, but the risks to effective cost control and decision-making remain. Budget and management responsibilities are divided into several departments of the department.

The senior responsible owner is responsible but can only affect these groups and cannot take action or force them to compromise cost or performance between components. In addition, the Senior Responsible Owner does not attend major meetings that make strategic decisions, such as those related to exports, that affect the delivery of Typhoon's operational capabilities. In this situation, it can be seen that the risk of increasing the delay cost of the project still exists due to the mismatch in responsibilities, budget, and management authority.

Evolution of collaboration

Departments recognize the shortcomings of existing collaborative structures and work with partner countries to simplify decisions and improve the efficiency of industry agreements to make aircraft upgrades and support more cost-effective and agile. The department's goal is to reduce costs and time by 50 percent for future upgrades. Several arrangements have improved in recent years.

- Countries agreed to consolidate existing international support and upgrade their contracts to four, which are 12 (11 of which are eligible for support).
- Plans for future upgrades are also being revised, national requirements are being developed on a small scale, and are being developed in a standard format to make it easier for the industry to understand requirements and create solutions faster as part of a rolling upgrade program.

In November 2010, NATO announced plans to streamline the organization structure, including NATO Eurofighters and tornado management instruments, to increase synergy between similar functions and maximize efficiency and effectiveness.

Governance follows the department's standard approach but is complex. Governance for typhoon projects follows the department's standard approach and is based on coordinated progress of eight components (training, equipment, manpower, infrastructure, doctrine and concepts, organization, information and logistics) that provide typhoon capabilities. The representative of the component owner attends the Program Board of Directors chaired by the responsible senior owner. Although similar structures have been in place for several years and there are signs that they are promoting better discussions, the programming committee has been in operation for

two years in its current form. For example, component owners took steps to identify risks that could adversely affect training if the development of the necessary infrastructure in RAF Leuchars progressed late and to quickly install temporary simulators to help mitigate the risks.

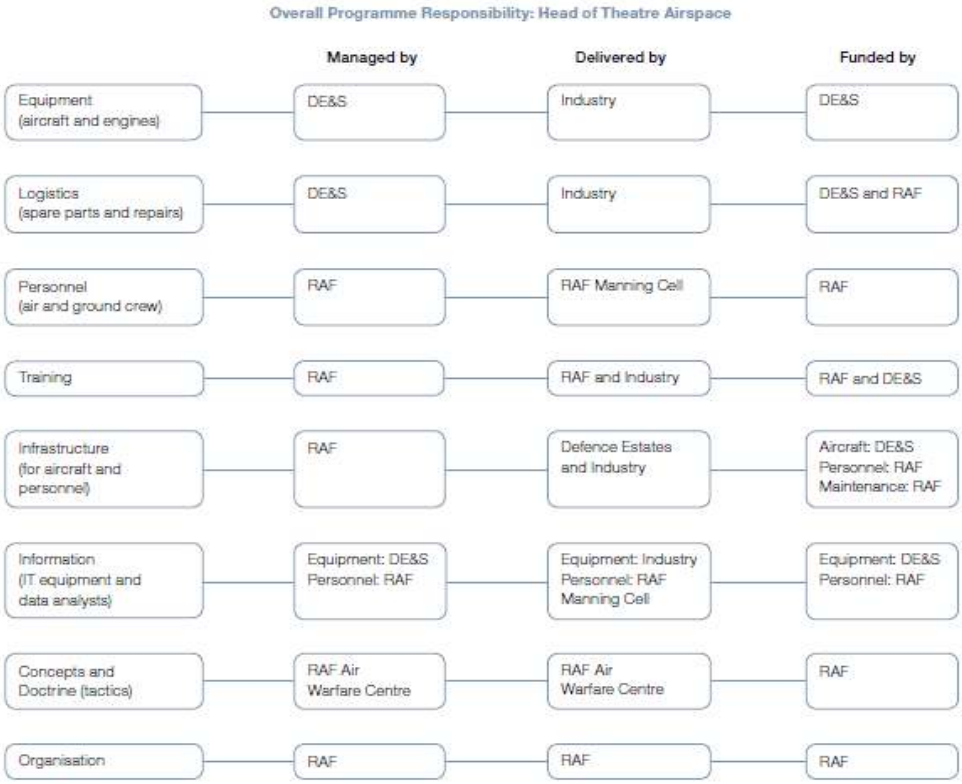
The introduction of the program board is a step further, but governance arrangements for the delivery of typhoon capabilities are still complicated. The key issue is that there is no individual responsible and clearly responsible for the entire project. As Figure 19 shows, the budget and administrative responsibilities for the eight components of competence are divided into different parts of the department and RAF. The senior responsible owner may affect the owner of each component of the capability, but cannot force action between components or compromise cost or performance.

Strategic decisions related to typhoons can affect capacity delivery. Decisions that have a significant impact on the delivery of typhoon capabilities, such as agreements with export customers, are taken beyond the programming committee structure. There have been several examples of tensions between the operational capacity decisions made by the Program Committee and such broad strategic decisions that require a wider view not only within the Department but also across other government departments and industries.

The typhoon has already been successfully exported to Saudi Arabia and Austria, and more opportunities are being pursued. The Department is actively working to maximize its export potential by recognizing the costs, operational, diplomatic and industrial benefits they can bring. Although senior responsible owners do not attend key meetings of top management groups within the department that make decisions about typhoon exports, export decisions may

affect the project. For example, funding for typhoon projects has not been coordinated to reflect the strategic decision of pilot training support for export customers. The transition time to export customer training will allow two RAF pilots to be fully trained in all roles in 2010–11 and four RAF pilots to be maintained in 2011-12. Similarly, support for export campaigns such as flight demonstrations should be managed by the Program Committee from existing resources and converted from RAF.

<Figure 19: Typhoon governance arrangements>



(National Audit Office, 2011)

Conclusion on Cost Performance

Major investment decisions were overly optimistic, the project was negatively affected by corporate decisions to balance the defense budget, and costs increased significantly at an unforeseen pace by the Defense Ministry.

There is an opportunity to secure higher cost-effectiveness in the future. The Defense Ministry has successfully deployed some blocks to make this possible. However, there is more work to be done to improve cooperative support arrangements, develop timely and cost-effective aircraft upgrade methods, and ensure greater certainty about national cash flows to enable reasonable long-term planning. A measure of success is whether the entire multi-role function can be distributed and supported cheaply when needed.

Procurement and support of expensive defense equipment jointly with other countries is a smart way to reduce costs at a time when budgets are limited. However, such contracts will only benefit if management and decision-making arrangements are timely and cost-effective. Typoon did not meet these criteria.

Typoon investment decisions were made using overly optimistic and immature cost data. Departments should use the current learning phase of the national support contract to approve and contract the next support phase, generating robust cost and performance data to build a cost model. And better empowerment should be given to task personnel to enable more timely and cost-effective decision-making. In particular, the following shall be done:

First of all, it simplifies decision-making and improves the department's ability to respond. Clarifying the respective roles of project sponsors and senior responsible owners, changes requirements nimbly to ensure that each has sufficient management and budget authority to prioritize investments within a given budget and across all competency components within the responsibility area. And increase the term of office of public officials in key positions to ensure that the decision is carried out properly.

In addition, export-related decisions and promotions must also

belong to the business area. Typoon has been successfully exported to Saudi Arabia and Austria, and the industry is seeking more opportunities with government support. To help make effective decisions, exports should be considered essential to each project from the outset. Doing so requires a clear understanding of the benefits and potential shortcomings of the decision and close consultation with other parts of the industry and government to ensure that the project maximizes revenue.

5.4.4 Joint Strike Fighter (F-35 Lighting II)

The JSF Program, the world's largest and most expensive development program, is a collaboration program between the U.S. Department of Defense and eight allies to develop and manufacture fifth-generation fighter jets to replace aging inventory. The participating countries are Australia, Canada, Denmark, Italy, the Netherlands, Norway, Turkey, and the United Kingdom.

The project was conceived as an international acquisition program to attract financial investment and technological innovation from partner countries, as well as early cooperation with governments where users of this state-of-the-art coalition platform may use military services.

The JSF program leads to cooperation between the U.S. government and allied governments, as well as cooperation between major contractors and allied industrial partners. It is established through the Framework Memorandum of Understanding (MOU), which identifies the roles, responsibilities and expected benefits of all participants. The relationship between the original contractor and the international subcontractor was structured by contract and licensing. The international strategy/cooperation framework of the program is shown in Figure 20.

<Figure 20: JSF International Strategy/Cooperative Framework>

(Steven L. Enewold, "Joint Strike Fighter Program Briefing," 2004.)

According to the Government Accountability Office (GAO) report, the United States and participating countries identify the JSF program as slightly different. The United States expects to benefit from sharing business costs and improving interoperability with its allies. Participants pointed out that they could exert a clear influence on aircraft requirements and that they expected to improve industrial relations with U.S. aerospace companies through subcontract competition with JSF contractors, and to reap the benefits and economic benefits.

The report also pointed out that the JSF program contributes to the U.S. arms cooperation policy. The purpose of arms cooperation is to increase military effectiveness through standardization and interoperability, and to reduce the cost of acquiring weapons by preventing overlapping development efforts with U.S. allies. The JSF program supports policies in the following areas:

- Politics/Military: Expanded Foreign Relations,
- Economical: Partner contribution reduces JSF program costs

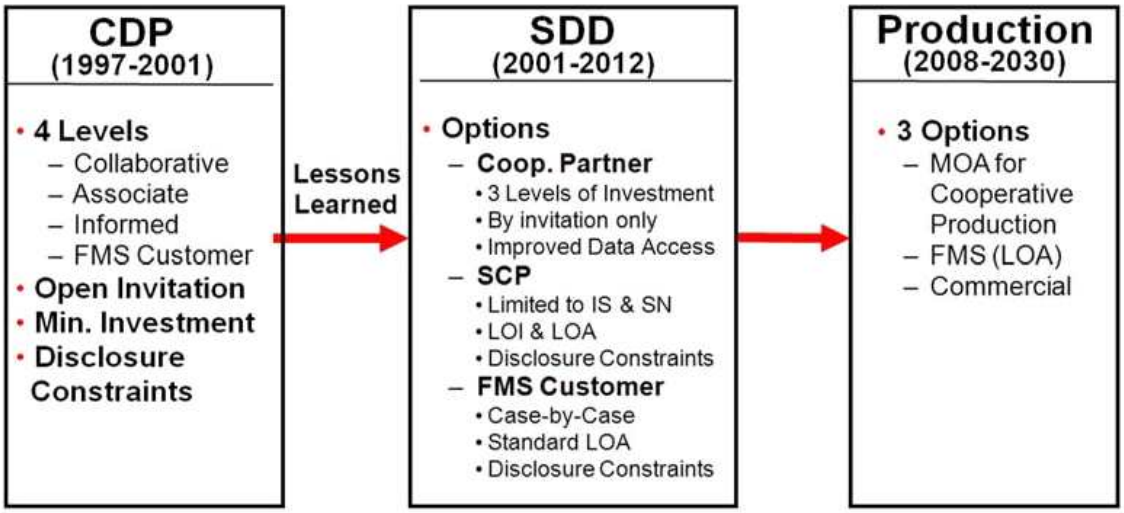
• Technology: Increasing accessibility to top technologies by foreign partners,

• Operations: Interoperability with allies enables improved mission performance

The JSF program is a little different from the existing international cooperation joint development program. Rather than representing a complete joint development effort, it can be characterized as a U.S.-led program that outsources significantly overseas in level 2 and 3 (Lorell et al., 2002).

Unlike previous international joint development partnerships, the first partners participated in the JSF program definition and risk reduction phase in 1996 (the UK also participated in 1995). Then, until 2002, another partner participated in the SDD phase of the program. Participation in the JSF program as Level 1, 2 and 3 partners in the SDD phase was only available until July 15, 2002. Partner countries could withdraw their participation at any time at this stage. The final phase of the international aspect of the 98 program is the PSDF, and the current participating partners participated in the program in 2006 and 2007. The procedure for conducting the JSF international cooperation program can be explained in Figure 21 in summary.

<Figure 21: JSF International Program Progression>



(Steven L. Enewold, "joint strike Fighter Program Briefing", 2004.)

Concept Demonstration Phase(CDP) Participation(Program Definition and Risk Reduction Phase)

Level I - Full Collaborative Partners: The UK is the only participant at this level. It invested $200 million in the CDP. Thus, the UK has full access to program data and structures as well as being able to influence requirements definition and performance characteristics.

Level II – Associate Partners: Denmark, the Netherlands, and Norway formed a group that paid a total of $30 million to participate in this level. These countries may have limited access data and limited requirements influence.

Level III – Informed Partners: Canada and Italy participated. level by paying $10 million each They are granted limited access to program information and representation, but do not affect the requirements.

Level IV - Foreign military sales partner: Turkey, Singapore, and Israel participated at this level. They have only the authority to negotiate directly with the Program Office on cost, operational performance, modeling and simulation research.

System Development and Demonstration(SDD) Phase Participation

The partner countries participated in the program system development and demonstration stage in three stages based on their financial contribution. Participating countries enjoyed proportionately the benefits of the program, including the number of employees representing themselves to the program office, access to program data and technology, and membership in management decision-making bodies. Finally, the data available show that participating countries contribute more than $4.5 million, which is 10% of the cost of the system development and demonstration phase. The benefits of participating in the SDD phase can be withdrawn without financial penalties. By participating in the SDD phase, partner countries can compete for "best value" based contracts. The financial contribution, production rate, and partner level of the allies can be seen in Table 8.

PSFD, Production, Sustainment and Follow on Development Phase

The final stage of participation is the actual purchase stage through production, maintenance, and development tracking. The Netherlands, Canada, Australia, and the United Kingdom participated in this stage in 2006, while Turkey, Norway, Italy, and Denmark participated in 2007. During the PSFD phase, participating countries devoted themselves to purchasing aircraft. If a country reverses its purchase decision after participating in this stage, it can be disadvantaged financially.

<Table 8: JSF Partner Financial Contributions and Estimated Aircraft Purchases>

Partner country	System development and demonstration			Production	
	Partner level	Financial contributions (in millions)	Percentage of total costs	Projected quantities	Percentage of total quantities*
United Kingdom	Level I	$2,056	4.96	138*	4.3
Italy	Level II	$1,028	2.48	131	4.1

Netherlands	Level II	$800	1.93	85	2.7
Turkey	Level III	$175	0.42	100	3.2
Australia	Level III	$144	0.33	100	3.2
Norway	Level III	$122	0.29	48	1.5
Denmark	Level III	$110	0.27	48	1.5
Canada	Level III	$100	0.24	80	2.5
Partners		**$4,535**	**10.93**	**730**	23.0
United States		$36,946	89.07	2,443	77.0
Total		**$41,481**	**100.0**	**3,173**	**100.0**

(GAO Report, GAO-06-364)

Unlike the SDD phase, the PSFD phase does not provide level-specific steps for each participating country. As participants signed the PSFD Memorandum of Understanding (MOU), countries announced details of their procurement plans, including the type of aircraft and the number of aircraft. The governance structure of the program has been expanded to allow all participating countries to have a say in subsequent development decisions. Unlike the SDD phase, the phase cost was divided in a "fair share" manner based on the proposed purchase amount in each country. In addition, unlike quantum SDD MOUs, PSFD is an agreement between all partner countries.

Initial Operational Test and Evaluation, IOT&E

The IOT&E step is a sub-procedure of the SDD phase. The partner countries were invited to participate in this sub-phase in 2009. Britain, Italy, and the Netherlands agreed to participate in the IoT&E program. The UK has the strongest participation in the IOT&E stage. The benefits of participation are rapid aircraft acquisition, pilot training on test cycles, and access to test results.

Best Value Acquisition Approach

Unlike other international cooperation programs, the JSF program does not guarantee a predetermined level of work to foreign or domestic suppliers based on the state's financial contribution to the program. It also does not allocate offset arrangements.

To qualify for the JSF subcontract bidding process, participating companies must demonstrate world-class products and technologies that represent a cost advantage over the program. If Lockheed Martin and its top partners select suppliers, they will push for exclusive source contracts with these companies based on schedules, performance, and cost benchmarks. Suppliers may compete again if they do not meet these benchmarks. <Table 9> summarizes the motivation for participating in SDD and the main key elements of the government approach and the concerns of partners.

a. United Kingdom

Government Approach

- Royal Air Force/Navy operational requirements are the critical reason for JSF participation.
- Early involvement in the program helped British companies to gain entry into the program.
- The U.K. government and industry are committed to the best value strategy; the government believe the industry to fight for work while acting to ensure a level playing field.

<Table 9: Summary of Country Strategies and Concerns>

Countries	Primary Motive behind SDD Participation	Major Key to Government Approach to JSF Program	Main Concerns with JSF Program
United Kingdom	Operational requirement	Early commitment to JSF Program	Delayed information disclosure

Italy	Operational requirement	Worked with Lockheed Martin to develop industry support	US contracting practices unfamiliar, Lengthy TAA approvals
Netherlands	Industrial benefit	"Public – Private Partnership"	US sub-tiers unwilling to source work to global suppliers, Lengthy TAA approvals
Canada	Industrial benefit	Pro-active "JSF Canada" organization	"Strategic Sourcing"
Norway	Industrial benefit	Teaming with other partner countries to increase competitiveness	US top tier contractors favor established suppliers
Denmark	Operational requirement	Liaison between Danish industry and Lockheed Martin and subcontractors	Large companies often absorb upfront development costs
Australia	Operational requirement	Government liaison between Australian industry and program IPTs	Export regulations – TAAs and GPA
Turkey	Industrial benefit	MOD liaison between industry and Lockheed Martin	Lack of communication

(U.S. DoD, JSF International Industrial Participation)

Concerns:

- Lack of disclosure of technical information can limit the potential of industrial competitiveness.
- The international nature of JSF exposes the U.K. to potential risks, particularly cost impacts of U.S. reprogramming or Congressional intervention through 'Buy-America' legislation.

Financial Impact:

- Incremental earnings attributable to JSF work is expected to run well into the billions in U.S. dollars over the course of the program's life, and bringing great vitality to U.K. industry,
- Nominal return on investment seems to be very high, exceeding 21 dollars for every dollar of direct program investment over the program life.

Primary Reasons for Participation

- To meet operational requirements of RAF and the Royal Navy
- To achieve operational commonality with the United States

- To achieve an affordable Air Combat System through economies of scale

b. Italy

Government Approach:

- Air Force/Navy operational requirements are the critical reason for JSF participation.
- Italian JSF investment (1.028 billion dollars) is funded by the Ministry of Defense, with support from the Ministry of Productive Activities,
- The LOI Lockheed Martin-Italian Ministry of Defense and the MOU for JSF participation with Italian industry preceded Parliamentary approval.

Concerns:

- Late commitment to SDD might have limited potential Italian contract wins.
- Italy believes that several issues have impaired their SDD participation on a "level playing field" basis.
- Italian industry has been upset by short RFP response times. It is stunted by a lack of familiarity with the "best-and-final-offer" concept (no interim negotiations) – both standard US contracting practices.
- Limited effectiveness of Global Project Authorization(GPA) has forced firms into lengthy Technical Assistance Agreement(TAA) processes.

Financial Impact:

- Italy is expected to earn more than a nominal return of over 476 percent on its SDD investment – 25 percent compounded annually – in the SDD, LRIP, and FRP.

Primary Reasons for Participation

- Italian Air Force & Italian Navy requirements for future tactical fighters
- To promote Italian industrial participation in JSF program

c. The Netherlands

Government Approach:

- During CDP, JSF was selected by the Dutch government as one of two aircraft platforms to build the Dutch aerospace industry of the future.
- In the Early 1997, the Dutch government promoted JSF participation through financial support for Dutch industry.
- A Public-Private Partnership (PPP) provided government sponsorship for SDD investment, in return for a 3.5 percent tax on all Dutch JSF production and support revenues to repay SDD investment.
- The efforts of JSF CDP and SDD are led by the Ministry of Economy, with key information provided by the Ministry of Industry, MOD and the Netherlands Air Force.
- The Dutch JSF organization planned to act as the "first responder" with Lockheed Martin and other JSF contractors and as the "business relations activator" of the Dutch industry, but could not prevent two non-compliance bids.

Concerns:

- Dutch companies feel that they cannot compete in 'fair competition' with American companies because of the security of geographical, financial, export controls, and supply restrictions.
- The initial concern of the Dutch Parliament regarding the return on investment is an ongoing threat to future participation in the

JSF program.

Financial Impact:

- The Netherlands is expected to earn a nominal return on its SDD investment well over 700%, a 40% annual return.

Primary Reasons for Participation

- To use JSF as a military aircraft platform for which the Dutch aerospace industry will technically be based in the future
- To evaluate JSF as replaceable for F-16.

d. Canada

Government Approach:

- The Canadian Ministry of Defense and Industry took the lead in encouraging Canadians to participate in the JSF program through an innovative organizational structure called 'JSF Canada'.
- JSF Canada actively sought opportunities for Canadian industries by meeting with major JSF contractors to investigate Canadian industrial foundations.
- Canada hopes to foster the best value performance on a global scale through partnerships with other JSF countries.

Concerns:

- Strategic sourcing may compromise the reliability of the highest value program in other programs (e.g., multi-mission maritime aircraft) similar to future Canadian parliamentary debates on JSF.
- Canada's International Traffic in Arms Regulations(ITAR) exemption has not been used, which has created delays in obtaining clearances to access technical RFP information.

Financial Impact:

- Canada expects a combined annual return on SDD investments to exceed 75% during the JSF program.
- The technical knowledge acquired through SDD is expected to generate future revenue with spin-off products.
- The JSF Supplier label will increase the revenue of other programs due to its marketing appeal.
- To evaluate JSF as a potential candidate for the Canadian Forces
- To promote interoperability between U.S., British and Canadian Forces
- To gain insight into U.S. procurement methodologies and best practices

Primary Reasons for Participation
- To promote Canadian industrial participation in the JSF program,

e. Norway
Government Approach:
- Potential industrial interests stimulated early intervention in CDP, and potential operational requirements surfaced later.
- Government/industrial groups were formed to investigate the overall industrial impact of the defense program.
- The Norwegian government is not organized to help the industry win JSF work.
- Norway has international partnerships with Canada and Denmark.

Concerns:
- Norway lacks a fair playing field because Lockheed Martin and their Phase I submarines tend to favor existing supplier relationships.
- Lockheed Martin's new strategic sourcing plan is not the answer.

Primary Reasons for Participation

- To facilitate Norwegian industrial participation in JSF program,
- To evaluate JSF as a potential Norwegian Air Force purchase.

f. Denmark

Government Approach:

- Denmark hopes to win a JSF contract using its relationship with Lockheed Martin and previous experience in the F-16 program.
- Denmark has strong industry support, including joint funding for SDD investments.
- Denmark believes that acquiring an alternative platform for the F-16 is a major advantage of participating in the program.
- Political opposition forced Danish defense companies to lobby for participation in the JSF program.
- Danish industry and government officials have been working diligently to organize marketing opportunities for Danish defense companies and capabilities.

Concern:

- In the best value-contracting process, large enterprises can often capture windfall profits at the production stage by absorbing pre-development costs to set low prices and eliminate competition.

Key Reasons for Participation

- To replace the current F-16 fleet with F-35 aircraft,
- To support the Danish defence industry
- To gain an understanding of the F-35 platform and program.

g. Australia

Government Approach:

- Australia is taking a government-industry integration approach to maximize opportunities for Australian industries within its best

value model.

- Australia has formed the JSF Program Office to coordinate both industry and competency aspects of the project.
- Australia has created a JSF industry team to maximize the opportunities of the country's industries.
- Australia is considering working with American companies and companies from other mutually beneficial partner countries.

Concerns:

- Australia was unable to bid for some JSF contracts due to the long TAA implementation process.
- Australian companies sometimes have difficulty competing with large US and Canadian companies that can subsidize JSF programs during the SDD phase. Australia believes that strategic sourcing contracts will help it overcome them to some extent, but it is still very much in favor of the best value agreement. Key Reasons for Participation
- To promote Australia's industry participation in JSF,
- To evaluate JSF as a potential platform for Australian troops.

h. Turkey

Government Approach:

- Turkey's Ministry of Defence chose to be a partner in the JSF program to support the defense industry and ultimately replace the fleet of F-4, F-5, and F-16.
- The Ministry of Defence is working to integrate the Turkish defense industry and the respective contacts of JSF contractors.
- The Turkish government provides development funds to financially support companies securing JSF opportunities.

Concern:

- Turkey believed there was a lack of information on the full universe of available JSF contracts. Eventually, they were excluded from the F-35 program, introducing the Soviet anti-aircraft defense system, even though they were NATO members.

Primary Reasons for Participation

- Positive impact on the industry in terms of revenue, jobs, and technology expertise
- The need to replace the upcoming fighter.

As mentioned in the study of industrial participation by DoD allies, multinational cooperation effectively relieves the cost burden of individual countries, but it causes unprecedented problems such as technology transfer and inefficiency of subcontract bidding. In summary, all participating countries have different expectations and concerns.

The U.S. Government Accountability Office (GAO) estimated that the total cost of developing and procuring 2,456 aircraft as of 2009 would be $300 billion, and the cost of life cycle and support would be more than $760 billion, so the JSF program would cost more than $1 trillion.

Overall, the JSF development cost estimate increased by about 29% from $34.4 billion in 2001 to $44.4 billion in 2007. According to the JSF Program Management Agency, an additional $12.2 billion was required to complete the development in 2014. The program acquisition cost per fighter jet (PAUC) was estimated at 81 million dollars in 2001, 100 million dollars in 2003 and 122 million dollars in 2009. PAUC has increased by 50% since the start of the development phase. Details of cost increases, schedule overruns, and the program's evolution are depicted in Table 10:

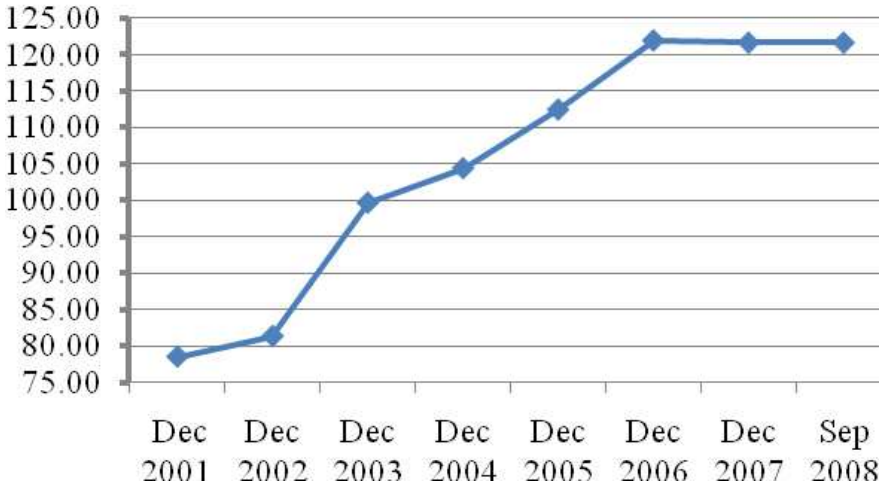
<Table 10: Changes in JSF Program Purchase Cost, Quantities, and Delivery Estimates>

	November 1996 (Program start)	October 2001 (System development start)	December 2003 (2004 replan)	December 2006 Date	December 2007
Expected Quantities					
Development Quantities	10	14	14	15	13
U.S. Procurement Quantities	2978	2852	2443	2443	2443
Total Quantities	**2988**	**2866**	**2457**	**2458**	**2456**
Cost Estimates (then year dollars in Billions)					
Development	$24.80	$34.40	$44.80	$44.50	$44.40
Procurement	Not available	$196.60	$199.80	$231.70	$254.00
Military Construction	Not available	$2.00	$0.20	$0.20	$0.50
Total Program Acquisition	**Not available**	**$233.00**	**$244.80**	**$276.40**	**$298.8**
Unit Cost Estimates (then year dollars in Millions)					
program Acquisition	Not available	$81.00	$100.00	$112.00	$122.00
Average Procurement	Not available	$69.00	$82.00	$95.00	$104.00
Estimated Delivery Dates					
First Operational Aircraft Delivery	2007	2008	2009	2009	2010
Initial Operational Capability	2010	2012 2010-	2013 2012-	2015 2012-	2015 2012-

(Estimates. GAO Report, GAO-09-303)

The average unit price increased sharply between December 2002 and December 2006. The increase in cost can be seen in Figure 22 and Table 11.

<Figure 22: F-35 Average Unit Cost Estimate>



<Table 11: F-35 JSF Selected Acquisition Reports Summary- Base Year 2002>

Month-Year	Current Estimate ($ in Millions)		Quantity	Average Unit Cost ($ in Millions)	Quarterly Changes $	
	Base Year	Then Year			Base Year	Then Year
Dec 2001		226,458.3	2886	78.47		+3.6
Dec 2002	161,543.9	199,736.4	2,457	81.29	1.4	-2.8
Dec 2003	191,632.9	244,834.3	2,457	99.65	20.3	19.1
Dec 2004	192,519.0	256,617.6	2,458	104.40	20.8	24.8
Dec 2005	201,729.4	276,458.9	2,458	112.47	26.6	34.5
Dec 2006	209,401.60	299,824.10	2,458	121.98	30.2	44.4
Dec 2007	210,014.50	298,842.80	2,456	121.68	30.6	44.0
Sep 2008	210,014.50	298,842.80	2,456	121.68	30.6	44.0

(US Selected Acquisition Reports, 2008)

The F-35 JSF program is undoubtedly one of the most unique and interesting programs in defense acquisition history in many ways.

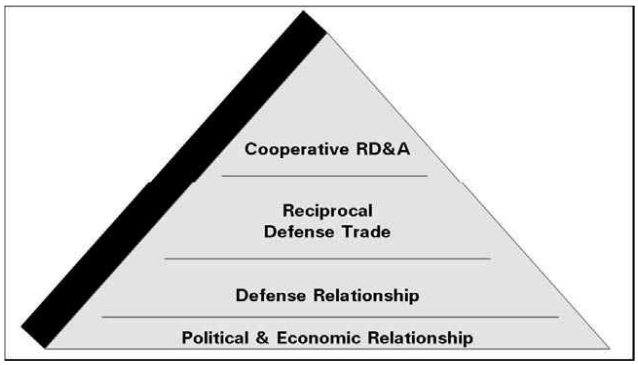
Interesting and unique features include international participation, its precedent and history, project organization, and the response of many national and business participants. It is also interesting because of its potential impact on the global defense industry. Jon A. Schriber, former director of JSF International Program, explains the uniqueness of the program as follows.

'It is unprecedented to be internationally involved in a major U.S. fighter jet development acquisition program, not only in the early stages of development but also in an important competitive phase. While other U.S. aircraft programs, such as the F-16 program, have successfully engaged international partners, it is at a much later stage. JSF has the opportunity to utilize lessons learned from past programs as well as ongoing cooperative development and production programs.'

Political and Operational purposes

According to the U.S. Department of Defense's International Arms Cooperation Handbook, the highest achievement of arms cooperation is a cooperative R&D program, as shown in Figure 23. Therefore, the JSF program represents the highest level of international arms cooperation, and the United States expects greater benefits than those provided by other types of cooperation.

<Figure 23: Hierarchy of Relationships Leading to Armaments Cooperation>



The political and opreational goal of the JSF program is to strengthen defense relations between the United States and its major allies. In other words, the U.S. is striving to have a stronger air force to keep close ties with its allies and cooperate in future operations.

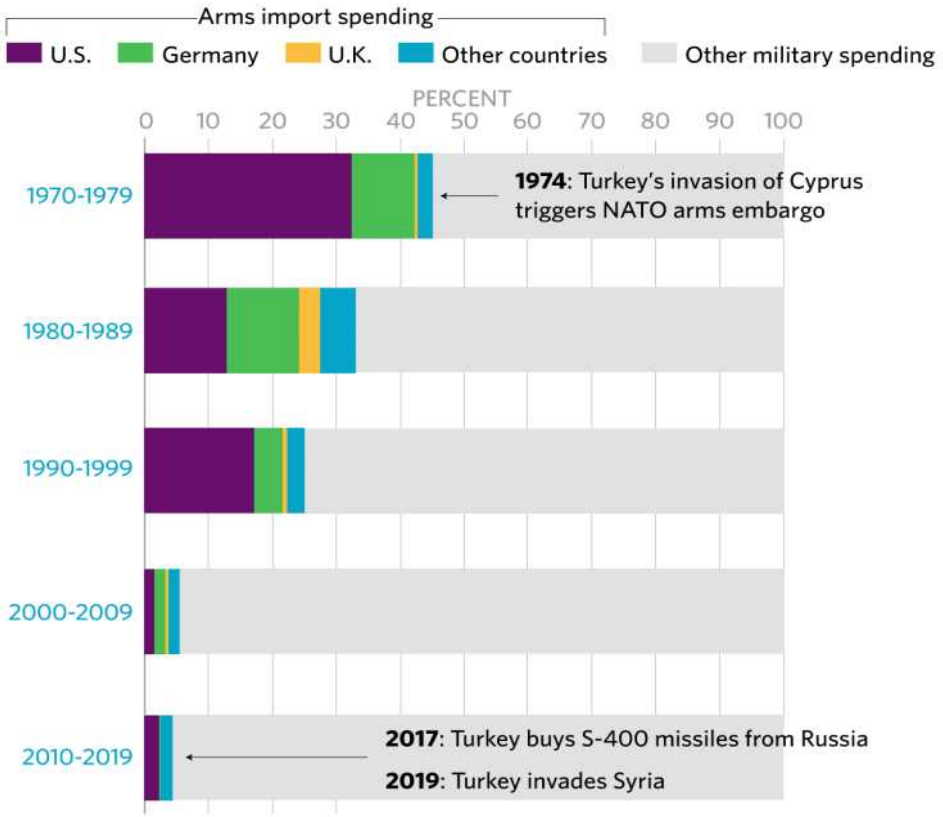
The JSF program began in 1994, but most of the participating allies participated in the program around 2002. The last aircraft will be delivered in 2034, and the F-35 will operate by 2064. Due to JSF's sophisticated acquisition strategy of distributing production facilities to countries around the world, participating countries are obliged to continue participating in the program over 60 years of aircraft life cycle. Without a doubt, the program will boost the nation's friendship and stimulate its acquisition of other defense cooperation projects, but it will also reduce the nation's independence. An email from Lockheed Martin and Northrop Grumman on 17 August 2009 states that more than 100 defense contractors in various countries are working to develop and produce JSF aircraft. Undoubtedly, subcontractors in 100 different countries create complex subcontract acquisition strategies and increase mutual confidence among participating countries. The nine allies must rely on each other to purchase and support the F-35. In political relations, on the other hand, the state is an ally until the common interests collide. The 60-year partnership is too optimistic politically, as the nation's common interests could change in less than a decade

A case in the point is the case of Turkey. Turkey has sought a more independent foreign policy process than ever since joining NATO in 1952, partly due to geopolitical and economic considerations. Despite being a NATO member, Turkey has higher political and military tensions with the United States than other JSF

program participants over issues such as the Kurdish separation movement, the Syrian civil war, and military intervention in the Cyprus conflict.

After the 1975-1978 U.S. arms embargo imposed as a measure against military intervention in the Cyprus conflict significantly hindered Turkey's acquisition of arms, Turkey sought to reduce its dependence on foreign resources by establishing a domestic defense industry (see Figure 24). Over time, Turkish companies supplied an increased percentage of Turkish defense demand for armoured vehicles and equipment ranging from naval vessels to unmanned aircraft. For key items that Turkey cannot produce on its own, Turkish leaders are generally seeking deals with foreign suppliers that allow greater co-production and technology sharing.

<Figure 24: . Arms Imports as a Share of Turkish Military Spending>



(Jim Zanotti & Clayton Thomas, 2020)

In the end, Turkey's choice of Russian SU-400 instead of Patriot as a surface-to-air defense system may have affected Turkey's general interest in procurement deals, which feature technology sharing and joint production, Turkey's intention to diversify overseas weapons sources, and Erdogan's interest in interfering with U.S. aircraft in the 2016 coup.

When the S-400 delivery began in Turkey, the Trump administration announced in July 2019 that Turkey would be excluded from participating in the F-35 Joint Strike Fighter Program. Explaining the decision to exclude Turkey from the F-35 program, Deputy Defense Secretary Ellen Lord said, "Turkey cannot deploy a Russian intelligence gathering platform where the F-35 is located. The F-35's strength lies largely in its stealth capabilities, so its ability to detect these capabilities will jeopardize the long-term security of the F-35 program." Turkey planned to purchase at least 100 U.S. F-35s and was one of eight first consortium partners in aircraft development and industrial production.

Eventually, for political and military reasons, the JSF program suffered some damage. Turkey was excluded from the program in July 2019 when it purchased the Soviet surface-to-air missile system (S-400) in 2017. However, the supply chain of 15 parts produced in Turkey incurred costs for parts delay and supply chain conversion, which continued until 2020.

When political ties are weak or the purpose of operational interoperability is weak, procurement of weapons systems affects partnerships with powerful countries. Acquiring long-term international cooperation requires stable and committed political relations between the allies.

The Economic Objective

The Allies participated in the SDD phase of the program in three

stages, and received corresponding benefits and contributed a cumulative $4.5 billion to the program. Allies contribute 10.9% of total SDD funding. As a first-degree partner, Britain donated $45% of its eight allies and nearly 5% of its entire program, or $2 billion. To pay for the cheap yet high-performance aircraft, the U.S. Department of Defense invited the allies as program partners. Apart from the shared desire to develop and operate aircraft, the United States and other allies have different expectations for the program.

The goal of the United States

The United States has two goals in terms of R&D. First, the U.S. does not want to fund a consortium that does not belong to the U.S. that has already been developed by its allies. For example, the F-35B's short-range takeoff technology is already used by the UK, and the United States does not own proprietary data. The technology is provided by the UK. Second, the United States shared research and development costs with its allies for innovative parts of the aircraft. Thus, the Allies donated $4.5 billion, or nearly 11% of the SDD phase, to share these costs.

In addition, the United States wants to benefit from economies of scale by sharing fixed costs and reducing costs in the long run. International participation in the JSF program offers significant benefits for economies of scale. The program will produce 3,173 aircraft by 2034, of which 2,443 are U.S. and 730 are allies. The Allies will procure 23 percent of the aircraft produced. The agreement will provide economic benefits of scale to the United States, a major country.

Finally, allies create valuable markets for the United States and major contractors by participating in the program early. The U.S.

attracted potential customers at the start of the program. By 2006, the participating countries had adapted to the JSF program and developed industrial relations with major contractors and the U.S. Department of Defense. Then in 2007, they promised to procure the aircraft without accurate test results and current acquisition costs. Therefore, the U.S. sold 23 percent of JSF aircraft before the project was completed.

Economic goals of participating countries

All participating countries have notable economic expectations for the JSF program. JSF International Industry Participation Studies by the U.S. DoD show that the Netherlands, Canada, Norway, and Turkey are primarily motivated by industrial or economic interests. However, Britain, Italy, Denmark, and Australia are primarily motivated by operational factors. They expected a return on investment.

The JSF program provides an opportunity for allies to realize return on investment by competitively bidding subcontracts. According to DoD's JSF International Industrial Partnership study, annual compounded returns from partners' SDD investments range from 25% to more than 100%. This means that participating countries could potentially earn $5 to $40 in return for every dollar invested in the program, as shown in Table 12. Canada's return to the dollar is nearly twice that of the UK due to relatively few partnership investments, while the UK has a much higher annual return on benefits due to the fast timing of industrial returns.

<Table 12: Summary of Partner Country Return Potential>

SUMMARY OF PARTNER COUNTRY RETURN POTENTIAL

Summary (US$M)	SDD - FRP Revenues 2002-2026	Partnership Investment 2002-2026	Nominal Return 2002-2026	Annually Compounded Rate of Return 2002-2026
United Kingdom	$43,456.5	$2,056.0	**2113.6%**	109.2%
Italy	4,896.4	1,028.0	**476.3%**	23.8%
The Netherlands	5,741.7	800.0	**717.7%**	38.1%
Canada	3,910.8	95.0 [1]	**4116.6%** [2]	66.7% [3]

(U.S. DoD International Armaments Cooperation Handbook)

In addition to direct economic benefits, the JSF acquisition program provides indirect economic benefits to participating countries. First, thanks to international arms cooperation, allies can learn about other countries' defense industries and future cooperation capabilities. Thus, participating countries can find markets to sell or purchase defense systems. For example, Turkey's TUSAS Engine Industry (TEI) first signed a contract with the General Electric F136 engine to manufacture JSF plant parts for Lockheed Martin. Following the successful production of TEI, it won contracts to provide design engineering and analysis of the F136, as well as other General Electric military and commercial engines. Later, GE signed a $700 million contract with TEI to manufacture commercial engine parts.

Second, JSF's international cooperation acquisition strategy avoids unnecessary development costs by preventing waste of research duplication. In order for a country to design and develop aircraft on its own, it must bear the entire program budget, including expensive R&D costs, indirect costs, and indirect costs. Conversely, JSF's acquisition strategy encourages countries to share research and its costs.

The Technical Purpose

The technical goal of the JSF program is to increase accessibility to the best technologies of alliance partners. The Pentagon wants to reduce research and development costs by acquiring existing airspace technology from its allies. For example, F-35B's short-range takeoff and landing and vertical landing technology, as well as lift fan systems that power U.S. Marines and modified British models, are examples of technology transferred from the Allies. For allies, the purpose is to provide benefits that allow participating countries to increase access to programs and contractor information by participating early depending on the level of participation.

However, the GAO reports published in 2003 (GAO-03-775) and 2007 (GAO-07-360) show that participating countries are not satisfied with shared data and technology. These reports point to participating countries' concerns about the U.S.-centered technology transfer problem. Participants complained about the U.S. reluctance to share core technology and some software code. Some media reports point out that many partner countries are threatening to withdraw from the program because of frustration with work sharing and technology transfer issues. British media strongly criticized the United States for its reluctance to provide key technologies, especially important software codes, to the United Kingdom. In early 2006 the UK mentioned the possibility of withdrawing from the programme. On May 26, 2006, then-U.S. President George Bush and then-British Prime Minister Tony Blair issued a joint statement in Washington that resolved to resolve the long-standing disagreement. The two governments agree that the United Kingdom will have the ability to successfully operate, upgrade, hire and maintain a combined attack fighter jet to maintain operational sovereignty over the aircraft, the two leaders said in a statement.

Technology sharing is the most frustrating and oldest problem in the JSF program. The complexity of the advanced technology involved makes the technology transfer problem even more difficult. The JSF program consists of very complex aircraft technologies, including 22.9 million lines of software programming (approximately 7.5 million lines are aircraft software codes, and the rest are related to logistics, training and support systems). Recent evidence suggests that the U.S. Department of Defense has developed an effective strategy for sharing technology with participating countries. Nevertheless, it is difficult to satisfy all countries that contribute various program funding amounts and expect significant technology transfers. The JSF program shows that technology sharing is likely to remain a problem in acquiring future international cooperation unless countries share costs and technologies equally.

The Operational Objective

The operational goal of the JSF program is to improve mission capabilities through interoperability with the Allies in future coalition operations. JSF will increase interoperability through system commonality between Allied air forces. Three versions of the JSF fighter plane share 70-90% of common airframe, providing interoperability and reducing production and maintenance costs.

Common Interests

The common interests of the participating countries are derived from the core objectives of the program. The economic benefits of the participating countries outweigh other program objectives. For this reason, the JSF program can be seen as economic cooperation rather than a political union seeking to establish an international cooperation project model promoted by the United States and eight allies.

The Best Value vs Off-Set

One of the unprecedented features of the JSF acquisition strategy is the best value acquisition approach. Jon A. Schreiber, a former director of the JSF International Program, defines best value as "one of the main principles of this program that enables fair and open competition in the global market." The JSF PSFD MOU defines the best value as "maximizing economic feasibility in line with broader project goals". The GAO report details this understanding, defining the best value as "a competitive approach that does not guarantee a predetermined level of work to foreign or domestic suppliers based on the country's financial contribution to the program." Implementing the best value approach means deviating from traditional trade-offs and developing a completely new and more competitive acquisition strategy for JSF acquisitions and potential cooperative acquisitions.

The U.S. government argues that offset trade should be largely limited to short manufacturing of limited numbers of aircraft. Offset Trades are not suitable for complex acquisitions such as JSF programs, which have a high proportion of subcontracting and require extensive participation from allies. The Army's medium- and long-range air defense system had problems with costs and schedules due to programs focused on meeting the requirements for division of work by industry rather than pursuing a cost-effective acquisition strategy. The F-16 multinational fighter program, another example of a joint production program using traditional work-sharing programs, often experienced the program's cost premium in terms of increased manufacturing costs associated with the use of foreign suppliers. In contrast, the acquisition approach of the JSF program is expected to award contracts to the

most competitive providers.

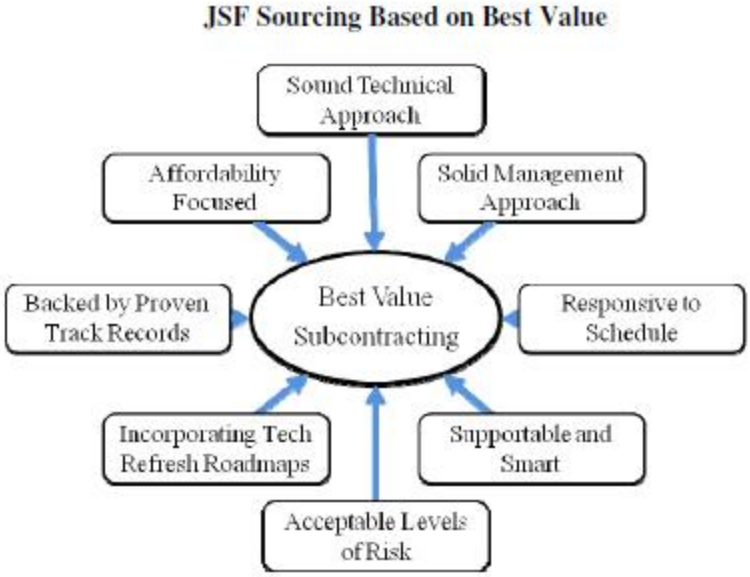
However, in order to compete in JSF's advanced aerospace subcontract, each participating country must be competitive enough to bid for the subcontract. The best value approach requires competitive countries in a sound defense industry to have the resources to compete with other countries. If participating countries cannot compete with other countries, it could cause problems among allies that could affect the success of the program.

Finally, the best value acquisition strategy is designed to replace traditional offset arrangements that are considered economically inefficient for complex contracts such as JSF programs. Figure 25 shows JSF sourcing through the best value acquisition approach.

5.4.5 European multinational cooperation projects in progress

Multinational defense industry cooperation is often carried out by established agencies or tasked agencies such as the Eurofighter Consortium.

<Figure 25: JSF Sourcing Based on Best Value>



(Loys Gray, F-35 International Support Equipment Briefing, 2007)

OCCAR; Organization for joint Armament Co-operation

The Organization for Joint Arms Cooperation (OCAR) was started by the United Kingdom, France, Germany, and Italy in the 1990s, and now Belgium and Spain are also member states. The OCCAR is not a procurement body, but a place to manage the business of the Member States. Currently, the UK participates in four of the 17 programs as follows.

A400M transport aircraft

The A400M meets the demands of efficient all-terrain transportation in modern military operations. Today's armed forces need flexible and cost-effective means to quickly deploy personnel and resources. This need was reflected in the requirements for joint European staffing approved by eight European countries, including NATO members, in 1997. On 27 July 2000, countries announced their support for the Airbus A400M. Aircraft not only provide greater interoperability possibilities, but also provide multinational training and support packages that can provide significant life savings. The programme lays a new foundation in European co-procurement by adopting a more commercial approach to acquisitions and support. The program was officially launched in May 2003 and incorporated into OCCAR. The current intention of the participating countries is to procure a total of 170 aircraft comprising: Germany 53, France 50, Spain 27, Turkey 10, Britain 22, Belgium 7, and Luxembourg are scheduled to be delivered in 2024.

Boxer mechanized infantry vehicles

The BOXER is an 8x8 all-terrain heavy-duty utility vehicle with a

unique concept of a mission module that is interchangeable with a common drive module, providing maximum strategic and tactical mobility in a wide range of operational scenarios. The BOX is capable of violent conflict situations, rapid response peace support, and global humanitarian operations, providing enhanced capabilities and higher levels of performance and protection than other vehicles in its class. The BOX program provides a new generation of all-terrain armored vehicles to the German (DE), Dutch (NL), Lithuanian (Litish) and British (UK) Army based on a balanced capacity for transport, mobility, protection, viability, growth potential and efficient lifecycle costs.

In December 2006, OCCAR signed a series production contract with ARTEC GmbH, a consortium founded by Kraus Maffei Begman, Reinmetal Land Systems, and Reinmetal Netherlands, for 272 units for DE and 200 units for NL. For DE, all vehicles have been handed over and are being converted to an A2 model. There are 131 new A2 vehicles currently in progress. For NL, the last delivery of batch 1 is until December 2020, and responsibility for the NL fleet is transferred to the NL Army from the Defence Materials Organization. In 2016, Lithuania signed a contract with OCCAR to purchase 91 BOX vehicles in a total of five models based on the DE vehicle design. The first vehicle was delivered in 2019, and was produced by 2021. In December 2019, the UK joined the BOXER program following integration activities and contract negotiations. In the UK, more than 500 vehicles will be delivered with four build configurations, and the first vehicle will be delivered in 2022 after the design and verification phase.

Maritime Mine Counter Measures (MMCM) unmanned systems

France and the United Kingdom have launched programs to evaluate and develop the capabilities of the "Marine Mine

Countermeasures" (MMCM). The purpose of the MMCM program is to provide agile, interoperable and powerful MMCM capabilities. The program will help determine the option to replace existing mine-protection vessels when they retire and the life cycle cost benefits of providing mine-protection capabilities in a new way. Its stand-off concept is based on off-board capabilities, which aim to have manpower outside the minefield whenever possible. These systems can speedily repel static underwater threats, giving strategic, operational, and tactical maneuver freedom and providing maritime force projection and maritime security at selected times and locations by the state to support extensive naval operations. The bilateral program was officially launched in late 2010 under the Lancaster House Treaty between France and Britain. In March 2015, OCCAR signed a pilot phase contract following a competitive bidding exercise

On 20 October 2016, England and France signed two- and three-phase contracts. The announcement follows a successful 15-month study, definition, and design phase. Steps 2 and 3 of the MMCM program are the manufacture and qualification of two identical MMCM prototypes/producers. These autonomous off-board unmanned systems will be deployed off shore or away from the mother ship, enabling the detection and neutralization of sea mines and underwater explosive devices. The MMCM programme also includes a four-step option for two years of support for the Marine Corps and Royal Navy system evaluation. At the French/British Summit in January 2018, the French President and the British Prime Minister expressed their intention to quickly put the system into operation. The subsequent production phase (Stage II) progressed quickly, and a follow-up contract was signed with the French and British official ProgD in October 2020. Phase 2 includes common and non-general development activities, multi-system manufacturing,

coastal operations and training center provision, and various cost contracting options including In-Service Support (ISS).

Surface-to-air anti-missile system (FSAF-PAAMS), installed on the Type 45 Destroyer as Sea Viper

On 26 October 1988, the French and Italian defense ministers signed a memorandum of understanding on bilateral cooperation in developing surface-to-air missile systems. The main anti-aircraft missile system is a new weapon system based on common elements developed in the framework of the FSAF program. FR/IT Horizon frigate and British Type 45 destroyer provide agile and rapid response "self-defense" and "local and naval area" defense maritime capabilities. OCCAR seeks to achieve a larger and more cost-effective economy by managing munitions procurement programs for land and marine systems on behalf of participating countries.

Britain's International Joint Development Program for Next Generation Fighter; Team Tempest

Britain is currently planning to develop a future air combat system. It is now known as Team Tempest with international partners. At this point, Italy and Sweden are included. The UK said it has deepened its Future Combat Air System (FCAS) partnership with Italy and Sweden through the international concept and evaluation phase since 2021 and is seeking important subsystem cooperation opportunities with Japan.

Team Tempest is part of the Future Combat Aviation System Technology Initiative Program announced at the 2015 Strategic Defense and Security Review. It consists of the RAF Rapid Capability Office, Defence Science and Technology Laboratory, Defence Equipment and Support and Industrial Partners (BAE Systems,

Leonardo, MBDA, Rolls-Royce). Innovation is at the heart of Team Tempest and is based on a strong British heritage for world-class service capabilities and advanced technology development programs.

International defence industry cooperation is an important feature of UK defence procurement. In particular, this is especially true in acquiring equipment that is difficult to financially develop with the UK's own development. At the 2021 DSIS, the UK said it would consider international cooperation opportunities, including NATO, earlier and more systematically, through multilateral links secured by the country when developing equipment. As a first tier participant in the Eurofighter development and JSF F-35 program, Britain's international joint development of next-generation fighters is likely to be a successful cooperation case due to efforts to try preemptive and efficient international cooperation based on accumulated experience and know-how.

6. International Defense Industrial Cooperation Strategy of Rep. Korea

6.1 Existing International Defense Industrial Cooperation Methods

In the laws and regulations related to the acquisition and management of defense projects in Korea, the method of acquiring weapons systems is classified into joint development and overseas introduction. R&D is divided into domestic R&D and international cooperation R&D. International cooperation R&D is divided into international joint R&D and technology cooperation R&D. International joint R&D is conducted by domestic and foreign R&D developers jointly with R&D resources for joint R&D goals, and technology cooperation R&D is conducted by domestic developers with their own R&D goals and responsibility and cost. Currently, the form of technical cooperation is largely data exchange (DE),

scientific and technological data exchange (Co-Research), dispatch of technical cooperation teams, technical services, and trade negotiations, and receiving a bundle of technical data from the partner countries.

Overseas introduction is classified into technology introduction production, overseas direct purchase, and lease.
Technology-introduced production refers to the transfer, lending, or supporting of the production authority of the weapon system in production, as it was developed in a foreign country and commercialized or judged to be available for combat as a test evaluation result. The detailed types of technology introduction production are classified into joint production, assembly production, and license production, and are applied either single or complex depending on the contents of the contract.

Direct purchases are divided into intergovernmental purchases and commercial purchases. Intergovernmental purchases are made through contracts between foreign governments and Korean governments as external means of payment or loan funds, such as Foreign Military Sales (FMS). The U.S. foreign military sale refers to a method in which the U.S. government sells military-needed goods at a fee for foreign means of payment and loan under government contracts to allies, allies, or international organizations in accordance with related laws such as the Arms Export Control Act. On the other hand, commercial purchase refers to the purchase of goods directly from overseas companies with external means of payment or loan funds. In direct purchase, Korea requires off-set trade.

On the other hand, leasing is used when it is more effective than research and development or purchase methods. For example, if the lease is economically advantageous, if the electrification period is urgently required, if the purchase acquisition is inefficient within five

years, equipment obsolescence occurs rapidly and the lease can be efficient for equipment or weapons systems requiring continuous performance improvement.

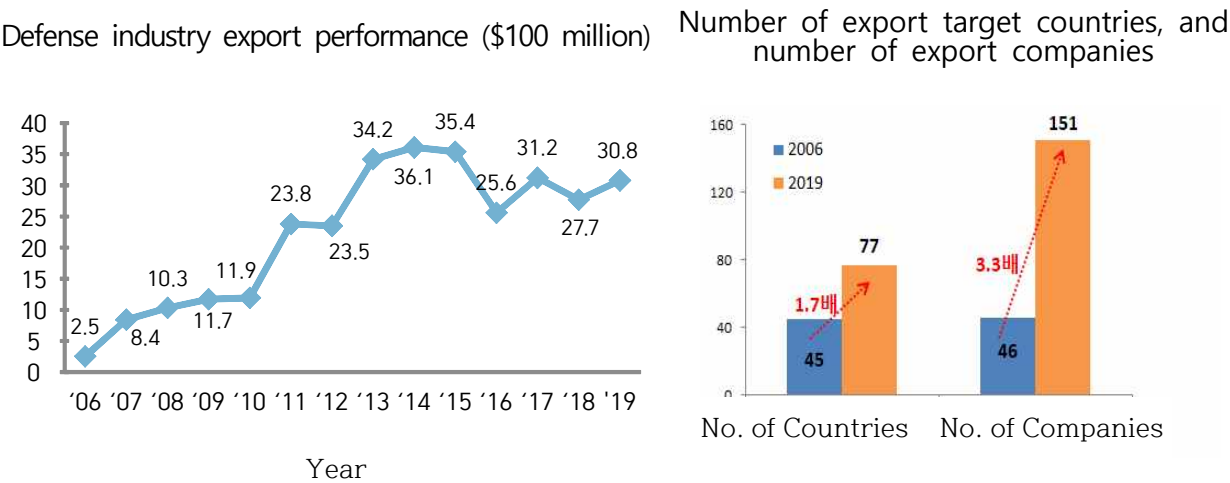
Looking at the methods of obtaining inorganic plans such as international cooperation R&D, technology introduction production, direct purchase, and lease, there are differences in degree, but international cooperation is required. Compared to mutual trade, cooperative production, and joint development distinguished by Lorell and Lowell, international cooperative R&D has the same concept as joint development, and technology introduction production can be understood as cooperative production. However, direct purchase and trade are somewhat different. While mutual trade agree to purchase the other country's weapons system in both directions, direct purchase does not include exports to our weapons system because only imports from the other country's weapons system are considered in one direction. However, our direct purchase can also be interpreted as a wide view of trade with two-way nature because trade is conducted in the case of spending more than $5 million in foreign currency.

In the strict sense discussed above, the definition of international defense cooperation is an approach as a meaning of acquisition rather than defense exports. Therefore, the term defense export and international defense cooperation differ in what they aim for. However, as a result of examining the European and U.S. international joint development programs and the U.K.'s industrial strategy report, exports occupy an important part of the big framework of international defense cooperation, and international joint development including exports is the highest level of international cooperation. International joint development considering exports has various benefits such as expanding interoperability and reducing costs, but the risk is also high.

6.2 Change of perspective on the international defense industrial cooperation

It can be said that defense exports have become important for Korea's motivation for international cooperation since the opening of the Defense Acquisition Program Administration. Exports, which were $250 million before the opening of the Defense Acquisition Program Administration, remained stable after the $3 billion breakthrough in 2013. In addition, since 2006, the number of export target countries has increased 1.7 times (45 countries → 77 countries) and 3.3 times (46 → 151). Export items were also diversified into aircraft (T-50, FA-50), ships (frigate, submarine), and ground equipment (self-propelled artillery, guided weapons), away from ammunition and parts.

<Figure 26: Changes in Korea's defense industry export performance, number of export target countries, and number of export companies>



(DAPA, 2020 Defense Industry Medium-term Strategy)

6.3 Korea's Status in the Global Defense Market

Korea was the eighth-largest arms exporter in 2017-21, accounting

for 2.8% of the world's total arms exporters (SIPRI 2022). Its arms exports were 177 percent higher than in 2012-16. Asia and Oceania accounted for 63% of Korea's arms exports and 24% of Europe's from 2017 to 21. Korea has also further developed arms export relations, especially in the Middle East. In Egypt in 2021, the artillery weapon system K-9 and the UAE in 2022 selected Korea's air defense system, Cheongung-II, as major military procurement projects. During the same period, arms imports accounted for 4.1 percent of the world's arms importers, ranking seventh in the world. Defense spending is ranked 10th (Military Balance 2022).

6.4 Strengths and Opportunities

The security environment on the Korean Peninsula, which has high military tensions, acts as a strength for our defense industry. As a result, external confidence in our military operating equipment is high. The K9 self-propelled artillery used in the 2010 shelling of Yeonpyeong Island accounts for about 50% of the world's self-propelled artillery market (DAPA, 2020).

Korea's K-brand effect acts as an opportunity for the defense industry. The defense industry is a microcosm of high-tech technology, and global awareness is high in areas such as electronics, shipbuilding (world's No. 1 order in 19), automobiles, and IT (world's No. 3 electronic production in 18) (DAPA, 2020). South Korea's invitation to the G7 summit in Cornwall, England in June 2021 was an event that could be seen as an advanced country responsible for leading the international economy, situation and global issues as a technology leader. The agreement with Britain to strengthen bilateral vaccine, climate, and security cooperation has resulted in the establishment of a big framework for defense cooperation.

The UK signed the Memorandum of Understanding (MOU) on the Principles of Defense Research and Development Cooperation between Korea and the UK to promote defense R&D cooperation in 2020. Based on the memorandum of understanding, it has become possible to secure key technologies that can be applied to advanced weapons systems in the future through joint research and development between Korea and Britain. The memorandum of understanding provides an institutional basis for promoting defense science and technology cooperation between the two countries, including exchange of information on defense science and technology, exchange of science and technology, basic research, applied research and test development. It seems necessary to expand the scope of cooperation based on this memorandum of understanding in the future. The existing scope of cooperation excludes joint development of weapons systems. Therefore, it is necessary to promote an agreement on this. The reason is clear. It is to acquire advanced technologies and joint development know-how accumulated by the UK, and more specifically, to join Team Temfest, which is pursuing international joint development with Italy and Sweden. As confirmed in the JSF F-35 case, early participation in international joint development flows is much more economically advantageous, and the management know-how of large-scale international joint development may be more difficult than technology acquisition. It may be an opportunity for Korea to participate as a development partner in the UK when the KF-21 prototype is released.

6.5 Weaknesses and Threats

Recently, export contracts have been achieved mainly in the Middle East, but it is also true that it has been stagnant at $3 billion for a while after the $3 billion performance in 2013. This is because the domestic defense industry is basically an industrial structure

dependent on Korean military demand, so there is a disadvantage of excessive performance and high price. On the other hand, many of our export partners require low-cost and appropriate performance and multi-purpose weapons systems.

In addition, it occurs when the E/L (Export License) approval of the technology holder becomes an obstacle to exports at the stage of export success due to insufficient original technology of core parts and SW due to platform or ammunition-oriented exports. In the case of the T-50, most of the key technologies, such as avionics equipment and engines, were owned by the U.S., so exports could not be made due to U.S. opposition to the technology leak to Russia. Even when exporting, there is a limitation because additional profits may be limited through the outflow of foreign currency due to imported parts and subsequent county balance support.

Another weakness is that if our arms exporting country is a developing country that is not economically or industrially developed, there are insufficient institutions or examples of export and defense cooperation methods to systematically and quickly respond to various demands according to the characteristics of the purchasing country. For resource-rich countries, various methods need to be pursued, such as receiving in kind, exporting using the aforementioned weapons system exchange method, and triangular transactions through third parties. The reason is that the importing country can actively consider purchasing only when the payment method is diversified to meet the needs of the purchasing country.

7. Conclusion

International relations in the post-Corona era are becoming more fragmented and military tensions are rising due to the retreat of neo-liberalism, Britain's withdrawal from the European Union, and

China's rise. In line with technological advances, the defense industry is also becoming a venue for high-tech technology. The UK is also preparing a new game changer, and as we saw earlier, the UK, a leading defense industry, has similar concerns (large-scale monopoly market, high cost structure due to single-source contracts, slow acquisition speed, schedule delay and cost increase). And their strategy is an export-oriented international joint development policy that can protect domestic industries and jobs, along with gradual improvement and game changer development for rapid acquisition projects, continuous innovation in technology development. This strategy also suggests the direction of international defense cooperation in the post-COVID-19 era.

The UK has a defence industry of a similar size to ours. However, there are long-term know-how and strengths in aviation than we do. Now that we have left the European Union, it is a slightly more advantageous opportunity for us to cooperate with the UK and find opportunities. Britain has been in a continuous partnership with Japan. Britain also says it is seeking opportunities to cooperate with Japan in its next-generation fighter jet business (DSIS 2021, 98). Korea may still be less aware of the defense sector of the country than Japan, but as their report states, they understand the importance of East Asia and vow to strengthen defense cooperation with mid-sized countries in the future, so we can fill the first step as an international joint development partner. To do so, the current memorandum of understanding on defense R&D cooperation also needs to expand the scope of cooperation.

The UK is Europe's largest defence industry market. Targeting the UK market is expected to become more active through direct or joint investment. In particular, it is necessary to actively enter the British defense market through direct investment through the establishment of local subsidiaries by Korean defense companies.

Britain's changed defense policy is not irrelevant to Brexit, as mentioned earlier. This is because, by returning to the job-oriented policy, a more flexible and more nuanced approach strategy has been established that takes a slight detour from the defense industry policy direction called "global competition by default" that has continued since 2012.

But basically Britain's defence industry policy is not closed. Considering that reciprocal parts of national relations, especially cooperation in the defense sector, should be fully considered, Korea's acquisition system needs to be partially improved. Currently, Korean laws require the purchase of domestically produced munitions first. Article 19 of the Defense Acquisition Program Act allows overseas introduction only when it is difficult to purchase domestically, which may fundamentally limit the introduction of foreign military supplies that are excellent in quality and combat function. It is necessary to revitalize domestic and foreign competition when procuring domestic military supplies by improving the system to the extent that restrictions are placed if necessary through guidelines rather than laws and regulations or restrict foreign introduction for security reasons.

It is necessary to revitalize domestic and foreign competition when procuring domestic military supplies. Attempts should be made to induce companies to develop innovative technologies by opening the domestic market to the private sector and overseas and creating a fierce competitive environment between companies. In the case of the United Kingdom, the top 18 companies account for half of the sales of defense spending, even though they maintained the strategy of "basically competition" from 2012 to 2021, which means that complete competition is impossible in the defense industry.

The UK has similar concerns about a single contract, even though there is no defense industry material designation system and defense company designation system. The proportion of single contracts accounts for more than 3/1. These statistics mean that much of the defense procurement is financed through a single-source contract despite the defense industry's "basically competitive" policy since 2012, and are a testament to how difficult it is to create competition in the defense sector. They have similar concerns about a single contract. We are currently strengthening these systems through the designation of defense products. However, in order for new technologies to be applied quickly and private new technologies to be applied quickly to national defense, it is necessary to consider a shift to a more flexible, simplified and open defense industry designation system.

In addition, if international defense cooperation was to prepare various conditions for exports, a system is now needed to go one step further and provide conditions for cooperation between companies and local investment by companies. Considering that the flow of international relations is changing more closely in the defense market, the defense industry can also become a necessity, not an option. This is because the UK does not distinguish between domestic and foreign companies and qualifies them to participate in the contract by whether the company actually produces the equipment in Korea. Since exports of the defense industry are also changing from one-sided sales to bilateral cooperation (technology, production, etc.), various cooperation measures such as joint investment with local companies, technology cooperation, and participation of suppliers should be devised.

Finally, international joint development is a necessary situation, not an option. The case of Eurofighter Typoon is a number of difficult examples of ‘muddling through’, the slow decision-making process.

However, the UK did not give up international joint cooperation, and the biggest reason was to reduce costs through exports, and in the case of JSF multinational cooperation projects, the benefits of active participation in international joint development in the future are much greater than those of compromise and incomparable. In order to develop the 5th generation fighter jet after KF-21, it is necessary to participate in international joint development such as Team Tempest at least for the foundation for international joint development in the future. Effective decision-making is not easy, as shown in the case of Eurofighter 2000 (Typoon). This know-how is a part that can only be obtained by directly experiencing and accumulating it, as it is necessary to consider the geopolitical security situation of the country and the culture that includes the country's way of handling work. In addition, technology development cooperation with leading countries can be more effective, and even if Korea is not a leading technology development country, participation in high-tech weapons system joint development projects such as JSF and Team Tempest can be expected to benefit domestic defense companies more than trade-offs. It is time to challenge international joint development with advanced defense countries to introduce core technologies, acquire know-how in decision-making procedures, and establish an effective international joint development partnership base.

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