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**Restructuring of
Korea's Defense
Aerospace Industry**
Challenges and opportunities?

Restructuring of Korea's Defense Aerospace Industry

Challenges and opportunities?

by Myeong-Chin Cho

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About the Author

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Acronyms and Abbreviations

ADD	Agency of Defense Development
AEC & C	Airborne Early Warning and Control
AEW-X	Next- Generation Airborne Early Warning Aircraft
AVIC	Aviation Industries of China
AWACS	Airborne Warning and Control System (AWACS)
BAA	Bilateral Airworthiness Agreement
DHI	Daewoo Heavy Industry
DMZ	Demilitarized Zone
DQCI	Defense Quality Control Institute
DSCA	Defense Security Cooperation Agency
EW	Electronic Warfare
FDIs	Foreign Direct Investors
FTF	Flap Track Fairing
F-X	Next Generation Fighter
HAL	Hardboards Australia Ltd.
HDRC	Helicopter Development Research Center
HYSA	Hyundai Space and Aircraft
IFVs	Infantry Fighting Vehicles
JSF	Joint Strike Fighter
KARI	Korea Aerospace Research Institute
KCDC	Korea Commercial Transport Development Consortium
KCTD	Korean Commercial Transport Development
KFP	Korean Fighter Program
KIAT	Korean Institute of Aerospace Technology
KMH	Korean Military Helicopter
KORAF	Korean Air Force
LoI	Letter of Intention
LMTAS	Lockheed Martin Tactical Aircraft Systems
MOCIE	Ministry of Commerce, Industry, and Energy
MOEF	Ministry of Economy and Finance
NNL	Northern Limit Line
PKM	Patrol Killer Medium
PMO	Project Management Office
P & WC	Pratt and Whitney Canada
ROC	Requirement of Capability
Pol	Proposal of Intent
SAM	Surface-to-Air Missile
SPI	Software Process Improvement
SSA	Samsung Space and Aircraft

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All the analyses and comments in this paper are mine. That is, they do not reflect any specific institutions' view. Therefore, I take the responsibility for the contents of the paper.

1. Introduction

Korea's security issues in the present and future can be seen as involving three distinct phases. The first phase is the current situation, facing a North Korean threat. A second phase would be a transition toward unification, which could take several decades until full post-unification stability is achieved. A third phase would be that after a stable unification, during which Korea is most likely to face new threats in the East Asian region.

In this security setting, the task of restructuring Korea's defense aerospace industry will undoubtedly be expected to face many challenges and obstacles, as Korea intends to seek more independence in building an indigenous defense industrial base. The first challenge comes from the inside: how can Korean defense planners orient themselves strategically in order to cope with new possible threats in the region; and how will Korea be militarily equipped? The second challenge comes from the delicate nature of the long-time Korea-US alliance: how should the relationship be re-defined and re-oriented to tackle new security concerns? And, to what extent can the United States allow Korea an independent arms procurement policy? As a matter of fact, there has already been a clash between actual US dependence and Korea's pursuit for a more diversification in weapon systems since the ending of the Cold War'.

In particular with regard to the US factor, the pattern of restructuring the existing defense industry of Korea looks complicated. In other words, the second challenge outlined above can also be viewed as an obstacle to the Korean policy makers and executives of the defense firms. The next-generation combat aircraft (F-X) project, one of the priorities in weapons procurement for Korean Air Force clearly reflects the US factor. It is no doubt that the decision of selecting the Boeing's F-15K will affect the direction of the Korean defense aerospace industry for the next half a century.

Purpose

The purpose of this research is to examine Korea's defense aerospace industry in pursuit of a new direction. In doing so, it aims to analyze the development of Korean aircraft industry while at the same time examining the extent of Korea's dependence on the United States and its effort to pursue more independence and diversification in acquisition of air weapons systems. The following four questions are raised in handling of the research subject; first, why does the Republic of Korea (ROK) seek more independence? Second, how feasible is this pursuit of

independence? Third, what would be the most desirable alternatives of the independence and diversification measures? Fourth, how much will Korea Aerospace Industries LTD. (KAI) be able to rely on defense sector and what are the examples of fostering civil aircraft industry?

Methodology and Structure

Chapter two deals with a changing security environment both in the Korean peninsula and East Asia, especially in terms of air power context. To account for the current situation, the meaning of the Summit of June 2000 is reviewed. Arguably, this Summit highlighted the fact that there is no sign of lessening the military power of both sides through showing the airpower in East Asia as well as both Koreas.

Chapter three deals with the period before KAI's establishment by describing how the four Korean conglomerates entered aircraft business and comparing the different ways in which they managed aircraft industry. In doing so, it attempts to compare the different corporate approaches of the four firms by analyzing the projects that the firms had been engaged in. In the end, the Chapter will show how the current situation has emerged.

Chapter four focuses on the background of KAI's emergence in October 1999. Moreover, the chapter introduces major projects in which KAI has been involved. The major projects include Korea Fighter Project (KFP), Basic Trainer Project (KT-1), Advanced Trainer/Light Combat Aircraft project (T-50) and Advanced Attack Helicopter Project (KTH).

In chapter five, the next-generation fighter (F-X) project is dealt with by analyzing the selection process for the new fighter aircraft. It gives a comparative analysis on marketing strategies of the four participating companies. The chapter also discusses the impact of F-X decision on Korean aerospace industry.

The sixth chapter gives concluding remarks and policy recommendations.

2. Security Environment in Terms of Air Power Context

Even after the Cold War, the economic crisis and the June 2000 Summit, there has been no real progress in reducing military tensions between the two Koreas. From the outset, the capability of producing arms on the Korean peninsula as well as the level of armaments are simply excessive in terms of population.¹ That is to say, at a time when we discuss the possibility of reunification following the June 2000 Summit, there is as of yet no signal of decreasing the defense expenditure on both Koreas. On the contrary, the defense budgets of both countries are on the rise.

As a result of the events of 'September 11' in America, there appears to be a stronger need for enhancing the military capability of Republic of Korea (ROK) and its interoperability with the US in order to be a more efficient coalition partner. This new factor increases the Korean defense uncertainties, namely how to pursue its own defense industrial policy without endangering the US-ROK alliance and its industrial dimension. Over the last years, ROK has been in pursuit of diversification of weapon suppliers and more indigenous defense projects, through gradually decreasing the degree of dependence of US weapon systems. As an expression of this uncertainty, the Korean government decided to select the F-15K as the next-generation aircraft (F-X). The decision looks inevitable in the Ministry of National Defense, which gives priority to consolidating the ROK-US relations and fostering the operational capability of the ROK-US Combined Forces.

New
uncertainties

North Korea's international position has looked more isolated after the Bush administration included North Korea as one of the three rogue countries called "the Axis of Evil" in the President's State of the Union Address of 2002. It was a big blow to the Sunshine Policy² of the Korean government, since the

¹ Democratic People's Republic of Korea (DPRK) commits about 31 percent of its Gross Domestic Product (GDP) to military spending. Out of every 1,000 people, 40 serve in uniform. By comparison, the Republic of Korea (ROK) spends 2.8 percent of its GDP on the military and 14 of every 1,000 people serve in uniform. The area of ROK is 98,480 square km, the population is 48 millions, whilst the DPRK's area is 120,540 square km, and its population 22 million. The DPRK maintains imposing forces in terms of numbers. About 1.2 million personnel serve in the active forces, with reserve forces totaling over 5 million, making it the fourth largest military force in the world.

² The Sunshine Policy refers to South Korea's new engagement policy toward North Korea. The successive South Korean governments

Korean government has patiently tried to make the North open the regime by offering a wide range of economic aids and funds.

In particular, the relationship looks more chilly after a naval clash between the North and South in the Yellow Sea, on 29 June 2002, when a North Korean patrol boat made a surprise attack against a South Korean naval vessel, killing four naval officers and sinking the vessel.³ This incident confirms the fact that North Korea remains a military threat, despite the historic June Summit.

2.1 The Context of Air Power

Since the sea change on the Korean peninsula after the June Summit of 2000 between the two Koreas, the peninsula is certainly becoming a focal point, as the region looks more complicated and vulnerable with regard to China's strengthening military power and the emergence of Japan's militarism. In these respects, the Korean military establishment has begun to realize that a strong move to revamp the Korean Air Force is needed as both a pre-and post-reunification step. This move is clearly embodied in the next-generation fighter (F-X), the attack helicopter (AH-X), the surface-to-air missile (SAM-X) and airborne early warning aircraft (AEW-X) programs.

Considering the security concerns of the Korean peninsula and the rapidly changing international situation, constant development of key defense technologies and new weapon

increasingly have come to identify the high level of mutual distrust as a key obstacle to reducing tensions. As the South also came to see the primitive economic conditions in the North and yawning social gap between the two peoples as major impediments to the ultimate integration of the two systems. Building trust gradually through economic and humanitarian exchanges came to be seen as a means for advancing both short and long-term 'interests of South Korea. See more on the issue of 'Sunshine Policy" in Levin, Norman & Han, Yong-Sup, *The South Korean Debate over Policies toward North Korea: Issues and Implications*, RAND, December 2001

³ Two North Korean patrol ships crossed the Northern Limit Line (NLL), over the Yellow Sea. One of the North Korean patrol ships opened surprise fire at a ROK Navy speedboat Patrol Killer Medium (PKM). The naval clash resulted in the death of four ROK sailors, one missing, and nineteen injured. One damaged South Korean PKM sank while being towed. From the North Korean side, one patrol ship was destroyed and "we believe that the North Koreans also suffered heavy casualties as well." Korean Ministry of National Defense web site, 1 July 2002. The detailed text is available at <http://www.mnd.go.kr> .

systems is more important than ever. More specifically, aircraft development capability constitutes one of the most essential concerns because future conflicts will be waged with the support of sophisticated air forces. As the nation's air force becomes the principal axis of military power, the aircraft industry develops into the backbone of the military industry. Achieving a self-defense capability is not possible without an independent aircraft development capability.⁴

The nature of the force available in the 21st Century will determine the effectiveness of the power of the ROK Air Force. Hence, force structure decisions made now are crucial to the strategic environment of the future. The key challenge for the ROK Air Force is to build an efficient and 'smart' air force to ensure the core competencies of air and space power, that is, information superiority, air and space superiority, precision engagement, and agile combat support.⁵

From an industrial policy perspective, promoting defense industries have had benefits for civil industry. In other words, benefits from leading military technology will spill over into civilian industries.⁶ Technologies developed through military aircraft development have already had spillovers into the civilian industries in other countries and have increased national competitiveness, for example in China, Israel, Japan, and Taiwan. Unfortunately, in the case of Korea, though government support resulted in 80 percent of the total domestic market being

Industrial
considerations

⁴ Cho, Myeong Chin, "Balance of Air Power in East Asia," *Asian Defense Journal*, October 2001, p.4.

⁵ Park, Sung-Kuk, The Challenge for the ROK Air Force in the 21st Century, in Crawford, Natalie, and Moon, Chung-in (eds.), *Emerging Threats, Force Structures, and the Role of Air Power in Korea*, Project Air Force, RAND, 2000, p.149.

⁶ For a country like Korea, with its limited economic, personnel, and facilities resources, the policy of expanding dual-use technologies which can be applied in both civilian and military fields is of utmost importance. The focus of this policy is on technologies already existing in the civilian area to be transferred to and utilized in the military area. At the same time, technology spin off from existing military technologies to the civil sector is emphasized to the greatest extent possible. For unavailable technologies in both areas, it is desirable that cooperative efforts to develop them would be undertaken. By pursuing this, maximum achievement with low cost can be expected. Dual-use technology promises benefits in all sectors, but it is in the aircraft industry where the benefits are most promising due to its strong spillover effect to other areas.

composed of military demand, spillover effects on the civilian industry and improvement of national competitiveness have not been as great as expected.⁷ This is mainly due to the inefficient coordination between relevant research institutes and companies.

2.2 Reshaping ROK's Airpower⁸

From the year 2004 onwards, the delivery of 40 F-X will begin to fill the inventory of the Korean Air Force. By October 2005, 60 – 90 T/A-50 Golden Eagle (supersonic trainer/light combat aircraft, formerly the KTX-2) are to be delivered to the Air Force. Moreover, the next-generation attack helicopter project (AH-X) to replace Korea's existing 70 Bell AH-1F/J fleet is expected to deliver 36 aircraft, commencing in 2004. The acquisition of 4 Airborne Warning and Control System (AWACS) (AEW-X) is expected to be completed by 2008. Thus, the year 2005 will be a watershed for Korea, for it will become a regional air power with an almost complete array of forces capable of projecting power, though their use is subject to US approval.

A united airforce ?

KAI is not yet capable of meeting all the requirements of the Korean Air Force. The degree of maturity it will attain depends on the choice of the F-X and cooperation with foreign partners. Above all, it requires parties concerned to feel 'a sense of teamwork' as has happened in countries like Israel or Sweden. This sense of teamwork should be regarded as an important factor in building a reliable air power in Korea.

If Korean reunification comes on or before 2015, is it feasible to integrate North Korea's MiG-29s? Or would it be better to make them obsolete? It is noteworthy that most of North Korean MiG-29s have been imported or assembled in the 1990s. The average life span of a combat aircraft is about 30 years, which means that the MiG-29s can be in service until 2020 or 2030. Therefore, from a strategic point of view it would be wiser to upgrade or operate them, since the MiG-29s would expand the scope of operational capability of the unified Korea's Air Force

On the other hand, the limitations of the ROK Air Force can be attributed to its dependence of intelligence-gathering

⁷ Cho, Tae-Hwan, Challenges in Research and Development for the Korean Aircraft Industry, in Crawford, Natalie, and Moon, Chung-in (eds.), *Ibid*, p. 338.

⁸ The following describes the current developments to enhance air power in both Koreas.

capability on the US 7th Command. In order to have independent operational capability, the ROK Air Force needs to possess additional systems such as strategic intelligence systems, airborne early warning and control (AEC&C) systems, tanker aircraft, electronic warfare (EW) aircraft, and anti tactical ballistic missiles (ATBM), and so on.⁹ The acquisition programs for these systems are expected to follow the F-X program.

2.3 Air Power of North Korea

The Korea People's Air Force (KPAF) possesses a huge inventory of 1,720 aircraft. Approximately 90 percent of the combat aircraft are older generation former Soviet or People's Republic of China (PRC) designs dating back to the 1950s and 1960s. Although the majority of these aircraft have been modified and updated, they are generally limited to daylight clear-weather operations and carry small weapon loads.

During the period between 1984 and 1988, the KPAF had received 46 MiG-23ML/UB Floggers, which formed the 60th Air Regiment. It is a third-generation fighter with limited all-weather and ground attack capabilities. From late 1987, 36 Su-25 Frogfoot, ground attack aircraft have begun to be delivered. The Su-25 was incorporated into the 55th Air Regiment. The heavily armored, all-weather Su-25 can carry a greater payload and deliver it more accurately than the KPAF's aging H-5 bombers.

At the beginning of 1988, the KPAF received its most modern and capable aircraft – the MiG-29 Fulcrum. Between 1988 and 1992, the DPRK imported 14 MiG-29s. It appears that the original agreement was for a regiment of 40 aircraft with the majority to be delivered in 'knock-down' form, and provisions for the DPRK to establish an assembly line for the aircraft.

All the MiG-29s were incorporated into the 55th Air Regiment along with the Su-25s. The MiG-29s can carry the R-60 (AA-8 Aphid), R-27 (AA-10 Alamo) and R-73 (AA-11 Archer air-to-air missiles). Since 1998, North Korea has procured 10 MiG-29 Fulcrums from Russia. It is believed that North Korean engineers bought components in sufficient quantities to enable the assembly of the ten aircraft. For the purpose of increasing the KPAF's air power, North Korea also acquired 38 MiG-21s from Kazakhstan through an illegal channel in 1999. These aircraft provide the

North Korean
inventory

⁹ Maj.Gen. Jin-Hak Lee, *Aiming High: Korea's Air Force Towards the 21st Century*, presented at the International Conference on Airpower in 21st Century Korea, Seoul, Korea, May 22-23, 1998.

North Korean
deployment

KPAF with a limited but much improved air defense capability and have the potential to pose a significant threat to ROK/US airborne reconnaissance capabilities during a war.

North Korea has deployed about fifty percent of its fighters in the front area, which makes a surprise attack to all areas of South Korea possible. In 1990-91, North Korea activated four forward air bases near the Demilitarized Zone (DMZ), which increased its initial southward reach and decreased warning and reaction times for Seoul. More than 420 fighters, bombers, transport planes, and helicopters were redeployed in October 1995, and more than 100 aircraft were moved forward to the three air bases near the DMZ. More than 20 Il-28 bombers were moved to Taetan which shortened their arrival time to Seoul from 30 minutes to 10 minutes. Over 80 MiG-17s redeployed to Nuchonri and Kuupri are able to attack Seoul in 6 minutes. By these redeployments, North Korea intends to make a first strike with outdated MiG-17s and the second strike with mainstay fighters such as MiG-21s and Su-25s.¹⁰

During his visit to Moscow in August 2001, North Korea's leader Kim Jong Il sought to obtain advanced weapons systems to modernize North Korea's aging military. Russian President Vladimir Putin promised a number of primarily defensive weapons systems during the summit. These include new short-range surface-to-air missile systems and an airborne early-warning radar, which would enhance North Korea's air defense systems. If Pyongyang can produce the money, Russia will likely expand the list in the long run to include more MiG-29s. This shows how keen North Korea is to improve the quality of its air force inventory to counter the technological advantages of the combined forces of the US and ROK.¹¹ In addition, during Kim Jong Il's second visit to the factory of Sukhoi, near Khabarovsk, he showed keen interest in the Su-30MKK and Su-30 series.¹²

2.4 Balance of Air Power in East Asia

In the Gulf War and the NATO air war over Kosovo, air power was more dominant, effective, and visible than in previous military conflicts. The allied states were free to fully project their power using airborne forces, as their enemies had no substantial

¹⁰ <http://www.fas.org/nuke/guide/dprk/index.html>.

¹¹ Cho (note 4), p.4.

¹² *Tass & Yonhap*, 21 August 2002.

air power of their own, and their air defenses were soon eliminated.

Figure 1: Air Power Comparison in East Asia

Country/Fleet	Defense Budget	Active Armed Forces	No. of Combat Aircraft
Korea (South)	12.8 bn	683,000	485
			160 F-16C/D
			195 F-5E/F
			130 F-4D/E
Korea (North)	2.96 bn	1,082,000	180
			130 Mig-21
			35 Su-25
			15 Mig-29
Japan	45.6 bn	236,700	359
			31 F-2
			199 F-15J/DJ
			103 F-4E/EJ
			26 F-1
China	14.5 bn	2,470,000	3000
			1,500 J-6/B/D/E
			400 J-7II/IIA/IIH
			65 Su-27SK
			40 Su-30MKK
Taiwan	15 bn	370,000	574
			60 Mirage 2000-5
			200 F-5
			130 Ching-Kuo
			126 F-16A/A
United States (5th and 7th Air Command)			180
			106 F-16
			54 F-15C/D,
			20 A-10
(7th Fleet)			130)
			F-14, F/A-18
Russia (Siberian Air Command)			500
			380 Mig-31
			Su-27
			120 Tu-22M
(Pacific Fleet Air Force)			71
			Su-24, 25, 27

Source: Author's archive, based on "Balance of Air power in East Asia," Asian Defense Journal, October 2001, p. 5.

However, any air war in East Asia will definitely be different, both in terms of the concentration of power and as far as the level of sophistication is concerned. Moreover, it is obvious that any military conflict will inevitably lead to the use of ground as well as naval forces. The security environment in the region looks even more dangerous than it did in the Gulf and the Balkans, as there are emerging flash points with potential for territorial disputes over Ok (Dakeshima) and Spartly islands, which might end up in a total war by using all the massive military resources in the region.

A head-on clash of air power would be unavoidable in all ranges of attack and strike, from dog-fighting to bombing, if there is a military conflict in the region. In order to win the war, it is essential to obtain the initial dominance of air space and sustain the dominating air power throughout the military campaign. Therefore, the arms race in East Asia seems to focus on strengthening air power, even though any war in the region cannot limit itself to air war because of stronger positions of the army or navy of each country at the moment.

The United States and Russia are crucial actors in determining the balance of air power in East Asia. Air power gives the United States great leverage against China, North Korea, and Russia, because technological advances have provided the US Air Force with aerospace capabilities that give it a tremendous edge over any potential adversary. US air power is likely to be the dominant element in all foreseeable operations.

In the meantime, as a major supplier of advanced combat aircraft, Russia is important to China and North Korea, since both countries have to a large extent been dependent upon Russian aeronautics. The relationship of both countries with Russia is vital to maintain sustainable aircraft deliveries, that is to say, an industrial base for adequate levels of air power.

3. Period before Korea Aerospace Industries, Ltd.

Korea is a latecomer, not only in the aircraft business, but also in other manufacturing sectors. Nonetheless, it has shown impressive performances.¹³ The Korean aircraft industry started

¹³ For example, Hyundai established a car company in 1967, and started to produce cars under a license agreement with Ford in 1973. Only 6 years after entry, Hyundai developed the first indigenous Korean model, the 'Pony', with the outsourcing of design and styling, and recruitment of foreign expertise. After successive car productions

with the acquisition of facilities and equipment for depot-level maintenance of military aircraft in the 1950s. In the 1960s, efforts were focused on incremental improvement of depot-level maintenance capability.

In 1973, the Korean government announced the Heavy and Chemical Industry (HCI) Development Plan, and shifted its policy direction from light manufacturing to heavy industry. The HCI Development Plan targeted strategic industries, such as shipbuilding, automobiles, steel products, machinery, non-ferrous metals, textiles and petrochemicals. It is noteworthy that HCI Development Plan was also motivated by the policy of self-defense against North Korea.¹⁴

From 1976, the Korean government changed its military aircraft procurement policy from direct purchase from abroad to domestic production. In 1976, the Korean government decided to produce 500MD helicopters by a license arrangement with the American company Hughes. From 1982 to 1986, Korean Air was also producing F-5E/F fighters under a license agreement with Northrop Grumman. Ten years later, F-16 fighters were being produced locally (from 1996 – 2000) as well as UH-60 helicopters.¹⁵

However, there was no definite government policy promoting the aircraft industry. This, combined with a failure to

Early efforts

and model developments, Hyundai developed a completely indigenous car in 1994, the 'Accent', which incorporated a new auto engine developed using in-house research and development (R&D). Korea produced 2.4 million cars, and exported 1 million cars in 1995. In approximately 30 years, Korea has become the fifth car-producing country in the world, and the eighth biggest exporter'.

Samsung demonstrated similar success and achievement in the semiconductor industry in 1975. It bought technologies for 64K DRAM from a US firm, and established a company in the Silicon Valley in 1983. Soon after this, Samsung developed 256 K DRAM in house. In 1988, Samsung developed 1M DRAM in house, and became independent in DRAM design and production in 1988 with cumulated investment of US \$800 million. In 1992, Samsung became the first company in the world to develop working samples of 64 M DRAM.

¹⁴ There was a tension between the US government and Park administration surrounding human rights in Korea. In 1971, one third of U.S. troops in Korea were withdrawn.

¹⁵ Cho, Hwang Hee, *Hang Kong Gi San Op Eo Kisul Hyuk Shin Kwa Jun Gae Bang Hyang* [The Patterns and Directions of Technological Innovation in Aircraft Industry], STEPI (Science and Technology Policy Institute), January 2000, pp. 14-15.

Consolidation

create a new R&D program for military aircraft for a long while, rendered the existing production facilities useless. A law for the promotion of aircraft industry was enacted in 1978. But this law only provided a basis for governmental support to the weak domestic aircraft industry without any meaningful contribution to the purposed promotion of the industry. In 1987, another law for the promotion of the aerospace industry was enacted to support research and development activities. This again failed to initiate any distinguished research and development program for several years.

This new law provided the basis for the establishment of Korea Aerospace Research Institute (KARI), and the committee for policy-co-ordination between ministers. KARI was established in 1991, but the committee is yet to be convened.

There are five dimensions to implementing the government policy:

- the military aircraft procurement policy
- the regulation of industry structure
- R&D support
- the offset policy
- the construction of infrastructure.

The first dimension, the military procurement policy, is a demand side policy. It is very important to promote government procurement policy, and to stimulate early demand for an emerging industry. In Korea, the government keeps control of the program cost below 130 percent compared with direct purchase. However, for most subsystems, domestic production requires a huge level of initial investment, despite the small production volume. This inevitably increases production costs. As a result, Korean producers concentrate on final assembly, airframes and aero-engine production. Most of avionics, interior, instrument, and hydraulic equipment are imported directly. This has hampered the development of subsystem suppliers in Korea.

According to the Aircraft Industry Promotion Law, the government can shape industry structure by approving the new entry into the aircraft industry of additional companies. Unlike many other countries, the Korean government favors domestic rivalry, rather than national champions. Korean Air and Samsung Space and Aircraft (SSA) have held the monopoly in the aircraft and the aero-engine sectors, respectively. However, the new government policy in 1984 changed this situation by allowing Daewoo Heavy Industry (DHI) to enter airframe production. In 1986, the government decided that SSA, rather than Korean Air or DHI, should be selected as the prime contractor for F-16

licensed production. On one hand, the government wanted to encourage competition for technology development in the short term. However, the government later distributed domestic production programs to all three participants. The fragmentation of the market provided fewer opportunities for learning.

The Korean government supported R&D co-operation between governmental research institutes and industry through Chang-gong 91 (Korean Air), and 8-seater twin-prop, all-composite aircraft (SSA), and the Korean Regional Transport Project, as well as the KTX-1 (DHI). However, the national R&D program for the Korean Regional Transport Project had failed even before the commercial launch, due to unclear targets, and inadequate political intervention.

The Korean government imposed a 30 percent offset to support the production capacity of Korean firms. It was a very effective measure for latecomer firms who wanted to acquire aircraft manufacturing technologies. From the 1990s, the Korean government changed its policy from direct offset to technology transfer. The KTX-2 advanced jet-trainer development program with Lockheed Martin is one of the offset programs of Korean Fighter Program (KFP).

In order to understand the background of KAI's establishment, it is important to find out how the positions of the Korean aircraft firms had changed since mid-1970s. It can be divided into three phases according to the dominant characteristics of the industrial structure. The first phase is described as the 'Korea Air's Dominance Period' between 1976-1983. The second phase is the 'Rivalry and Competition Period' during 1984 and 1993. Finally, the third phase is the 'Samsung's Emergence and Consolidation Period' between 1992 and 1999.

3.1 Korea Air's Dominance Period (1976-1983)

Until 1976, there was not a single Korean firm with experience in aircraft manufacturing. Korean Air was in the best position in terms of technological assets. With its experience in aircraft operation and maintenance as well as good facilities, Korean Air was able to become the first company to produce aircraft and parts in Korea. For this reason, the Korean government gave the company the right to produce the first Korean military helicopter, 500MD, in 1976. Soon after, Korean Air was selected as the F-5E/F prime contractor.

SSA of the Samsung Group was the second company to become involved in the aircraft industry. However, it was not involved in aircraft manufacturing but in aero-engine production. The industrial structure in the Korean aircraft industry has been

Phases of expansion

shaped and altered by the government from the beginning. During the period of 1976-1983, Korean Air and SSA had monopoly positions in the aircraft and aero-engine sectors, respectively.

In this period, the two Korean firms acquired assembly technologies for aircraft and aero-engines, but no airframe parts were exported. Domestic military demand materialized, but no significant investment was made (see Figure 1).

Figure 2: Phase One- Korea Air's Dominance (1976-1983)

	Technological Assets	Physical Assets	Market Position
Korean Air	Aircraft maintenance, Aircraft system assembly	Aeronautical engineering graduates and a few experienced engineers	Monopoly in airframes (Domestic)
SSA	Aero-engine maintenance, aero-engine assembly	Aeronautical engineering graduates and a few experienced engineers	Monopoly in aero-engines

Source: Revised from Table 9.1 Hwang, Chin-Young, *The Aircraft Industry in a Latecomer Economy: the Case of South Korea*, op.cit. in footnote 16.

3.2 Rivalry and Competition Period (1984-1993)

During this period, the government introduced rivalry instead of supporting a national champion. In 1984, Daewoo Heavy Industry (DHI) was allowed to enter the aircraft market. And in 1987, Hyundai Space and Aircraft (HYSA) was awarded the contract for civil helicopter production with Kawasaki of Japan. Strong competition among major Korean conglomerates, called *Chaebols*, was promoted for military aircraft production projects.

Previous investments could be closely related to the 'switching cost' of a prime contractor in a defense contract. As military contracts in Korea were on a cost-plus system, the Korean government had to support new investment for production facilities. However, previous investments for F-5E/F licensing production consisted of building and tooling for final assembly, exclusively for F-5E/Fs and 500MDs. The differences

in program costs for KFP among competitors were not big enough to maintain the Korean Air's position.¹⁶

Korean Air established an R&D center to develop a light aircraft. Korean Air has also been involved in the MD-11 spoiler risk-share development project. Its unexpected failure in the KFP competition pushed Korean Air to join a technology development race in Chang-Gong 91. Nonetheless, many experienced engineers began to move to SSA and DHI during this period.¹⁷

DHI had the advantage in the competition of being the KFP prime contractor in terms of its physical assets. However, DHI was unsuccessful in the bidding process, since SSA was selected as the prime contractor. Instead, DHI participated in the Do-328 fuselage production project as a risk share partner. Although DHI was not able to take part in the development, they, in fact, were capable of managing a complicated international risk share business.

After being designated as the KFP prime contractor, SSA swiftly scouted experienced engineers, especially from Korean Air, as well as technicians retiring from the Korean Air force.¹⁸ However, SSA's experience in airframe manufacture was still limited.¹⁹

HYSA began to produce the BK-117 helicopter as a knock-down assembly, but its technological efforts were very weak. Though HYSA assembled the BK-117 helicopter, it had no production facilities for manufacturing airframe parts. The company focused on marketing the BK-117, whilst it was not serious about technology acquisition.²⁰

In this period, the competition to be the prime contractor for domestic military aircraft production was so fierce that Korean firms shifted their target to the international subcontractor market. As a major airline, the purchasing power of

¹⁶ Hwang, Chin-Young, *The Aircraft Industry in a Latecomer Economy: the Case of South Korea*, SPRU, University of Sussex, May 2000, p. 105.

¹⁷ Most technicians in the aircraft production section of Korean Air reckoned that they were not being treated as a major group, but as a minor and even secondary group by comparison to the airline business. Moreover, the wage levels of Korean Air were relatively lower than those of SSA.

¹⁸ The Korean Air Force carried out its own maintenance and overhaul for military aircraft, and they had many skilled workers.

¹⁹ Interview with KARI

²⁰ *Ibid*, Hwang, note 16, p. 107

Korean Air was considerable. That is why the company could obtain orders from Boeing, McDonnell Douglas, and Airbus. Purchasing power of commercial transport is a complementary asset for international subcontract market of Korean Air.

Figure 3: Phase Two- Rivalry and Competition Period (1984-1993)

	Technological Assets	Physical Assets	Market Positions
Korean Air	Aircraft assembly, airframe parts production, airframe subassembly development	Aircraft assembly facilities (Hanger, tooling, runway), airframe production equipment	Domestic military aircraft market, international airframe market (wing parts)
SSA	Aero-engine production, airframe parts production	Aero-engine production equipment, some airframe production facilities	Aero-engine market, KFP production, simple airframe parts export
DHI	Fuselage parts and subassembly production, risk-share subcontracting	Airframe manufacturing equipment	International frame subcontract market (fuselage assemblies), unprofitable
HYSA	Helicopter semi-knock down assembly	No meaningful investment	Civil helicopter market, unprofitable

Source: Revised from Table 9.2 Hwang, Chin-Young, *The Aircraft Industry in a Latecomer Economy: the Case of South Korea*, op. cit. in footnote 16.

3.3 Samsung's Emergence and Consolidation Period (1992-1999)

The technological capabilities of the three Korean firms had remarkably improved. Domestic production programs influenced the learning opportunities for the Korean firms. In particular, when the Korean government selected prime contractors for six national projects in 1990, it decisively affected the change in the positions of the firms (see Figure 3).

Korean Air had not invested in building sufficient physical assets to hold its dominant position in the 1980s. In the meantime, DHI had advantages in airframe manufacturing

facilities for KFP project. However, the Korean government took no consideration of this fact, choosing SSA as prime contractor for the KFP business.²¹ It is not difficult to explain the reason why the then-Roh Tae Woo government decided to do such a big favor to the Samsung Group, even though the Daewoo Group was in a better position to carry out the project. The industry-government relations, i.e. the relations between the conglomerate and the Blue House (Presidential Office) have played a vital role in the government's decisions in big business projects like KFP and KTX-2. Samsung's lobbying tactics have increasingly been aggressive, as has been shown in the Group's recruiting pattern. For instance, a number of former KORAF generals were hired in the late 1980s.²²

SSA was the primary beneficiary of the decision to choose SSA in 1990 and took over the dominant position in the domestic market with the KFP and the KTX-2 projects. For these two projects, SSA was eager to acquire aircraft manufacture and assembly technologies as well as advanced management systems. For instance, nearly 400 engineers were trained by Lockheed Martin, and 144 foreign engineers were invited by SSA to provide technology assistance. SSA also constructed a runway for test flights. As an offset program of the KFP, SSA has been engaged in an advanced supersonic jet trainer project, called KTX-2, with Lockheed Martin. In the end, SSA emerged as a leading company in the Korean aircraft industry.

SSA emerging
as dominant
producer

SSA has enjoyed a monopolistic position in the aero-engine sector, and it has been successful at preventing other Korean firms from entering the aero-engine market. In fact, Korean Air attempted to diversify its business into the aero-engine sector in the early 1990s. However, the government rejected the application of Korean Air because of its concern about the over-production capacity in the aircraft industry.²³

In the meantime, DHI found its position weakening in the domestic market, losing the fighter market in the KFP competition to SSA, and the helicopter market to Korean Air. Nonetheless, it became the prime contractor for the KTX-1 subsonic basic trainer. Although the basic trainer is a much smaller project than the jet trainer one, DHI has successfully developed the KTX-1 together with the Agency of Defense

²¹ Hwang,note16, p. 109.

²² Hwang,note16, p. 187.

²³ Hwang,note16, p.109.

Development (ADD). Through the project, DHI has experienced a complete cycle of full-scale aircraft development.

On the other hand, HYSA was unable to obtain any order from the Korean government. Without the necessary technological capabilities and physical assets, it was impossible to win a competition for a domestic military project. The firm participated in the B717 wing program and tried to specialize in wing production and production of large airframe structures.

Figure 4: Samsung's Emergence and Consolidation Period (1992-1999)

	Technological Assets	Physical Assets	Market Position
Korean Air	Helicopter assembly, airframe subassembly production, and risk-share development	Aircraft assembly facilities, airframe production equipment, runway	International airframe market, domestic rotary market
SSA	Fighter assembly, parts and subassembly, supersonic trainer development	Aero-engine production facilities, aircraft assembly facilities, with runway, airframe production equipment	Aero-engine market and domestic fighter market, priority: of jet trainer market for 2000s
DHI	Subsonic light trainer development	Airframe manufacturing facilities	Domestic basic trainer market for 2000s (a relatively small market)
HYSA	Main wing and large structure production	Main wing and large structure production facilities	Fragile position in international main wing market

Source: Revised from Table 9.3 Hwang, Chin-Young, *The Aircraft Industry in a Latecomer Economy: the Case of South Korea*, op. cit. in footnote 16.

As is shown in Figure 4, the Korean aircraft industry had an over-capacity problem for airframe manufacturing. This is one of the reasons for the establishment of a consolidated company, Korea Aerospace Industries Ltd.

3.4 Comparative Analysis on Corporate Strategies of Four Aircraft Firms

It is understandable that the Korean firms have actively accumulated foreign technologies, as well as assimilating and improving them dramatically in many areas.

3.4.1 Korean Air

Korean Air, an affiliate of Hanjin Group, was the first aircraft manufacturing company in Korea. In 1960, the Hanjin group founded Korea Air as an airline company. As a monopoly company, Korean Air operated commercial transports as national flag carrier until 1988, when the second airliner, the Asiana Airline was established. In 1976, Korean Air became involved in the aircraft manufacturing industry, acquiring repair and overhaul technologies for the maintenance of their fleet.²⁴

The company carried out license production of the 500MD helicopter from 1977. It had a contract with Hughes to produce 500MD/D military/civilian helicopters. This was the first license production in the Korean aircraft industry. It is noteworthy that this diversification path was a product of government guidance, not a corporate strategy. The decision was made by the government (then-President Park Jung Hee).²⁵

Programs at
Korean Air

F-5 E/F Fighter Project

In the process of the 500MD helicopter production, Korean Air was designated as a prime contractor of the F-5 fighter license production by Korean government. Korea Air enjoyed the first-mover's advantages and the monopoly position. In 1980, the Korean government exchanged a MoU (Memorandum of Understanding) with the US government for F-5 license production, followed by the sales and license agreement between

²⁴ See the details in Hwang, Chin-Young, 2000, pp. 104-5.

²⁵ As Korea had participated in the Vietnam War, the Korean army recognised the importance of helicopters for surveillance and immediate transportation of soldiers from place to place. In particular, helicopters were very efficient in guerrilla warfare. Furthermore, the modified version of the 500C, the 500MD, was very appropriate for the mountainous Korean terrain. 500MD was an attack helicopter and had advantages over the An-2. North Korea has operated An-2s for sudden attacks at a low altitude. However, the 500MD was faster than the An-2 and superior in arms to the An-2.

Northrop Grumman and the Korean government, and a supply agreement between Korean Air and Korean government. There was no direct agreement between Korean Air and the American company for the project. Korean Air produced the first aircraft in 1982, and produced 68 F-5E/Fs until 1986. Among them, 30 F-5s were produced by SKD (Semi Knockdown) assembly. In the case of SKD assembly, there were no locally produced parts. From 1983 onwards, some locally made parts were assembled. However, the number of localized F-5E/Fs was only 38.

Through the F-5 fighter production program, Korean Air was able to gain experience in tooling and machining technologies. Korean Air produced 3,348 items, including aft fuselages and ailerons, representing 22 percent of the F-5/F in value. However, after two license production programs, Korean Air faced severe criticism about its slow technology acquisition progress. Although the government designed programs, the low level of localization progress were blamed on Korean Air. Korean Air invested 161 million won during 1981-1983. Most of the investment was from land buildings, and only 2 percent of the investment in technology. Training programs have been focused on production, not design or system integration. The trend did not change even in the UH-60 program ten years later.

In comparison with license production programs, international subcontracts were a means of survival for Korean Air. All domestic production was completed in 1986, and it was necessary to find export markets to maintain the aircraft manufacturing division. The first subcontract was the B747 flap track fairing (FTF) production in 1986.²⁶

Korean Military Helicopter (KMH) Project

Sikorsky Aircraft Corp. and Korean Air have agreed to develop multi-mission helicopters for the government of Korea. Under the terms of a Memorandum of Understanding signed on 17 October 2001, Sikorsky and Korean Air Lines forged an agreement to cooperate on the Korean Multi-Purpose Helicopter program.

²⁶ FTF is a structure to support flaps that improve the lift of an aircraft. Korean Air supplied 300 ships/set and extended its supply until 2002. The deal was worth almost US \$200 million in total. However, these were small parts and simple jobs. Furthermore, Boeing provided all the drawings for manufacturing and tooling.

"We are excited to return to the Korean marketplace with our colleagues at Korean Airlines," said Sikorsky President Dean C. Borgman. "We believe our combined talents will meet the needs of a very important customer." ²⁷

The Korean Multi-Purpose Helicopter may ultimately involve the purchase of hundreds of aircraft to fulfil a variety of Korean military requirements. These aircraft would replace Korea's current inventory of aging aircraft.

As part of the collaboration, KAL will establish and staff its own Helicopter Development Research Center (HDRC) as a branch of the Korean Institute of Aerospace Technology. Sikorsky and KAL have agreed to work together to evaluate potential collaborative engineering projects for HDRC staff that would be of mutual interest and benefit to both parties.

Sikorsky and KAL have already jointly sold and produced more than 100 Black Hawk helicopters for the Korean military, the first of which entered service in 1990. These aircraft have now logged nearly 200,000 hours of service, and are critical components of military planning in the Korean theatre.

The KMH project is intended to develop a helicopter designed exclusively for the military that will suit the geographical characteristics of Korea. The joint team plans to develop the pilot project by 2003, and begin full-scale manufacturing of the helicopter for the Korean Armed Forces by 2008.²⁸

3.4.2 Dae Woo Heavy Industries

DHI's previous experience in the defense industry has been helpful in its moving into the aircraft industry, especially in customer relations. DHI has been involved in the defense industry since 1973 and has developed technological as well as project capabilities. Since then, it has developed and supplied Korean infantry fighting vehicles (IFVs), ground-to-ground missiles, anti-aircraft rockets, anti-aircraft guns, guided weapons and missile systems, anti-ship guns and naval gun mount systems. The military business requires key project capabilities, such as bidding, cost and schedule management, selection of subcontractors, etc.²⁹ The Daewoo Group has understood the mechanism of the military business.

²⁷ Defense News, 17 October 2001.

²⁸ Ibid.

²⁹ Hwang, Chin-Young, p.152.

Programs at Dae
Woo

DHI participated in the aircraft industry with the Offset program of Peace Bridge-I. The purpose of the Peace Bridge-I program was the purchase of 32 F-16 fighters from General Dynamics. KAL and SPI were reluctant to participate in the Peace Bridge-I Offset program because it required a large amount of investment in production facilities. The production volumes required by the contract were not sufficient to recoup the initial costs incurred. Nevertheless, DHI decided to take over the offset program because the F-16 fighter might be a candidate for the next Korean fighter program. Daewoo saw the opportunity in this offset program and was aware that the program cost would be several billion dollars. DHI believed that it could gain a decisive advantage in the competition to become prime contractor, if it had equipped its exclusive production facilities in the F-16 Offset production. Therefore, DHI invested US \$30 million in the program, which was only worth US \$14 million of F-16 center/aft fuselages, ventral fins, and side panels.

However, after President Park's assassination in 1979, his successor, President Chun Doo-Hwan reduced the previous ambitious development plan significantly, and delayed the next fighter production program for ten years, which resulted in the 'freezing' of domestic market demand. He introduced a policy of domestic rivalry, rather than the national champion policy, in the Korean aircraft industry. This provided the opportunity for DHI to enter the industry. President Chun allowed new entrants in the frozen market. DHI invested heavily in the F-16 offset project, but could not reap benefit from government projects over a long period.

In spite of DHI's failure to become the KFP prime contractor, it continued to be involved in KFP airframe parts as a subcontractor of SSA. Although the Korean government decided to select SSA as the prime contractor for KFP, it insisted that the production of F-16 airframe parts (except final assembly, engine and other equipment) was shared equally among the big three (KAL, SSA, DHI). The purpose was to utilize the prior investment of existing companies and to induce collective learning by promoting domestic rivalry. Because the KFP program was delayed until 1996, there was no domestic market. Therefore, DHI decided to enter the export market based on its prior experience of the F-16 offset program and low labor cost.³⁰

With this subcontract, DHI learned Boeing's management techniques, such as its quality assurance (QA) system. The QA

³⁰ *Ibid*, p.156.

system is critical in the aircraft industry because safety and quality are the most important requirements - even more important than price.³¹

Subassembly: Do328 Risk-Share Project (with Dornier of Germany)

DHI contracted with Dornier on a risk-share basis.³² For DHI, it was not easy to join a program like this because of its limited experience in aircraft manufacturing. In order to join such a program, participants should retain or should be able to contribute at least one of the following capabilities; 1) technology, 2) financial capability to share program cost, 3) reputation, or 5) marketing capability. Unfortunately, DHI and the other Korean firms had no such capabilities except for the financial capability pooled from the Chaebols.

The DHI's work share was between 5 and 40 percent of the airframe structure manufacturing excluding engine, avionics, and electrical equipment. DHI had never carried out such a large-scale project. It was extremely difficult for DHI with only four years experience in the airframe manufacturing business. At the beginning, Dornier had suggested a bigger package, including design work, to partners. Aermacchi of Italy agreed to the proposal, but DHI did not take up the offer, because of its lack of technological capabilities. DHI could not even manufacture some of the complicated components first agreed on. For example, DHI could not deal with doors(e.g. the emergency, baggage door, service, and passenger doors). This configuration and contour of the doors were too complex for DHI at that time. DHI gave up the job and transferred it to Westland of the UK.

³¹ The quality assurance system in the commercial sector is quite different from the military sector. In military sector, the producer is obliged to follow military specification, whilst in the commercial aircraft sector, there is a separate authority for safety regulation.

³² Partners share development costs, which are spread over estimated sales volumes. If the aircraft sales exceed the estimated number, then the risk-share partner stands to make additional profit. If not, they have to bear a loss. It is quite a risky business, but a relatively easy way to get stable production orders from major aircraft manufacturers. Contracts like these are currently very popular. Major aircraft development projects, such as Airbus, Eurofighter, Boeing 767 and 777, and so on, have been launched as international risk-share or revenue-share programs because of their huge development costs, uncertain market conditions and fierce competition.

Programs at Dae
Woo

As the program was undertaken on a risk-share basis, DHI could not claim either for parts and subassemblies already produced, or for jigs and fixtures, which had to be disposed of. In addition, DHI had to pay a penalty for the increased costs of transferring the doors to Westland.

Achievement

Before the Do328 program, DHI had produced only simple machining works like panels, ribs, stringers, skins with sheet metal, and so on. However, DHI learned complete fuselage manufacturer and assembly technology in the course of the Do328 program. The most important thing was to experience the full aircraft development process. Although DHI did not carry out the design work, it could gain experience in the whole process of a manufacturing cycle. In particular, it was able to learn interface management between the design team and the manufacturing team, between different manufacturing teams and partners, as well as cost management and configuration management techniques.

Building up the supplier network was another achievement. In 1988, DHI was working with 15 small and medium firms as subcontractors. DHI became the first company to built up reliable relationships with subcontractors in the four Korean aircraft companies. However, on the business side, DHI had to pay high costs for this experience. At first, it had no idea about risk-share contract. DHI suggested 400 aircraft as an estimated delivery, and DHI believed it would achieve BEP (Break Even Point) at 250 units. However, the market conditions did not meet expectations.³³

KTX-1: System Integration

In 1990, DHI was selected as a prime contractor of the KTX-1 project³⁴ and the light helicopter program. The KTX-1 program

³³ Short haul passengers dislike propeller-driven aircraft, because they are too noisy and uncomfortable. As a result, Dornier was only able to sell 115 aircraft. Finally, Fairchild took over the plant.

³⁴ The KT-1 is a basic trainer designed to replace the T-41B and T-37 basic trainer for the Republic of Korea Air Force. The Korean Trainer Development Project, called the KTX-1, was started in February 1988. The first prototype, the KTX-1-01, made its first successful flight on 12 December 1991. Since then, a total of 5 prototype aircrafts have been dedicated to flight tests and have accumulated more than 2,000 flight test hours. The production contract

was initiated to replace the aging trainer fleet, T-41 and T-37, of the Korean Air Force (ROKAF). The program started in 1988 as an internal R&D project, rather than as a national project, within ADD (Agency for Defense Development). The KTX-1's maiden flight was made in 1991. However, after DHI's joining the project in 1990, the R&D project was designated as a national project. The development phase was completed by 1988, and production began from 2000.

The Korean government set higher goals for the aircraft industry from late 1980s. The aerospace industry development promotion act was enacted in 1987. In addition, MOCIE (Ministry of Commerce, Industry, and Energy) announced the long-term development plans in the aircraft industry in 1989.

In 1990, there was a selection procedure for prime contractors of six military aircraft programs; the UH-60 (helicopter), the KTX-1 (basic trainer), the KTX-2 (advanced jet trainer), the F-5 Upgrade, the F-4 Upgrade, and the light helicopter. Amongst them, DHI won only the KTX-1 and light helicopter projects. Although KTX-1 was an indigenous development project with an inexperienced government research institute (ADD), DHI committed itself to the goal of becoming a system integrator. In order for this, it established R&D centers in Korea and Russia respectively.³⁵

While ADD is responsible for concept design, test and evaluation for KTX-1, DHI is in charge of detail design, final assembly integration, including wing manufacturing. SSA and Korean Air were involved as subcontractors. SSA is responsible for aft fuselage and engine, and Korean Air took care of center and rear fuselage. Five other subsystem manufacturers are

Programs at Dae
Woo

was made with the Korean Aerospace Industries Ltd. in 1998. All of the primary design efforts were led by the Agency for Defense Development. The KT-1 is the first military aircraft designed and developed in the Republic of Korea.

³⁵ DHI established the Daewoo Institute of Science and Technologies (DIST) in Moscow in 1994. After the collapse of the Soviet Union, DHI could work with the world-class aeronautical engineers at a relatively low cost. However, recruiting Russian engineers to Korea was difficult; thus, DHI decided to establish a R&D institute of its own in Moscow. DIST has provided experienced engineers and facilities at a reasonable price. DHI was able to acquire expertise that it could not find in Korea. For instance, wind tunnel testing is very expensive for a test facility, not only in terms of construction but also maintenance, even though the cost of wind tunnel construction depends on the scale of the test section.

Role of ADD in
KTX-1

engaged with landing gear, canopies, avionics, hydraulics, and pylons.

Related Institutions

First, MOD is the final decision-maker in the program. It controls the budget, coordinates between each institution and organizes 'the committee for defense improvement' which took important decisions at national level.

Second, KORAF is the final user of the KTX-1. It worked closely with the development team and determines the requirement of capability (ROC) and carried out operational tests (OR).

Third, Ministry of Economy and Finance (MOEF), and MOCIE are also involved. MOEF has the function of coordinating between ministries and allocating budgets to the MOD. MOCIE is involved in industrial development policy and supported localization. It organizes the committee for the selection of the KTX-1 prime contractor and announces the selection officially.

Fourth, there is a regulatory body for quality assurance. The Defense Quality Control Institute (DQCI) is the government regulatory authority for military equipment. It is not a major actor in the development phase, but is important in the production phase. It develops a QA procedure for the procurement phase with the design team.

These institutional structures changed during the production phase from 2000. MOD, KORAF, DHI, and the Defense Quality Control Institute became more involved. A Project Management Office (PMO) was established within KORAF to manage the overall KTX-1 program.

The KTX-1 project has been useful in building up an organizational capability at the level of Korean aircraft industry, including various ministries, GRIs, universities, and regulatory bodies, and so on. These institutions have had to experience new interactions both at inter-organizational and intra-organizational levels beyond DHI. The project has therefore fostered the Korean national system of innovation in the aircraft industry.

3.4.3 Samsung Aerospace Industries

Up to 1970, the Samsung group had grown on the basis of manufacturing consumer products for import substitution. From the 1970s, Samsung diversified into heavy chemical industry in line with government industrial policy. The Samsung Petrochemical Company Ltd. and Samsung Heavy Industries

Company Ltd. were founded in 1974. Samsung entered into the shipbuilding industry by acquiring the Daesung Heavy Industry Company in 1977 and got a foothold in the defense industry with the establishment of the Samsung Precision Company in 1977 (which in 1987 changed its name to Samsung Aerospace Industries Ltd.); subsequently, Samsung entered the aero-engine market.³⁶

The process in Software Process Improvement (SPI) of building up technological capabilities in the aero-engine sector was similar to that followed by Korean Air. The first phase involved maintenance, simple assembly as a license production, and offset production. Based on this experience, SPI attempted to participate in commercial programs as a sub-contractor. Finally, SPI joined international programs as a risk share partner or co-developer. SPI enjoys a monopoly in the aero-engine sector in Korea. It supplies all the aircraft engines for the military aircraft localization programs such as the KFP (F-16), as well as the UH-60 helicopter program; SSA is also the only supplier of military aero-engines, including their maintenance and overhaul in Korea.

SPI's corporate strategy was quite different from that of KAL. As an air transportation company, KAL's management style was passive and defensive. By contrast, SSA was very aggressive in seeking to catch up in the domestic aircraft industry.

From the beginning, SPI was a defense company with the military and the government as its major customers. SPI appointed Kang Jin-Koo, an electronic engineer, as President and Kim Kyung Soo, a retired vice-marshal of the Korean Army, as a member of top management. Most of the senior executives had engineering backgrounds, and some came from the military. SPI recruited many retired military officials to maintain a critical network with the people involved in the decision-making on the military sector.³⁷ This is another feature of the Korean defense business. Human networking is always a useful method, affecting the decision-making system.

In 1984, SPI established an R&D center to demonstrate its commitment towards technology development. SPI recruited an air commodore from KORAF, Kim Jae Soo, as president of the center. In late 1984, SPI was certified as an airframe parts producer by MOCIE (Ministry of Commerce, Industry and Energy). The external linkage capabilities were one of the core

Early projects at
Samsung

³⁶ Hwang, note 16, pp. 187-8.

³⁷ *Ibid.*, p. 191.

Building up
capacity at Samsung

assets of SSA, and enabled it to achieve a dominant position in the Korean aircraft industry.³⁸

External Factors

The growth and diversification of the Samsung group were closely related to market growth in consumer products. However, its entry into the defense industry was the result of strong governmental push.³⁹

Capability Building Process- Aero-Engine Sector

The first step of SPI into the aero-engine sector was the acquisition of aero-engine maintenance technology. SPI contracted a licensing agreement for J-79, J-85 jet engine (F-4 and F-5 fighter engine) maintenance with General Electric (GE), and A250 (500MD), and T-53 (UH-1H) the engine maintenance license with Hardboards Australia Ltd. (HAL).

As a next step, SPI contracted with GE for J-85 engine license production as a sub-project of the F-5 E/F program in 1980. SPI localized 78 items and achieved 42% of localization by value for 3 years. From 1984, SPI moved into more complicated projects, such as the A225 engine development project, as a risk share partner. Allison of the US was responsible for the design and final assembly, and SPI and three other companies in China, India and Japan were involved. SPI produced 34 percent by value of the engine.⁴⁰

Korean Fighter Program (KFP) Project

The idea of the KFP project arose in 1983. President Chun had KORAF prepare a development plan for the aircraft industry. The KORAF suggested fighter localization and received a Letter of Intention (LOI) for participation from domestic companies: KAL, SSA, DHI, and KHI (Korea Heavy Industries Ltd.). In

³⁸ *Ibid*, p. 193.

³⁹ The Korean government developed munitions systematically; from light firearms to heavy combat vehicles such as tanks. In 1972, 24 private companies were designated as defense companies and this had expanded to 52 companies by 1976. Up until that time, most defense products had been produced domestically, with the exception of aircraft and advanced precision and electronics-related items. Government strongly recommended that Samsung should become active in the aero-engine sector.

⁴⁰ *Ibid*, p. 192.

1985, KORAF announced the KFP officially and received proposals for localization from three companies (KAL, SSA and DHI).

Unlike Korean Air, SSA had experience in airframe parts and subassembly prior to a system assembly project. However, the KFP project was not a simple knockdown assembly project because it involved substantial parts manufacturing and subassembly manufacturing.

After F-5E/F license production, the Korean government in 1985 decided to localize more advanced fighters. The F-5 E/F was a light attack fighter, but it was modified from the jet trainer T-38 (USA). It could not compete with North Korea's MiG-21. In order to be a successful bidder, SSA prepared carefully to transform its image to that of an airframe company. From 1983, SSA had participated in airframe parts manufacturing such as the F-5 offset program and the B747 Stringer in 1986. In 1986, SSA received the contract for the Bell 412SP helicopter fuselage. All those activities were aimed at achieving the necessary experience to become the prime contractor for the KFP, partly based on management capabilities, partly on intense lobbying (see above).

The Korean government decided to select SSA as the prime contractor for KFP in 1986, but the government did not make a decision on candidate fighters (between the F-16 and F-18) until 1991. At first, government chose the F/A-18 (McDonalds Douglas) as a primary candidate for negotiation in 1989. However, during negotiation of the final contract, MD increased its program cost from US \$5 billion in 1989 to US \$6.2 billion in 1990. Added to the devaluation of Korean currency, which was taking place at that time, this represented a 46 percent increase. The Korean government switched to the F-16 (General Dynamics). From 1994, SSA started to produce F-16 fighters. This was Korea's largest military aircraft procurement program. The program cost was around US \$5 billion. SSA continued to produce 120 F-16s until 1999.⁴¹

The KFP licensing program was an international military program that involved the two governments. KFP was contracted as a commercial licensing program, though the US government would have preferred a FMS (Foreign Military Sales) agreement. In FMS agreement, US manufacturers supply aircraft to the US government, and then the US government sells them to foreign governments. In this case, local companies are involved in parts manufacturing, subassembly, and final assembly as subcontractors

Samsung becoming dominant

⁴¹ *Ibid*, p. 199.

of US manufacturers. In contrast, under commercial licensing, local firms pay a licensing fee, but take responsibility for the production of the aircraft and its equipment. US manufacturers supply parts and components to local firms with technical assistance. The project was signed on a commercial basis. It is noteworthy that SSA, rather than the US government, was responsible for the localized F-16.

Achievements

The KFP program was an important turning-point for SSA. With the designation as KFP prime contractor, SSA became a leading company in the Korean aircraft industry. SSA's success was due to its project management capabilities. SSA employed an aggressive strategy to overcome a latecomer's disadvantage in contrast to the defensive strategy of KAL. Although KAL had more accumulated know-how in aircraft manufacturing, it failed to carry out its technological leadership. In the meantime, SSA was able to demonstrate its program management and investment capabilities and was thus able to enter into the aircraft manufacturing industry.

However, the project was supposed to come to an end in 2000. In a rigid labor market like Korea, diminishing workload might result in a low rate of return or even the loss of business.

The decision regarding the additional production of twenty F-16s aims to bolster the aircraft industry rather than to meet the strategic requirements. This would avoid laying off thousands of workers. Reduction in the workforce would otherwise be inevitable since the KTX-2 project, which will take the F-16's place on the production line, will not enter mass production until the end of 2002.⁴²

KTX-2 Advanced Jet Trainer

In 1991, SSA has begun to develop KTX-2 advanced trainers. In 1990, the government decided to initiate six major military aircraft procurement programs. SSA was designated as a developer of the KTX-2, and the prime contractor of the F-4 Phantoms avionics upgrade program, which was later cancelled. SSA was successful as a prime contractor for advanced fighter/trainer projects. Meanwhile, DHI was designated as a light aircraft developer and

⁴² Cho, Myeong Chin, "Korea Unveils New-Look Aerospace Industry," *Interavia*, February 2000, p. 19.

light helicopter producer, and Korean Air was allocated to medium weight helicopter production.

The KTX-2 program was initiated as a KFP offset program, consisting of airframe parts and aero engine parts production, as well as technology transfer for KTX-2 development. Airframe, engine parts production and export opportunity were the main priorities of the offset program. However, the Korean government gradually changed the emphasis of its offset policy from receiving orders for export to technology transfer.

Conflicts in the
KTX-2 program

Institutional Structure

The KTX-2 was the second military aircraft development project after the KTX-1. Its organization was different from that for the KTX-1. In the case of the KTX-1, ADD was the main developer, while DHI was a major partner of carrying out system integration and final assembly. The KTX-2 project started with the same structure, but at the end of the conceptual design stage, the structure was changed.

A KTX-2 project team was established within KORAF, which carried out the project management. In fact, the main actor was changed from ADD to SSA. ADD carried out test and evaluation, supporting SSA in development. That is, unlike the KTX-1 program within which ADD had responsibilities for development, SSA had full responsibility of the KTX-2 development.

The change of the organizational structure was unexpected, and there were many conflicts between ADD, SSA, and the Air Force. It cannot be denied that there was keen interest among the participants to maximize their participation. The program cost was huge, and technical risks were relatively low. As a customer, KORAF wanted to handle the project directly without any interference from the MoD or ADD. SSA did not want to have two 'bosses' for the project. Besides, SSA had received the necessary training from Lockheed Martin.

Though the Chang-Gong 91(Korean Air), and KTX-1 (DHI) already existed, these were subsonic, propeller-driven aircraft. Their technological complexity cannot be compared with that of a jet supersonic advanced trainer/light attack aircraft. The development cost of the latter is more than US \$1 billion, and the production of more than 90 aircraft is expected to start in 2005. SSA aims at having full responsibility for the project, and maximizing the opportunities to learn design and development technologies from Lockheed Martin. However, SSA could not call on experienced researchers at ADD as ADD withdrew from detailed design and was only involved in test and evaluation. This

is likely to result in increased costs for learning. Coupled with the change in organizational structure, the system requirement for the trainer has changed from intermediate level aircraft (subsonic jet trainers), to higher level aircraft (supersonic jet trainer/light attack).

In early 2003, the KTX-2 project was interrupted, experiencing a two year' delay. This was due to related problems. At the beginning of the project, the system requirement was for a 'subsonic' advanced trainer. However, during the conceptual design, this requirement changed to a 'supersonic' advanced trainer. The development cost increased to US \$1.2 billion, almost double the original estimate. When the procurement costs for 94 aircraft (50 trainer, 44 light attack) required an additional budget, exceeding US \$2 billion, this raised serious problems for the Korean government.

The government reviewed the project. To deal with the project at the governmental level, the first Aerospace Industry Policy Review Committee, chaired by the Prime Minister, met on 3 September 1997. In spite of the incremental cost, the government decided to resume the project for survival of the Korean aircraft industry with MoD responsible for 50 percent of development costs, MOEF 20 percent, SSA 17 percent, and Lockheed Martin Tactical Aircraft Systems (LMTAS) 13 percent.

Korean Commercial Transport Development (KCTD) Project

SSA was involved in a project of developing a 100-seater commercial transport aircraft. In the case of military aircraft, the major customer is the national government. Government might make sacrifices on costs for several reasons, such as strategic decisions or maintaining the domestic defense industry. However, a commercial aircraft development project is quite different. Korea has only a small domestic market for air transportation to guarantee commercial projects.

Originally, the plan was to develop a 50-seater regional aircraft indigenously, but the government changed this to a 100-seater aircraft project with China. There were two reasons for this change. The first was the small domestic market, and the second was political consideration in enhancing the relations with China. In 1994, when the then-president Kim Young Sam made the first official visit to China after normalizing the diplomatic ties with China, China wanted industrial cooperation with South Korea. The aircraft industry was one of the areas to be considered at that time. For the Korean side, commercial transport looked promising, as China is a large country with vast air traffic demand.

The Korean government intended to provide 50 percent of the development cost. For this international joint venture arrangement, 13 Korean aircraft companies formed Korea Commercial Transport Development Consortium (KCDC) in 1995, and SSA was selected as the lead company. In 1994, the Korean and Chinese governments signed an MOD for joint development. SSA and Aviation Industries of China (AVIC) agreed to be equal partners holding 35 percent and 40 percent each. The third partner such as Boeing or Airbus would be invited to have less than a 20 percent share in the project. The framework looked feasible, since China has the market, and Korea is able to share development costs. Both parties thought that they could obtain technological assistance from western companies. However, the cooperation between Korea and China gradually eroded, particularly when they showed disagreement over the third partner, the final assembly site, design office site, as well as work share. In the end, the project terminated in 1999 without any outcome. With the failure of the KCTD project, the Korean aircraft industry realized that the development of an indigenous commercial aircraft was too ambitious. Thus, the Korean aircraft industry learned a lesson about the complexities and difficulties associated with international joint ventures.

Assessment of KCDT

SSA attempted to enter the international commercial aircraft market aggressively. However, the KCTD program showed the limitations of SSA and the Korean aircraft industry. The program had several inherited problems from the beginning.

First, the program was initiated by KARI and the government. The government intended to fund 50 percent of the development cost. In return, the government wanted KCTD to have an initiative in the international co-development project as a national project. However, the project goal was not clear. It started as a technology development project, but it changed to an international development project with China for marketing and diplomatic reasons. At the same time, the Korean government insisted on having a final assembly line in Korea, whilst the Chinese government wanted to have the final assembly line on their soil. This created serious disagreement.

Second, the organizational structure was too complicated. Although SSA was a leading company, it had no power to control KCDC. It had to get approval for every decision from MOCIE. KARI was responsible for project management and administered the budget authorized by the government. Moreover, there was

discord in SSA's cooperating with Korean Air and DHI. The internal frictions aggravated the situation.

Third, Korea has not signed a BAA (Bilateral Airworthiness Agreement) with any European country or the US. As passenger safety is always a major issue with aircraft, regulations for safety control are essential. Without a BAA, it would be impossible to export the aircraft. Furthermore, it usually takes 4 to 5 years to obtain an approval certificate for new aircraft. It means that Korea can only sell its aircraft about ten years after the development. Thus, the financial considerations were strongly underestimated.

3.4.4 Hyundai Space & Aircraft

Although it is remarkable that Hyundai has successfully accumulated technological capabilities in the automobile and shipbuilding industries, it was the smallest airframe company in Korea, and its technological capabilities were also the weakest. First of all, its corporate strategy misfired. Hyundai had been trying to become a prime contractor in domestic military production, but had no relevant experience or requisite assets. Hyundai's stance was that, 'were the government to select it as a prime contractor, then it would invest in the aircraft industry and quickly develop technological capability of an international level. However, without the necessary capabilities, Hyundai had been unsuccessful in bidding to be a prime contractor.

Before launching the aircraft business, Hyundai started the precision machinery industry, by creating Hyundai Precision and Industry Company (HDPIC). HDPIC is a container manufacturing company that occupied 30 percent of the world container market in 1991.

In the defense industry, HDPIC was Korea's sole manufacturer of the main battle tank, called the '88 Tank', which was developed indigenously. In 1987, the company decided to participate in the aircraft industry, founding its aerospace division. HDPIC entered BK117 Helicopter production by license agreement with Kawasaki Heavy Industries Co. (Japan) in 1989. In 1994, the aerospace division of HDPIC was established as the Hyundai Technology and Development Co. (HTDC) for the aircraft industry. It also changed its name to the Hyundai Space and Aircraft Company Ltd., (HYSA).

Since Hyundai was the last of the four Korean conglomerates that entered the aircraft business, HYSA had faced unfavorable external obstacles. The first obstacle was to obtain a new business approval from the government. To produce aircraft-related products, permissions from government are

Early projects at
Hyundai

required by law.⁴³ The company was unsuccessful in winning the competition to become a prime contractor, mainly because they had neither previous experience, nor investments in helicopter or aircraft manufacturing. This hampered HYSAs from becoming a well-established aircraft company.

In particular, the BK-117 helicopter assembly project was unsuccessful because of the small civil market. HYSAs attempted to build light aircraft with a Russian partner. All its efforts stopped at the stage of a feasibility study. In 1996, HYSAs took over the B717 main wing risk-share project from Hanra Heavy Industries Co. Ltd. The project was a major advancement for HYSAs. However, it was too ambitious, as HYSAs did not have the necessary experience in airframe parts manufacturing and subassembly projects for carrying out such a large project.

As a matter of fact, Hyundai aimed at becoming an aircraft system integrator from the beginning. Hyundai did not want to remain as second-tier supplier, simply manufacturing parts and subassemblies. The top executives of the Hyundai Group also hoped that HYSAs would be a leading aircraft company, since the largest conglomerate's goal was always to become number one in every sector that it is involved in. However, it failed in its mission.

B-717 Wing Project

Hyundai had repeatedly tried to be an aircraft system integrator but experienced difficulties given that fact it is almost impossible to become a system integrator in a short period of time. Hyundai discussed the possibility of modification of the old large passenger aircraft into the freight airplane with Pemco (US) in 1995.⁴⁴ Hyundai also tried to establish a joint venture company with Yak (Russia), and Mikoyan (Russia).⁴⁵ However, all the efforts failed, before entering a full-scale development stage. Finally, Hyundai chose the B-717 wing project as an alternative business.

From the late 1980s onwards, McDonnell Douglas (MD) Aircraft Company was suffering from the severe competition from Boeing and Airbus. MD launched the program as an international co-development program. MD needed subcontractors who would supply parts and sub-assembly cheaply. At

⁴³ However, in 1990, the 'Aircraft Industry Development Promotion Law' was introduced, with the intention of abolishing the procedure of government permission.

⁴⁴ Donga-ilBo, Korean Daily Newspaper, 11 November 1995.

⁴⁵ Donga-ilBo, 24 December 1995.

that time, Hanra Heavy Industry (HHI) was looking for a new industry to invest in. Although HHI had no experience in the aircraft industry, Jung In-Young, the chairman of the Hanra Group, decided to enter the MD-95 program. However, the Hanra Group faced financial difficulties, and in the end went into bankruptcy in 1998. In fact, the Hyundai Group guaranteed the contract between Hanra and MD.⁴⁶ Hanra was forced to abandon the contract, and it was not able to compensate for its non-fulfillment. This meant that Hyundai had to recoup the Hanra's losses from MD, taking over MD-95 main wing assembly from HHI.

The MD-95 (later the B-717)⁴⁷ wing project was an example of Hyundai's stereotypical corporate strategy. With that strategy, the Hyundai Group was successful in the automobile industry and shipping industry. However, the aircraft industry was a different story. In other words, Hyundai Group's success in its core businesses does not necessarily translate into success in a very different industrial branch. Furthermore, Hyundai Group's management seriously overestimated their abilities to accomplish the task of becoming 'number 1' in the aircraft industry.

4 KAI's Establishment

After the global aircraft industry passed a peak of prosperity in the 1980s, international competition intensified. The competition became fierce; consolidation of aircraft companies accelerated after the Cold War, while stagnation of civil aircraft demand was caused by the worldwide recession. As the market decreases and competition increases in both the military and civil aircraft industries, aircraft industries around the world are exerting a great effort in increasing intrinsic and extrinsic competitiveness for survival.

As a part of this effort, the leading aircraft companies have gone through mergers and acquisition. To reduce development costs and risks related to market uncertainty, the leading aircraft

⁴⁶ Jung In-Young, Chairman of the Hanra Group, was a younger brother of the late Jung Ju-Young, founder of the Hyundai conglomerate.

⁴⁷ McDonnell Douglas initiated the B171 program as MD-95. With the end of Cold War, US defense budget was cut. For this financial reason, the commercial sector of MD merged with Boeing in 1997, whilst the defense sector merged with Lockheed Martin. Boeing continued the program, after changing its name from MD-95 to B717.

companies are consolidating in their own countries and have engaged in cooperation for co-development and co-production with leading companies internationally. At the same time, the main reason behind this cooperation is the economic gain made by avoiding duplicate investment and sharing the risk for research, development and production.

4.1 Background of KAI's Birth

While KFP production was a high note in the late 1990s, the Korean industry was fragmented and losing money. A currency crisis had rolled across Asia, dropping the value of the Korean won by 50 percent. As part of its drive for economic reform, the Korean government forced a consolidation in aerospace manufacturing.

Under the direction of the Korean government, Korea Aerospace Industries, LTD., was finally launched on 1 October 1999. The creation of KAI is a double-edged strategy. One is to equip its Air Force with self-supplied aircraft. The other is to prevent excessive competition and overlapping investment in the aerospace industry. The rivalry of the three Korean conglomerates, *chaebols* in the aerospace sector had often been seen as a chronic hindrance in sharpening its competitive position. Under these circumstances, the economic crisis gave added urgency to the government's promise to wield its authority over the *chaebols* more powerfully than ever before.⁴⁸ While they held numerous parts and assembly subcontracts for commercial aircraft, the manufacturers were too dependent on government contracts to say no.

Attempts to bring in a foreign partner did not pan out, so the task of underwriting the new company was left to the government through the banks it controlled, private lenders and the industry. KAI was born with Samsung Techwin (formerly Samsung Aerospace), Daewoo Heavy Machinery and Hyundai Motors (the successor to Hyundai Space and Aircraft) holding 28 percent each of its shares. The banks hold the remaining equity. The aerospace division of Korean Air opted not to join. KAI has set a US \$1.5-billion revenue goal by 2005. It expects 53 percent of its work to come from fixed wing aircraft, 30 percent from helicopters and the rest from aerostructures, space systems and other programs. The long-term view is that about 60 percent of its revenue will be military based.

⁴⁸ Cho, note 41, p.18.

4.2 KAI's Challenges

Technical Aspect

Airframe design capability shows latent potential for advancement as do other areas of manufacturing techniques. At the same time, severe deficiencies have been pointed out in the areas of parts production technology, in specific areas such as surface treatment, heat treatment, and basic materials, all of which are closely tied to the local machine and machine tool industry. Also, it is recognized that the level of know-how related to system integration design, as well as test and evaluation, is low. These are acute deficiencies in our efforts at aircraft development. There are also similar relative weaknesses in avionics and flight control due to insufficient local R&D in these areas.

Organizational Aspect

Coordination between various government organizations, segments of industry and academia related to the aircraft industry is crucial. In this area, government-sponsored research organizations should work closely with their counterparts in the private sector, bringing together expertise in R&D from the public sector and production processes from the private sector.

Because of the diffuse nature of the government organizations, it is difficult to assess the efficacy of individual agencies working in conjunction with each other. For instances, budgetary matters are under the Ministry of Finance and Economy, manufacturing is under the Ministry of Trade, Industry and Economy, military procurement under the Ministry of Defense, commercial aircraft production under the Ministry of Construction and Transportation. The simultaneous involvement of all of these elements increases the probability of unnecessary complexity and highlights the necessity of close cooperation between these government departments. This diffuse involvement by the government can also be an obstacle, hampering efficient allocation of limited capital and human resources.

MoD and MOCIE believed that rivalry was a critical factor for innovation. However, DHI argued that the KTX-2 program should have been carried out by the same company as the KTX-1 in order to make use of and develop the accumulated technology from the KTX-1 development. This sort of decision-making has often been seen in the Korean defense procurement, mainly

From KXT-1 to
KXT-2

based on the relations between the Blue House (Presidential Office) and the conglomerates.⁴⁹

Need for International Cooperation

One difficulty with the efforts to develop an independent aircraft capability has been the need to engage in extensive R&D at high costs and at the same time to rely on subsequent demand to offset these costs. Relying solely on domestic demand is not feasible since domestic demand will never be high enough for production on a scope that would allow production to take advantage of economies of scale. Therefore, one imperative has been to engage in joint cooperative efforts both in R&D and in increasing demand. A recent tendency in the global aircraft industry has been the growth of civil-military dual use technology, reflecting the overall reduction of demand in the military sector. Mergers and acquisition (M&A) or construction of international cooperative consortia are being actively formed to share the burden of risks and to broaden the scope of target markets. Nonetheless, KAI has missed a change to bring Foreign Direct Investors (FDIs) to their business.

4.3 KAI's Businesses

4.3.1 T-50 Golden Eagle (previously KTX-2)

As the prime contractor for the T-50, KAI is responsible for system integration and manufacturing. The trainer will be assembled and delivered at KAI's Aircraft plant in Sachon, Korea.⁵⁰ In partnership with KAI for the development of T-50,⁵¹

⁴⁹ When it came to the final decision on KDX (next-generation submarine project), Daewoo had to suffer from the latecomer, Hyundai, mainly because the chairman of Daewoo was no longer as influential as before, partly because Hyundai's relations with the Blue House looked much better than those of Daewoo in terms of political affinities.

⁵⁰ Samsung's former plant is the KAI's development and production centre. Sitting on a square mile of land with room for expansion, it abuts the air force's 3rd Air Training Command (basic training) air base and employs nearly 1,900 workers. Its facilities include an avionics lab, a research and development center, a component fabrication shop, a hush house that holds engine test noise level to 55 dB, and a major final assembly building, large enough to run parallel F-16 and T-50 lines, with room to spare for SB427 helicopter production. The original KFP order has been completed, and Sachon is largely occupied with a supplemental order that runs to 2004 for 20 additional fighters.

LM Aero is providing technical assistance, the operational flight program for avionics and flight control, and the manufacture of the wing. The T-50 program is currently in full-scale development.⁵²

Under a partnership arrangement, KAI and LM Aero have jointly invested in the T-50, making it the only advanced supersonic trainer currently in development. The T-50 is designed as an advanced trainer for fighter pilots selected to fly world's 4th and 5th generation fighter aircraft. It is a highest efficiency training system because it provides trainee pilots rapid transition to a modern fighter environment, utilizing the latest advancement in aviation technology. T-50 can also function as a Light Combat Aircraft for the defense of national borders.

Export Feasibility

There is a very real problem emerging in the fighter community today. The aircraft currently used to train fighter pilots started production in the 1950s and 1960s and are approaching the limit of their service life. Age and attrition as well as widening gaps between past and current technologies are creating concern in many fighter communities around the world.

The T-50 may have a technical edge over its competition, but it faces a lot of it. Besides BAE Systems' Hawk 200, the competitors include Aero Vodochody's L-159, the MiG-AT, EADS' proposed Mako and the Yak-130.

KAI and Lockheed Martin have had their eyes on the T-50, replacing some 509 US Air Force T-38A/Bs. But that 40-year-old design is undergoing an engine and avionics upgrade and may receive new wings to keep it flying to 2020. In the meantime, another gloomy picture comes from India's decision that it would purchase 66 Hawk trainers of BAE Systems for an estimated US \$1.5 billion to replace its trainer fleet of Kirans and Iskras.⁵³

⁵¹ In profile, the T-50 looks much like an 80 percent scale model of the F-16. There is one noticeable difference, however. The T-50 uses a bifurcated engine inlet instead of the F-16's single gage. The aircraft's components and systems have been based on as much off-the-self technology as possible, assuming that such a shelf is for fourth and fifth-generation fighters. Despite its F-16 pedigree, Lockheed Martin's Fort Worth team has used the latest manufacturing technologies, such as the robotic drilling techniques it developed for the JSF.

⁵² T-50/A-50 Golden Eagle, <http://www.koreaaero.com>.

⁵³ Aviation Week & Space Technology, 12 August 2002, p. 34.

The successful maiden flight of the T-50 Golden Eagle on 20 August 2002 signifies the advancement of Korea's aerospace industry, which will enable the company to design and produce supersonic level aircraft. The successful flight is being viewed as a stepping stone in Korea's attempt to produce its own fighter jet by the year 2015.⁵⁴

During its maiden flight, which lasted around 40 minutes, the T-50 successfully completed all phases of its flight program, which included navigation, take-off, flight, and landing. The trainer uses a General Electronic's F404-GE-102 engine, which has earned high marks for its durability and stability. The T-50 is scheduled to go into mass production and delivery by 2005. The trainer is expected to play an integral part in allowing Korea to become active in the aerospace export market. Currently, most of the trainers used around the world are old and outdated, and have forced many nations to look for replacement models.

Therefore, KAI believes that there is a very promising export opportunity. In reality, according to a research done by KAI and Lockheed Martin, the market demand for an advanced trainer is estimated to be at about 1,200 planes. The market for a light fighter using the advanced trainer as its model is estimated at 2,100 planes, bringing the total demand to about 3,300 planes. The aerospace industry predicts that 350 T-50 trainers and 450 A-50 light fighters will be in demand internationally. Thus, the industry expects to sell about 800 planes, grab 25 percent of the market, and reach total sales in the amount of US \$30 billion. The T-50 advanced trainer will play a key role in developing high quality labor, and also induce the participation of domestic firms, which will result in the creation of new employment opportunities while seeking more business opportunities.

The T-50 Golden Eagle demonstrated supersonic flight on 18 February 2003. Mach 1.05 was achieved at 40,000 ft; the T-50 Golden Eagle is also showing great stability at slow speeds with a low angle of attack. The KAI/LMAC marketing team will play heavily on the aircraft's supersonic capabilities as they offer it for export sales in a crowded field.⁵⁵

4.3.2 The KT-1 basic trainer

By late October, Daewoo had delivered 28 of the 85 that the service has ordered. The KT-1 also qualifies as the country's first

⁵⁴ <http://www.mnd.go.kr> 24 August 2002.

⁵⁵ *Aviation Week & Space Technology*, 24 February 2003, p. 24.

KAI's achievements

export aircraft. KAI won a US \$60 million contract in January to supply seven KT-1s to Indonesia and will make its first delivery in January 2003. The maintainability of the KT-1 was highly praised by the experienced Korean Air Force maintenance teams. The KTX-1 Operational Flight Test and Evaluation Program was successfully completed at the end of 1998 and followed by standardization and approval for production.

The first delivery of the KT-1 to the Korean Air Force was accomplished in late 2000. The Korean Aerospace Industries Ltd. is contracted to export the KT-1 to the Indonesian Air Force in 2001. KT-1 Upgrade Program (the XKO-1 Program) - The XKO-1 program upgrades the KT-1 with advanced avionics and armament systems to replace the aging O-2 aircraft. This program is led by the Agency for Defense Development. The key avionics system is the integrated mission and display computer designed by ADD. The XKO-1 will be equipped with a store management system and improved avionics to accommodate external fuel tanks and armament capabilities to carry out close air support missions. Since its design conception, Colombia, Mexico, Turkey and other states have showed interest in the XKO-1 program by inviting proposals.

Through the KTX-1 and ongoing XKO-1 programs, ADD has gained expertise in armament system integration, key avionics components design and development, software development, and test/evaluation. The goal of ADD is to design and develop fighter aircraft to replace the F-16s in 2010.⁵⁶

KAI has recruited Canada's CMC Electronics as its partner in the development of an enhanced avionics suite for a proposed export version of the KT-1 basic trainer. The variant is aimed at counter-insurgency operations (COIN) and armed training.⁵⁷ KAI has already delivered 55 Pratt and Whitney Canada(P &WC) PT6A-powered KT-1 trainers to the South Korean Air Force.

⁵⁶ Characteristics and missions of KT-1: The KT-1 is the first aircraft developed using full application of CAD for an aircraft of its class. The design implementation complies with category Class IV of the US military specification and the acrobatic category of FAR/JAR Part 23. The aircraft is powered by a single turboprop engine. The aircraft is capable of formation flight, night flying, instrumented low/medium altitude navigation, and acrobatic maneuvers. See ADD website <http://www.add.re.kr>.

⁵⁷ Flight International, 28 January-3 February 2003, p. 15.

4.3.3 Others

The SB427 eight-place utility helicopter

A joint venture with Bell Helicopter, it is seen as a replacement for MD-500-class commercial helicopters. It is powered by twin P & W 207D engines, which helped KAI win its first order for ten SB427s from China, where they will be used as air ambulances and fire fighters. China wanted twin engines as a safety factor for flights over urban areas.

KMH

The South Korean army's requirement for a 15,000-ib-class utility/attack helicopters is in feasibility study. Called the KMH, the program has drawn interest from Boeing with the AH-64D, Bell with the AN-1Z or a tiltrotor application, and Rosoboronexport/Kamov with the Ka-52K. The winner is expected to provide about a 50 percent offset level. Program development is to get underway next year and will extend to approximately 2010. A potential production run of 350 utility aircraft and another 150 configured for attack is anticipated.

Skylander

Co-production programs have increasingly drawn the attention of European manufacturers. The French engineering group Geci International has received an investment pledge from KAI for the Skylander turboprop. KAI agreed to invest US \$30 million in the Skylander program⁵⁸. KAI will build the aircraft's wings.

⁵⁸ Geci International, a French engineering group, has launched a utility twin turboprop called Skylander. Powered by 1,100 –shp. Pratt and Whitney Canada PT6A-65Bs, the unpressurized Skylander will carry up to 19 passengers or 3 metric tons of freight. A maritime patrol version also is being planned. An optimistic market forecast predicts that 4,500 Skylander-category aircraft could be needed by commercial and military operators over the next 20 years. The aircraft's price tag is currently estimated at US \$3.5 million.

Figure 5: Korean aerospace plans and programs, 2002

Fixed Wing	<ul style="list-style-type: none"> 1) Additional Korea Fighter Program (F-16) <ul style="list-style-type: none"> a) Period: from 2000 b) Licensed by Lockheed Martin 2) Korean Basic Trainer (KT-1) <ul style="list-style-type: none"> a) Period: from 1999 b) Self Development Project c) Directed by Government d) Headed by Korea Aerospace Industry, Ltd. 3) Korean Advanced Jet Trainer (KTX II) <ul style="list-style-type: none"> a) Period: from 1992 b) Co-Development with Lockheed Martin
Rotary Wing	<ul style="list-style-type: none"> 1) Korea Light Helicopter Program (KLH) <ul style="list-style-type: none"> a) Period: from 1999 b) Directed by Government c) Co-Development: KAI/Eurocopter 2) SB427 Program <ul style="list-style-type: none"> a) Period: from 1995 b) Size of Project: 1,200 Helicopters c) Co-Development: KAI/Bell Helicopter
Others	<ul style="list-style-type: none"> 1) Aerospace Engines <ul style="list-style-type: none"> a) F100 (F-16) b) PT6A-62 (KTX-1) c) F404 (KTX-2) 2) Overhaul, Repair and Modification
Satellite	<ul style="list-style-type: none"> 1) Korean Multi-Purpose Satellite Program <ul style="list-style-type: none"> a) Period: from 1994 to 2013 b) Mission: Science, Ocean Color Monitoring, Communication, etc. c) Technology Co-operation with Foreign Company: TRW (KOMPST1) d) Launch: October. 1999 <p>From 2000 to 2003: Development of KOMSAT2 Future Plant From 2004 to 2007: Development of KOMSAT3 From 2008 to 2013: Development of KOMSAT4</p> <ul style="list-style-type: none"> 2) KOREASAT #4 Program <ul style="list-style-type: none"> a) Period: from 2000 to 2005 b) Mission: Development of KOREASAT4 c) Prime Contractor: Lockheed Martin
Future Plan	<ul style="list-style-type: none"> Development of KOREASAT 5 from 2006 to 2012

Source: Author's files

5. An Analysis of F-X Project

5.1 Background

The mid-term five-year (2001-2005) defense planning of the Korean armed forces puts more emphasis on modernizing military equipment, with a 9.4 percent increase in the defense procurement budget. According to a senior defense official, defense planning is more aimed at catching up with the armament level of neighboring countries in consideration of the post reunification period than the current strategy of deterring North Korea's invasion. One of the procurement objectives is the next-generation fighter (F-X) program:

- Number of Fighters: initial order 40, plus option of 40
- Estimated Cost: US \$4 billion
- Initial delivery date: 2005

Importance to the Korean Air Force

Requirement aircraft capable of fulfilling air superiority and deep strike missions to replace the Air Force's F-4D/Es (McDonnell Douglas Phantoms). Choosing the right aircraft is the nucleus of the air force's upgrade designed to turn the Republic of Korea into a regional power within 20 years, with a view to holding its own on the geopolitical scene after any reunification with the North.

To protect Korean national interest and resources from potential conflicts with neighboring countries, quick-reaction forces that are capable of exercising all types of air operations in the Korean Air Defense Identification Zone (KADIZ) are also required. This does not imply that the Korean Air Force must become a 'superpower'. Quick reaction, precision engagement, and extended combat range are the core capabilities to be achieved. The size of high quality weapons systems will be small enough so that neighboring countries may not consider them a threat against their vital national interest. Undoubtedly, the advanced fighter (F-X) is the key element to satisfy the above requirements.⁵⁹

Objectives

⁵⁹ Interview with KORAF officials.

Figure 6: Key Dates of F-X Program

Date	Program
November 1997	Announcement of the Program: 120 Fighter
May 1998	Selection of Four Candidates: <ul style="list-style-type: none">● Boeing's F-15K● Dassault's Rafale● Eurofighter Typhoon of European Consortium● Rosvoorouzhnie' Su-35
March 1999	Scaling down the number to 40 Fighter
September 1999	Forming the Evaluation Team
August – December 2000	Evaluation and Test flights by the Korean Air Force
December 2001	Announcement of New Evaluation Criteria and Marking Method
27 March 2002	Selection of Last Two Bidders: Boeing and Dassault
18 April 2002	Final Decision to F-15K
28 May 2002	Approval of President Kim Dae Jung

Source: Author's files

As a matter of fact, Korean aerospace industry was pushing the Ministry of Defense to secure the best licensed production deal and significant technology transfer in the F-X program, while the Republic of Korea Air Force wanted the aircraft best suited to its operational requirements. The Air Force was skeptical of the benefits of local assembly, if this pushed up acquisition costs.

There are four variables that will be considered in making a final decision on the F-X project: price, performance, technology transfer, and political factors. The main concern of non-American candidates was the political factor that the United States was in a better position to exert influence over high-ranking Korean officials to purchase F-15K. Price is always flexible and negotiable, since there is no fixed price tag for fighter aircraft. This is because the final winner can benefit from at least a 30-year guaranteed production line. Therefore, in the world fighter market, the offset commitments are as important as price-fixing for the product itself.⁶⁰

⁶⁰ Cho, note 41, pp. 22.

5.2 A Comparative Analysis on Marketing Strategies of Four Bidders.

5.2.1 Boeing

Boeing lauds the F-15's battle record (100.5 kills against zero losses), and technology upgrades, bringing the F-15K up to speed with fourth-generation fighters. Boeing is offering the APG-63 radar with an active electronically scanned array. It means that the Koreans would obtain a more advanced radar than the US Air Force operates on its F-15Es. The offer is seen as a tempting one, since it can give the Korean Air Force a sense of air superiority over the F-15J/DJs of Japan's Air Force.

F-15 offer for
F-X

The US State Department has approved Boeing's offer to Korea of one of its most sophisticated air-launched cruise missiles in a bid to entice Seoul to buy the F-15K. According to a 13 August 2001 statement from Boeing, it would provide the Standoff Land Attack Missile Expanded Responses (SLAM-ER). Douglas J. Kennet, vice president of communications and community relations for Boeing, said that Korea could become the first non-US SLAM-ER customer.⁶¹ In fact, however, Australia had been offered the missile, but it did not choose to buy it.

"SLAM-ER is an excellent weapon that provides long-range strike capability around the clock in virtually any weather. It would add even more modern combat power to the F-15K," said Mike Marks, Boeing vice president and general manager for Bomber and Weapons Programs. Experts say that the offer must be viewed as a bid to sway the Koreans towards selecting the F-15K on the consideration that this weapon system has the capability to carry the missile.

The F-15 assembly line in St. Louis would die if the Seoul deal were lost. This clearly indicates that the production of F-15 has reached a stage of retirement. Andy Lewis, executive vice president of *Eurofighter International*, argued that the Korean order of F-15s and some follow-up orders would allow Boeing to keep its production lines open until the American plane maker can start production of the next-generation Joint Strike Fighter (JSF). However, Boeing lost the JSF project to Lockheed Martin.

⁶¹ Korean Air Force asked Boeing to include the SLAM-ER into the weapons systems. The offer is a result of Korean Air Force demand, not a spontaneous offer from the US. Interview with Colonel Cho Ju-Hyung.

Therefore, the Korean contract became even more crucial for the survival of Boeing's defense business.

The letter of 56 Congressmen to Defense Secretary Rumsfeld, dated 2 March 2000, urged the Pentagon to give the go-ahead for the initial production of the F-22. However, the letter played a negative role in selling the F-15K to Korea. In the letter, it was said that the F-15 was a rapidly aging fighter, and that therefore the production of the F-22 should be accelerated in order to put them into service by 2005. Thus, the letter was viewed negatively by Korea, as if the last ditch effort for marketing the F-15K was a closing-down sale with a normal price tag.

US politics

General Richard Hawley, commander of the Air Combat Command (ACC) said that an aircraft of the F-15 class would not be able to penetrate deeply into sophisticated enemy integrated air defense environments populated with air-to-air and surface-to-air weapons. The F-15 will not be able to operate effectively against upcoming threats such as the Eurofighter and Rafale and upgraded versions of the Sukhoi Su-27.

Also according to Brigadier General Daniel Leaf, Air Staff Director of Operational Requirements, the F-15 is the undefeated heavyweight champion of air superiority. Even so, it is still a 1970s-designed airplane, updated to the maximum. Thus, it is necessary to build a new airplane, like the F-22. Likewise, the F-22 is needed to replace the F-15. There is no service life extension program for the F-15. In addition, the F-15 could not simply operate past 2010 in the US Air Force. However, Skip Bennet, director of Boeing's Korea program said the US Air Force plans to keep the F-15 for another 20 or 30 years, noting that there is no immediate prospect of Boeing closing the F-15 production lines. The E model of F-15 started flying and went operational in 1988, he added.

Interoperability Issue

The United States said that it would not help integrate US weapons and cryptographic systems, should Korea buy non-US aircraft in its US \$4 billion next-generation fighter program. In a report by the Defense Ministry to Rep. Kang Chang Sung of the opposition Grand National Party (GNP) for parliamentary inspection, the ministry said it had received a letter dated 25 May from the US Defense Security Cooperation Agency (DSCA) to that effect. This could make it harder for Seoul to choose aircraft other than the US F-15K, since integration is indispensable for enabling fighters to distinguish friends from foes and communicate with each other.

At this time, "it is not possible respond positively to your request for Letters of Offer and Acceptance (LOAs) for the integration of various US weapon systems on the Eurofighter-Typhoon, Rafale, or Su-35 fighter aircraft," was the response of Edward W. Ross, director for Middle East, Asia and North Africa at the DSCA, to a ROK Air Force inquiry via the Korean Embassy in Washington.

In the letter, Ross affirmed that before he could approve any LOA for munitions, integration, or support packages for the Rafale or Eurofighter Typhoon, it would be necessary to address the full range of technology transfer and release issues on a weapon-by-weapon, platform-to-platform basis. "This would be a lengthy process and in the end it is not possible to foresee which, if any, weapons might be approved," the DSCA director said.

Paul Wolfowitz, US Deputy Secretary of Defense, also answered negatively to an inquiry by the Republican Congressman J. D. Hayworth of Arizona on the potential integration of the US-made AIM-120 advanced medium air-to-air missiles (AMRAAM) with the French Rafale for potential sale in Korea.

"We have no plans to authorize the AMRAAM to be offered or integrated with the French Rafale, or any other competitor, to meet South Korean fighter aircraft requirements," Wolfowitz said in a reply to the US Congressman. On the other hand, US Department of Defense officials say the speculation has been overblown, noting that Raytheon has received the requisite licenses to integrate AMRAAM, which the ROK already uses on its F-16 aircraft and on the Typhoon. The officials added that the DoD did not form an opinion on whether AMRAAMs could be integrated on the Rafale because of a lack of information and because no such request has been made. However, the French Dassault claimed that Rafale could meet NATO standards so that it was possible to make the Rafale interoperable with US weapon systems.

US pressure to buy from Boeing was an unsettling reminder of South Korea's junior-partner status to the United States. The effort began in spring 2000, when George W. Bush pushed for a Boeing purchase in his meetings with Kim Dae Jung. After that, Boeing sent a delegation to Seoul that included several key members of Missouri's congressional delegation, including Senator Christopher Bond, a Republican, and Richard Gephardt, a Democrat who represents the city of St Louis.

The pressure went up a notch in October 2001 when Boeing lost a huge US \$200 billion contract for the US Joint Strike Fighter to its largest rival, Lockheed Martin. A few weeks later,

US pressure

Bond warned that very unfortunate things could happen to US-Korean relations if Seoul decided against buying Boeing's F-15 Eagle.⁶²

5.2.2 Dassault

Rafale offer for F-X

The first production of Rafale began in 1998, and it has already begun to be used by the French Air Force and Navy. Dassault played up its willingness to transfer all the technology its aircraft has. It is offering Korea very favorable production and cost terms. It is willing to provide Scalp EG air-to-ground cruise missile developed by Matra BAe Dynamics. France has every reason to be forthcoming because it has only received orders from its own forces, thus the Korean contract was pivotal for the recovery of its development and production costs.

Figure 7: Features of Rafale

Strength	Weaknesses
Lowest life cycle cost amongst contenders: smallest required number of operating one wing (20 aircraft) is 60 technicians.	Small number of production order: 294
Better survivability because of lower-altitude flight capability than the F-15.	Poor sales record of TGV
No battle-proven fighter, but manufactured as an advanced version of Mirage, a combat-proven fighter. Accumulated marketing know-how in various markets.	Taiwanese legal action concerning bribery for the sale of six French Lafayette-class frigates

Source: Author's file

The fighter was reported to have earned good reviews from Korean pilots who had test flown the aircraft as a means to evaluate whether it meets Air Force operational requirements. Korean Air Force pilots regarded the Rafale as a highly maneuverable piece of hardware, making it a pilot's dream.

5.2.3 Rosoboronexport

The first Su-35 was manufactured in 1986 and the Russian Air Force ordered 12 Su-35s, although the pace of development has

⁶² *Asia Times*, 16 July 2002.

been slow. Despite the tight domestic market, in 2000 Sukhoi boosted its order backlog, mainly thanks to the contract for license production of the Su-30MKK in India, and an additional Chinese order for combat trainers.

For the sake of marketing, the Russian export agency put more emphasis on the advanced maneuverability and possibility of technology transfer. Russia says that the Su-35 aircraft is not only economical but possesses phenomenal power and agility.

An official from the Korean Ministry of Defense commented on the Russian proposal that marketing had not been very professional. Also, there were concerns with the stability of supply and after-sales services from Russia.

Sukhoi offer for
F-X

5.2.4 European Consortium

Eurofighter International makes the order book of 710 Typhoons a marketing point. It is the most modern fighter amongst the four candidates for the F-X project. With regard to its first production, Eurofighter Typhoon is one generation younger than the F-15, produced in 1972. As the marketing team asserts, Eurofighter is at the beginning of its life, whereas the F-15 is at the end of its life. It committed itself to supplying an armament package comprising the Matra Bae Dynamics ASRAAM, Meteor and Storm Shadow, air-to-ground missile with a range of 600km.

Eurofighter International has offered Korea a partnership in a consortium which could give it many opportunities to become involved in the future development of the aircraft. Korea would also be provided with an instrumented production aircraft to assist with the integration of its preferred weapons. Eurofighter pointed out that there were advantages in joining a program such as Typhoon before it has fully completed its development – indeed, scope exists for Korea to tweak the specification of the Tranche 2 aircraft (the variant it would have to procure, given it requires F-X to enter service in 2004/5) to precisely match its needs at relatively little delta cost.

BAE's new flexible Typhoon final assembly line at Warton was viewed by Eurofighter as an optimal element of the Typhoon export package. Since the jigs and tools of the Warton line are limited in number and the core capability is vested in CAD/CAM software and laser alignment technology, the system would be flexible enough to perform assembly of other aircraft in Korea in due course.

During the competition period, the Eurofighter team has shown organizational weakness, because of the ownership shift after the creation of EADS and EMAC, there is uncertain future of the Eurofighter marketing arm, *Eurofighter International*. It

Eurofighter offer
for F-X

undermines the coherent marketing of Eurofighter Typhoon. EADS is throwing its weight behind the Eurofighter Typhoon in key export battles which pitch the aircraft directly against the Dassault Rafale. The European aerospace giant inherited a 46 percent workshare in Eurofighter from its German and Spanish merger partners, while the French side contributed former Aerospatiale's 46 percent stake in Dassault.

The Eurofighter had also offered extensive technological transfers and assistance on depot-level maintenance. Eurofighter was the only one of the four contestants not to be pushing an indigenous final assembly deal, choosing instead to increase its offset commitment to 100 percent if Korea selected the Typhoon.

The selection of Eurofighter might have given Korea the increased linkage by its partner companies, BAE Systems and EADS. Both companies are shareholders in the Airbus Integrated Company that has secured enough orders for manufacturing A380. EADS and BAE offered the Korean industry advanced manufacturing technology for aerospace equipment – technology that could help Korean industry to win high-volume aero-structure work on programs like the A380 airliner as well as the Typhoon.

With regard to the prospect of reunification, the Eurofighter Typhoon was recommendable. The reason is that the unified Korean Air Force ought to integrate the North Korean Air Force into its systems by making the 15 North Korean MiG-29s interoperable with the united Air Force, as united Germany did to the 24 MiG-29s of the former East Germany with help of MiG Aircraft Product Support International (MAPS) - run by DASA, VPK MAPO and Rosvoorouzhenie. Since DASA is one of the consortium members of the Eurofighter, and belongs to EADS, Korea will benefit from its access to DASA when it needs expertise in handling the North Korean MiG-29s.

In addition, choosing the Eurofighter Typhoon might mean that Korea could make more friends in the post-Cold War period. In addition to its partnership with the US, it would ensure sound multilateralism, which provides a more flexible platform for Korea's foreign policy-making, because the four countries of the European consortium are also major member states of the European Union (EU), which is increasingly playing a crucial role in international affairs.

Nonetheless, Marino Barrea, campaign director of Eurofighter International, has said that it is regrettable that the fighter project is seen as a two-way competition between Dassault

and Boeing, adding that such a situation is a result of fierce lobbying and promotion campaign.⁶³

5.3 Final Decision

5.3.1 Offset Programs

Offset programs are a unique feature of foreign procurement practices and have been an effective means to obtain the transfer of technology from abroad. Korean research institutes as well as industry have benefited from these programs and have been able to gain wider access to advanced technologies through them. The Ministry of Defense has encouraged the use of offsets in purchase of foreign military equipment since 1983. For example, in the case of KF-16, the offsets related to the production of forward fuselage contributed to enhancing the manufacturing technologies. From an operational standpoint, purchasing technologically proven weapon systems is preferred to opting for domestic licensed production or complete domestic development.⁶⁴

Major offset offers

A senior Boeing official said that Boeing would guarantee the development of an indigenous fighter by 2015 if Seoul selected its F-15K for the F-X fighter acquisition project. In connection with the indigenous fighter program, Boeing offered 29 technology transfer projects in four key areas, including fighter development; requirements definition and analysis; airframe, avionics and armament systems design; and testing, evaluation, operations and support. Doug Kennett, vice president of Boeing's communications and community relations, said: "We are committed to working with Korea, as it develops its indigenous fighter."⁶⁵ The world's largest defense firm also unveiled an offset program worth US \$2.8 billion in return for being rewarded the F-X project.

To compete with Boeing's proposed offer worth US \$2.8 billion for industrial and technology transfer, Dassault Aviation offered nearly US \$4 billion in contracts and technology for more than 10 years to win South Korea's next-generation fighter jet

⁶³ *Korea Herald*, 21 March 2002.

⁶⁴ Cho, Tae-Hwan, "Challenges in Research and Development for the Korean Aircraft Industry," in Crawford, Natalie, and Moon, Chung-in (eds.), *Emerging Threats, Force Structures, and the Role of Air Power in Korea*, Project Air Force, RAND, 2000, p. 337.

⁶⁵ *The Korea Times*, 12 October 2001.

acquisition project.⁶⁶ The offer was close to a total amount of US \$4 billion. It exceeds 70 percent of the total cost of the F-X program. The offset program includes over 100 projects and spans over more than ten years. Dassault would provide contracts to Korean Aerospace Industries Ltd. (KAI) to manufacture large sections of its aircraft not only for Korea, but also for France and other customers in the future.⁶⁷

In the meantime, William H. Lawler, Boeing vice president of strategic operations and planning, said the offset program was part of a "grand project to establish a partnership between Boeing and the Korean aerospace industry." He continued that, "in the mid-term, the company is committed to help South Korea tap new markets and increase its business base. The plan includes cooperation in engineering services, aircraft modernization programs, spare parts production, training and additional technology transfer" In the long-term, Lawler said, "Boeing will deliver technology transfer projects that support the development of new aircraft programs, including the indigenous fighter by 2015." ⁶⁸

5.3.2 Announcement of the F-X Winner

On 27 March 2002, the Ministry of Defense narrowed the number of contenders down to two, Boeing and Dassault, while dropping the Eurofighter Typhoon of a four-nation European consortium and the Sukhoi Su-35 of Russia's Rosoboronexport from the competition.

Although Dassault's Rafale beat the F-15K by a slim margin of 1.15 percent in the first round of the competition, a second round was supposed to take place because the margin was less than 3 percent, a requirement which had not been clear to all the competitors beforehand. In the second round meeting, the MoD examined non-technical policy factors, including defense, diplomatic and trade partnerships, while excluding all the criteria of the first phase of evaluation, which were price, combat

⁶⁶ *Korea Herald*, 6 December 2001.

⁶⁷ Robins, Yves Robins, "Offsets, Industrial, and Technological Benefits in the Context of the FX Program- Strategic Alliance for the Korean Aerospace Industry: a Dassault Aviation View," The 4th Air Power Forum, Yonsei University, 5 December 2001.

⁶⁸ Lawler, William, "Offsets, Industrial, and Technological Benefits in the Context of the FX Program - An American Prospective and Industry Development Plan," The 4th Air Power Forum, Yonsei University, 5 December 2001.

US winner

capability and technology transfer.⁶⁹ The criteria looked undoubtedly favorable to Boeing in light of the military alliance between South Korea and the United States, which has maintained a military presence of 37,000 US soldiers. If differences between the best candidate and the runner-up in the first stage turn out to be within three percentage points, the ministry will enter a second stage of appraisal that will take into account political and strategic factors such as national security, international relations and export potential, officials said.

The ministry said it would give top priority in the second stage of evaluation to Seoul's military alliance with the United States, drawing criticism that its guidelines are biased in favour of the American Boeing.

Figure 8 Outcome of 2nd Round FX Evaluation

Item	Details	F-15K	Rafale
Effects to National Security	Joint Operation	Excellent	Poor
	Military Cooperation	Excellent	Good
Effects to International Relations	North Korea	Excellent	Excellent
	International cooperation	Excellent	Excellent
Effects to International Market		Excellent	Excellent
Market Potential		Excellent	Excellent
	Trade	Excellent	Average
	Trade Balance	Excellent	Good
Final Verdict		Excellent	Good

Source: Author's file

In the end, as expected, on 18 April 2002, Korea selected Boeing's twin-engine F-15K, an advanced version of the F-15E, General Electric became the winner of a US \$350 million jet

⁶⁹ Dassault asked a South Korean court to prevent the Korean government awarding the fighter jet contract to Boeing, claiming that there has been no transparency or fairness in the selection and that the procedure had been changed at every stage of the evaluation process. *Financial Times*, 4 April 2002.

engine deal over its rival Pratt and Whitney.⁷⁰ In the meantime, the Republic of Korea's Ministry of Defense cited the F-15K's strengths as its multirole performance, payload-carrying ability, combat radius, engine performance, survivability, proven performance, software maintenance and upgrade capabilities, and the fact that 15 new technologies will be applied to the aircraft.⁷¹ It is stressed that the US Air Force will maintain sizeable numbers of F-15 in the inventory beyond 2030, guaranteeing Korean allies a steady support base for their F-15K fleet. Boeing has built more than 1,500 of the various models of the F-15 since 1974, including more than 230 US Air Force F-15Es.

The Republic of Korea joins Japan, Saudi Arabia and Israel as key US allies equipped with the F-15 warplane.⁷² Korea will buy 40 F-15Ks from Boeing with deliveries expected to begin in 2005.

In the provisional contract, Boeing said that it would deliver two F-15K jets in 2005, 10 in 2006, 16 in 2007 and 12 in 2008, according to sources.⁷³

5.3.3 Price Re-negotiation

Boeing has offered to lower the price of 40 F-15K fighter jets by as much as US \$170 million in the final contract with South Korea.⁷⁴ The offer is largely intended to mollify critics of the controversial F-X project, in the wake of the government's decision to choose the US company, despite the lower price and better offset package offered by the French aircraft maker Dassault Aviation SA. "In price negotiations, Boeing proposed to lower the price from US \$4.46 billion to about US \$4.29 billion," a senior defense official said on the condition of anonymity. "But we will continue to negotiate discounts with Boeing officials in order to cut the price by more than US \$200 million by the end of this month". Boeing came under fire for raising its bidding price to US \$4.46 billion this year from last year's proposal price of US \$4.2 billion without readjusting the proportion of the offset package.⁷⁵

⁷⁰ *Korea Times*, 18 April 2002.

⁷¹ St. Louis Business and Technology, 19 April 2002.

⁷² *Ibid.*

⁷³ Korean Information Service, 19 April 2002.

⁷⁴ Author's interviews.

⁷⁵ Because of this price increase, Colonel Cho Ju-Hyung became so upset that he decided to reveal the behind-the-scenes story of the F-X deal to the media, alleging that the selection process was rigged in favor

In a bid to jumpstart the ailing local aerospace industry, South Korea set the package of technology transfer and local work at 70 percent of the bidding price. In a February provisional contract with the Defense Ministry, Dassault, which was eliminated in the final round of competition, proposed to build a fleet of 40 fighter jets at the cost of US \$4.27 billion. Its offset program reportedly exceeded 70 percent of the bidding price. Wary of mounting public criticism, however, Boeing has been enthusiastic about offering better terms for the contract in the process of re-negotiations with the Defense Ministry, according to defense sources.⁷⁶ In an effort to ease public concern about continued parts supply, the Defense Ministry demanded that the supply of replacement parts be covered by the US government-guaranteed Foreign Military Sales program.⁷⁷

5.3.4 Concluding Remarks

The final decision, based on political and diplomatic factors as it was, rather than on technical or economic considerations, does not bode well for Korean aircraft industry's self-reliant defense capability. It will also play a negative role in future defense contracting, since Dassault Aviation, one of the leading aerospace companies, has lost its confidence in the Korean defense market.

Furthermore, the final decision has invited furious internal recriminations and suspicion that South Korea, once again, had succumbed to US pressure to buy US weapons. These suspicions are not only internal to the military, in particular the Korean Air Force, but also reflect the public opinion. The general public is tired of the long-time US dependence and disappointed by the Bush administration's having labeled North Korea as part of the 'axis of evil'. Many idealists believed that the F-X project was a decisive opportunity to have a more independent posture than the existing US defense supply line.

On the other hand, realists see the Korean national security as having been consolidated by choosing the F-15K. In other words, US presence on the Korean soil is so important that it is worth securing it through buying American weapons systems.

Does this mean that South Korea missed an opportunity to join forces with a European company as a result of the political

of Boeing. Colonel Cho was sentenced to three years of imprisonment on charge of bribery and disclosing classified military information.

⁷⁶ *Korea Times*, 12 May 2002.

⁷⁷ *Korea Times*, 13 May 2002.

establishment's 'Real Politik', or did the US government, Senate and other defense-related lobbies exerted such a pressure that South Korean government had no chance to avoid the deal? It seems that under current political circumstances on the Korean peninsula, 'Real Politik', combined with the excessive US squeeze leave no choice to the South Korean government but to buy American-built aircraft. For how long is this situation likely to continue? For the time being, the future remains uncertain but if the Europeans wish to win next time they must be more politically and economically active in South Korea in particular and on the Korean peninsula in general.

6 Conclusion - Prospects and Policy Recommendation

The history of Korea's aircraft industry began after the Korean War. At that time, the industry was engaged in depot-level maintenance of US-made aircraft. After 1960s, the Korean aircraft industry showed incremental improvement of depot-level maintenance capability. The turning point was the Korean government's policy of Heavy and Chemical Industry Development Plan, which targeted strategic industries including the aircraft industry. Since then, the aircraft industry started domestic production instead of direct purchase from abroad. The four Korean conglomerates had been involved in the aircraft business until October 1999, when the Korean government instructed the companies to merge into a single entity, Korean Aerospace Industries Ltd.

Although Korea is a latecomer in the aircraft-manufacturing sector, it has shown much progress within a relatively short period of time. Through successive production of military aircraft such as the MD-500, the UH-60, and the KF-16, there has been a limited spread of technology to other areas of manufacturing as well as areas of research and development.

Moreover, the KT-1 and T-50 projects have provided the Korean military aircraft industry with opportunity of understanding the military aircraft business. However, civilian projects like the Korean Commercial Transport Development (KCTD) and the B171 Wing project have not created expected outcomes. Nonetheless, profitable and well-established civilian projects need to be pursued, since a heavy dependence upon military aircraft business is not desirable in the long run.

In the past, the four *Chaebols* used to participate in the aircraft industry. Their business areas were concentrated in airframe and system assembly. This resulted in fierce competition between the *Chaebols* in the Korean aircraft industry. It is

debatable whether such strong rivalry works favorably in a strictly limited domestic market size, not only for the purposes of a domestic market, but also in terms of launching firms successfully in the world market. Four companies shared a small domestic market, resulting in insufficient learning and production efficiency. Rivalry in small batch aircraft production in a small domestic market size has not proved to be as effective as was intended. This became a major reason for founding Korea Aerospace Industries Ltd.

With regard to diversification, Korea's main focus has been to build non-American business relations. Those efforts can be regarded as a first step towards independence posture from the heavy US reliance, more specifically, as a preparatory step for a more indigenous position in the aircraft industry. Such efforts have not been remarkable in terms of scale. The examples include co-operation with Dornier of Germany, Japan's Kawasaki Heavy Industries and KAI's participation in the Skylander project with Geci International of France.

For the future of Korean defense aerospace business, the following policy recommendations are presented.

Policy Recommendations

- KAI's competitive edge should lie in 'core technologies', not simple project management with financial capabilities provided by specific conglomerates. In other words, creating a niche sector is an essential factor for KAI's survival in an ever-more competitive global aircraft industry.
- Although the Korean domestic market is not big enough to make new projects feasible, the demand for military fighters, trainers, and helicopters is substantial. Therefore, the government policy should focus on this demand in its long-term procurement planning. Moreover, the policy is supposed to provide opportunities for the acquisition of system integration capabilities. The Korean aerospace industry has an opportunity to acquire state-of-the-art technology through working with Boeing. However, the success of this cooperation depends on KAI's capability of making the best use of the offset package committed by Boeing.
- Through the experiences of KT-1 and T-50 projects, fostering small and medium sized suppliers is necessary. Moreover, with the repetition of licensing production programs, airframe firms have already invested considerably in manufacturing equipment. As a result, airframe producers

have cost advantages over other subsystem manufacturers. However, the airframe sector had reached over-production capacity before the creation of KAI. Therefore, the government should pay more attention to building up subsystems and components manufacturers.

- Since the Korean aircraft firms have merged to form the Korean Aerospace Industries Company Ltd. (KAI), the KAI has become a prime contractor for all domestic aircraft projects. This represents a fundamental policy shift from domestic rivalry to a national champion. It also helps the government streamline the aircraft industry policy. On the other hand, it should be stressed that a national champion policy might bring negative effects such as inefficiency arising from a rigid bureaucracy and lack of competition.
- For a more efficient organizational structure, Korea Air Force (KORAF) should play a role in developing a stronger aircraft industry. That is, it is necessary to have a competent customer, i.e. a knowledgeable air force. And ADD, as the competent regulatory body, should be re-structured.
- The government structure for coordinating related ministries should be reconsidered. According to 'the aerospace development and promotion law' of 1986, the Ministry of Commerce, Industry and Energy is responsible for the coordination and overall planning for the aircraft industry, a mandate it exercised in the creation of KAI. However, MOCIE has taken few policy measures for the aircraft industry. Even though there is a committee for the coordination between ministries, it has been convened only twice so far and has not demonstrated effective functioning. Therefore, the Korean government needs to revitalize MOCIE or to establish a new institution to take on the responsibility of coordinating the roles of all the related governmental and civil institutions.
- The global aerospace industry has noticeably been undergoing restructuring through mergers and acquisition. The fate of the national champions is no longer safeguarded by governmental policy. The new trend has moved their business boundaries beyond the traditional patterns. Under these circumstances, it is necessary for the Korean aircraft industry to consider a strategic alliance with foreign partners, not necessarily in the vicinity of South Korea or with its old ally the US, but with member states of the European Union. This may provide a way of sustaining the aircraft business in the world market.

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