

RAPID GROWTH OF AERONAUTICAL INDUSTRY IN ROK

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Abstract

Korea started aircraft development of the indigenous basic trainer from 1989. Since then, KT-1, T-50, KUH have been developed and produced. It takes only quarter century to enter the full scale development phase of advanced fighter aircraft(KFX) in 2015. Brief history of Korean aeronautical industry has been presented in this paper.

1 Introduction

Korea is planning to develop indigenous advanced fighter from 2015, which is attempted by only few countries. This project is the result of progressive development of Korean aeronautical capability build-up since 1988 when KT-1 basic trainer development started.

This rapid achievement of Korean Aerospace Industry may be originated from continuous efforts of Korean people. There is a history of flying vehicle in 1592 during Japanese invasion. Pilot training school was operated in America for Independence Forces of Korean Exile Government in early 1920s. During the Japanese Colonial period for 36 years from 1910, many young aviation frontiers were trained in Japan, and one of them who flew over Seoul become national hero in Dec. 1922. During Korean War, many youngsters were trained as pilots and engineers by America. They became leaders of ROKAF. And also they worked for civilian airline KNA which was most favorite company in Korea in 1950s. KNA become Korean Air later.

Korea was one of the poor countries in the world when Korea got independence from Japan in 1945, and had tragic Korean War from 1950 to 1953. However, Korea has built up its

economic capability in a very short period of time, and jumped into the developed country becoming a member of OECD 1993. This economic growth is result of several times of 'Korea 5 year Economy Development Plan' by the government during 1970s. Korean GDP is one of top class in the world. This rapid economic growth of Korea is unique in the world.

This economic growth and national security problem set alight to Korean anxiety of producing aircraft in-country.

2 Background of Korean Aeronautical Industry

From late 1960s to early 1970s, North Korea continuously threatened Korean security, such as terror to national cemetery, sending special commando to attack presidential house, sending guerrillas, capturing US airplane and ship etc... Furthermore US Nixon administration started pull-out their troops from the Korean peninsula which had biggest military power to secure Korea. Under such security circumstances, Korean government decided to build-up self-defense capability purchasing advanced weapons, such as tanks, battle ships, and fighter aircraft and reserved armed force system in parallel with economic development plan. Agency for defense Development (ADD) was also founded in 1970 to promote indigenous capability of defense Research and Development similar to civilian side of Korea Institute of Science and Technology (KIST) which established in 1966.

During the Korean War (1951-1953), L-4, L-5, and F-86 Sabre Jet had been maintained in Korea with the help of Americans. Korea had a little capability of the maintenance of F-86



aircraft after the Korean War. Many sporadic efforts to make production of in-country airplane such as Buhwal (resurrection) by ROKAF and Jaehae (sea power) by ROKN were tried in the military depot.

In 1970, under the president Park Chung Hee administration, aeronautical industry development program was included in the 5 year heavy industry build up plan. In accordance with enhancement program of Korea defense capability, F-5 was selected as major equipment for Korean Air force to replace F-86. F-A/B was purchased directly, but F-5E/F model was decided to be produced in-country. MD-500 small helicopter was also selected to support anti-tank capability of Koran Army which outnumbered against North Korean main battle tank.

F-5 E/F Fighters were produced under the license of Northrop Aircraft Company. 500-MD was produced under the license of Hughes Aircraft Co... Korean Air was selected as an

aircraft manufacturing company, which was the only one civilian company having aircraft maintenance capability in those days. Samsung Aeronautical Company also established for license production of jet engine at that time. Through this license production of fighter and helicopter, aircraft manufacturing technology has been improved to the certain level which made it possible to invoke for indigenous airplane design and production. However it was final assembly level due to cost push problem for the developing country.

After finishing those license production programs in the middle of 1980s, Korean government reviewed previous license production program and what is the best way to promote Korean Air defense capability and aeronautical industry build up with several Institutes such as ADD, KIDA (Korea Institute of Defense Analysis), KDI (Korea Development Institute), KIET (Korea Institute for Industrial Economics & Trade) and KARI (Korea Aerospace Research Institute). The result was to produce advanced fighter aircrafts, such as F-16 or F-18, in Korea. After in-depth study of Selection procedures of aircrafts and domestic major contractor for several years, General Dynamics (now Lockheed Martin) F-16 and Samsung Aeronautical Company were chosen to be prime contractor for Korea Fighter Program (KFP). Over hundreds of aircrafts was produced in three phases of co-production arrangement, from semi knock down to domestic production of parts including avionics and final assembly, for more than 10 years.

3 Establishing Indigenous Aircraft Development Programs

ADD had experiences of producing Pazmany PL-2 light airplane with ROKAF maintenance Depot, planning of aeronautical capability build up in Korea and technical administration for F-5E/F license production in 1970s. ADD also developed jet propelled UAV, SOLGAE, in early 1980. This UAV was designed with the assistant of Cranfield University. Small jet engine design and production technology were also accumulated indigenously in those days.



On the other hand, Ministry of Industry and Commerce (MOIC) also planned to build up Korean aeronautical industry capability. Government and KARI tried to develop small passenger aircraft, Chang Gong-91(blue sky-91), with Korean Air. Chang Gong-91 stopped further development after first flight in1991. This program led to 50-100 seat commercial transport aircraft development. However this passenger airplane also finished without any progress due to lack of commercial market.

ADD also developed surface to surface missiles since 1976. Constructions of transonic wind tunnel and structural test facility was done in accordance with this missile development in late 1970s.

Based on those experiences, ADD studied what would be next stage of license production for Korean aeronautical industry in late 1980s. ADD made long term plan for building up Korean Aircraft Industry Development Program (AIDP) in accordance with F-16 coproduction program. ADD decided to develop indigenous basic trainer and advanced trainer leading to fighter development indigenously. Analysis of the life estimation was performed for aircrafts used in ROKAF. Aging T-41, T-37, O-1, O-2 were very imminent to be replaced. The development of parts for commissioned airplane, such as brake discs for F-5 E/E, F-4 and F-16, also conducted for ROKAF. This disc development led to carbon-carbon brake-discs for advanced fighters.

4 KT-1 Basic Trainer Development

KT-1 started as pilot program to enhance design capability without military requirements. ADD started KTX-1 development for the purpose of accumulation and demonstration of indigenous design and production capability in Korea in the beginning. This trial becomes exploratory development phase of basic trainer development. During exploratory development phase it was designated as KTX-1. ADD made a design team with industries, such as Daewoo Heavy Industry, Korean Air, and Samsung Aeronautical Company. After almost one year study from the scratch, experimental aircraft configuration was selected as tandem two seat 550HP trainer based on FAR part 23. Young Korean engineers tried very hard to develop turbo-prop aircraft and

made successful first flight on Dec. 12 1991. European countries gave much support to this project.

However, systematic and user-oriented program were left to KT-1 development. To convince launching customer, Korean Air Force, was not easy task without any concrete experience. Intensive analysis was performed to make technical advantages against possible competing advanced basic trainers such as Pilatus and Tucano. Comprehensive efforts to develop world best basic trainer was able to coincide with launching customer's requirement within a very short time by the enthusiasm of Korean engineers. Another miracle was accomplished in the Korean aeronautical history making first flight of KT-1 in three years from the scratch.

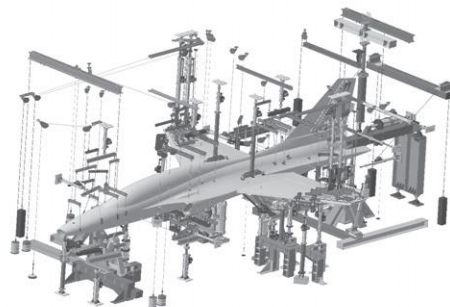
The experience of jumping from manufacturing technology to airplane design of systematic complex system utilizing aerodynamic programs and CATIA design tools made confidence of young engineers. The Americans involved in our FFRRT (First Flight Readiness Review Team) was very helpful for the design and flight. And they commented much diagnosis in critical design review and First Flight Readiness Review (FFRR) with that it would take more than two year to make correction. However for hard working Korean engineers, it took less than six months which made wonders for reviewers. Maintenance programs, cost analysis and trade off studies on layout and power plant selection were also made. It leads to make easier for engineers to go further supersonic trainer T-50 planning.

ROKAF made official requirements after first flight of KT-1, and advanced development phase and engineering development phase were conducted for 950HP engine and other performance capability, such as very low stall speed etc.. early 1990s. Two more aircrafts produced during those FSD phases. Test pilots were also trained in UK and US. Through the various tests of flight performance and integrated logistics by ROKAF, KT-1 becomes one of the world best basic trainers. It has been produced more than 200 aircrafts; among them some were exported to Turkey under License production and, air force of Indonesia, and Peru

that are using KT-1 as trainer and light attack mission. Recently KT-1 demonstrated its low speed flight safety when one student pilot of ROKAF flew over 48km back to the base with stopped engine airplane.

5 T-50 Advanced Trainer Development

Early 1990 when F-16 coproduction program started and KTX-1 was developing, conceptual study on advanced trainer as KTX-2. As a part of offset agreement with Lockheed Martin (LM, former GD), KTX-2 conceptual design was started with LM engineers in Fort Worth Texas USA for 2 years. Design goal of KTX-2 was to replace aging F-5B and F-5F. ADD formed allied conceptual design team with LM and Korean industry engineers in 1992. KTX-2 become T-50 when ROKAF established their ROC. Based on this conceptual design, ROKAF selected supersonic trainer and light attacker as T/A-50 in 1995. Full scale development started



in 1996 and finished in 2002. LM invested 13% of development cost. The trainer system development was conducted world first supersonic trainer aircraft, but also simulator and maintenance capability. During FSD phase, every possible aeronautical resource was utilized in Korea, i.e. wind tunnels and structural test facilities in ADD and KARI.

Korea Aerospace Industry (KAI) was established by merging aeronautical engineering sections of Samsung Aeronautical co., Daewoo Heavy Industry and Hyundai Aerospace co. when FSD started.

T-50 has been improved to light attacker to replace F-5s as FA-50.

TA-50 also exported more than 100 aircrafts and proved as an only one supersonic trainer/attacker in the world. ROKAF Black Eagle acrobatic team demonstrates its fantastic performances of T-50 all over the world.

Currently T-50 is preparing to participate on the competition of USAF T-X program. We hope T-50 would have successful result in T-X competition in 2017.

6 SURION(Korea Utility Helicopter, KUH) and its Variant Programs

ROK Army is one of the biggest rotary wing aircraft fleets in the world. Although Sikorsky UH-60 is one of major aircrafts in ROK Army, main utility helicopters are very old 500-MD and UH-1. To replace them, ADD made conceptual design for multi-purpose helicopter (KMH) in early 2000 under the request of ROKA. It became national aeronautical programs by MND and MOCI in 2004. Two ministries formed joint Program Management Office (PMO) and conducted development. ADD's role was Technical PMO. PMO decided to develop utility first, and attack helicopter later. Korea Aerospace Industry (KAI) became prime contractor. ADD developed mission equipment package (MEP) and KARI developed rotor system.

After successful development of KUH in 2014, it is under production now for Army as well as many other variant versions for NAVY, Police, Forest service etc...



Based on KUH experience, Korea is developing Light Attack Helicopter (LAH) for ROKA and passenger helicopter for civilian purpose now. FSD program started last year. KAI is prime contractor and many Korean industries, such as LIG nex1, Hanwha Thales, are participating in this program.

7 UAV development

From late 1980, ADD developed small reconnaissance UAV, Songgolmae, for ROKA. After deploying that UAV, Korea developed medium sized UAV for next generation legion and small UAVs for divisions of ROKA. Smart UAV also developed by KARI.

8 BORAMAE(Peregrine falcon; Korea Fighter, KFX) Development

ROKAF had the problems of outnumbered fighter aircraft against North Korea, and replacement of aging F-4 and F-16s in the near future since late 1990s. ROKAF made a decision to have FA-50 as low end fighter and F-15 & F-35 as high end. ROKAF needs over 100 aircraft of medium class fighter as well.

For this medium class fighter, ADD had feasibility study of indigenous development and made conceptual design for ten years. ADD also developed advanced technologies, such as stealth design and material development as well



This KFX will improve Korean aeronautical industry capability drastically in the next decade.

9 Conclusion

KT-1 will have 25th anniversary of first flight on December 12 2016. KT-1 was selected one of the 70 best achievements in Korea since 1945. Within quarter century Korea achieved design capability build up from the scratch to the advanced fighter and helicopters. Korea is also developing advanced UAVs and many kinds of satellites. No other country in the world achieved such a rapid growth in aviation history. Korea will be one of dominant country in the world aeronautical engineering in the future.

Korea strongly believes that needs for international cooperation in aeronautical industry not only in military but also in civilian aeronautics.

We hope international cooperation for the mutual benefit and progress of aeronautical industry in the world.

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as AESA radar. Cost effectiveness study also had more than seven times by different organizations and universities due to heavy burden of R&D cost. In 2015 Korean Government made final decision to develop KFX, and made contract of about 7B US\$ for R&D in next 10 years. More than 10B\$ will be spent for production. And nearly same amount of export are expected.