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The F-16's Evolution from a Lightweight Day Fighter to a Deep Strike Aircraft

by Cem DOĞUT

In 1968, the United States started a new aircraft project following the development of the high-performance interceptor Mig-25 by the Soviet Union. The requirements of the F-X project were 40,000 lb. MTOW, a maximum speed of 2.5 Mach, and a high thrust-to-weight ratio. In 1969, McDonnell-Douglas's F-15 was selected, leading the way to the birth of the fighter that would replace the F-4 Phantom II. It carried a powerful radar (APG-63) and plenty of missiles (4 AIM-7 and 4 AIM-9) to deal with the Mig-25. As the F-X project continued, the challenges of equipping the Air Force with such a capable and expensive aircraft began to arise. The team that led the debate was nicknamed the "Fighter Mafia" at the time. The core staff of this team was Colonel John Boyd, Colonel Everest Riccioni, Analyst Pierre Spray, and Engineer Harry Hillaker. The Fighter Mafia believed that the ideal fighter should be light and highly maneuverable. Thus, it could easily change its speed, altitude, and direction. Also, it would be difficult to detect the light and, therefore, the small plane. It would also be cheap to manufacture and operate. Later, Boyd and his team received funding from Northrop and General Dynamics to develop these concepts. The Air Force did not support these efforts, as it would undermine the F-15 (Project F-X). Finally, they realized that the budget would not be enough to get enough F-15s and then the Fighter Mafia's ideas started to be valued. The Advanced Day Fighter concept emerged and was named the F-XX project. With the support of the Department of Defense, the Air Force Prototype Study Group was established in May 1971. Two of the six candidates were selected, and the Lightweight Fighter (LWF) project was initiated. The request for proposal was published on June 6, 1972. In light of the lessons learned from the Vietnam War, the Six-day War, and the Indo-Pakistan conflicts, the USAF requested a fast and high maneuverable aircraft that weighs 20 tons and is optimized for combat at Mach 0.6 - 1.6 at an altitude of 30,000 - 40,000 feet. In May 1972, the proposals of General Dynamics and Northrop were selected, and the YF-16 and YF-17 prototypes were manufactured. The prototypes made their maiden flights on February 2, 1974, and June 9, 1974, respectively. That same year, NATO members Belgium, Denmark, the Netherlands, and Norway wanted to replace their F-104Gs. The winner of the LWF project would also have the opportunity to be sold to these countries when the U.S. Air Force's desire to replace its F-4 and F-105 aircraft, combined with these countries' need for a new fighter-bomber, the LWF project turned into the Air Combat Fighter (ACF). The YF-16 aircraft had also evolved into a multi-role fighter from a day fighter, and the number of its underwing pylons was increased from two to three. The radar requirements were also changed, and the Westinghouse APG-66 multi-mode mission radar was selected.

On June 13, 1975, the U.S. Air Force announced that it had chosen the YF-16. In this choice, the P&W F100 turbofan engines used in the F-15 aircraft played a significant role as much as the YF-16's superior acceleration, climbing, and maneuverability to the YF-17. This selection also reduced engine unit costs and operating costs.

In the 1970s, the Fighter Mafia's ideas became a reality thanks to engineers in Fort Worth, Texas. The resulting lightweight fighter incorporated various advanced technologies that were not previously used in operational aircraft. A LERX (leading-edge root extension), which is a small extension to an aircraft wing surface, was added forward of the leading edge to improve the airflow at high angles of attack and low airspeeds. Additionally, the aircraft's response time was reduced by using the fly-by-wire system instead of the heavier hydraulic system. The YF-16 is the first aircraft designed and manufactured to be aerodynamically unstable. This characteristic, which is also known as Relaxed Static Stability, increases the agility of the plane. By its very nature, a stable aircraft wants to switch to a level flight if its controls are released. This is called Positive Static Stability. RSS planes require numerous control inputs or trim changes to fly. On the other hand, these momentary changes are executed by the F-16's onboard computer, which is integrated into the fly-by-wire system to ensure that the aircraft flies properly. The ejection seat reclined 30 degrees from vertical to reduce the effect of g-forces on the pilot. The plane also features a side-mounted control stick to ease control while maneuvering. With the HOTAS, HUD, and the bubble canopy, the pilot's situational awareness was increased. All these technologies had been tried in some aircraft and research programs before. But with the YF-16, it was the first time that all elements came together on a production aircraft.

The LWF planes were designed to have high maneuverability; however, they had to grow when they were converted to ACF. Their

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YF-16, the prototype to the F-16 Fighting Falcon, flies an aerial refueling mission in March of 1975

capabilities started to be increased during Full Scale Development (FSD). The number of pylons was increased from five to nine. By mid-1975, the aircraft's size and weight increased with new capabilities. Almost two years after winning the ACF competition, the first F-16A aircraft manufactured by General Dynamics made its first flight on December 8, 1976, followed by the F-16B in August 1977. Unlike Soviet aircraft, the two-seat F-16B had full combat capability, and both the F-16A and B had the same dimensions. The only difference was that the B models had approximately 17% less internal fuel capacity. Internal fuel capacity was lowered for the rear cockpit.

The USAF decided to buy 650 F-16s in the late 1970s. On June 7, 1975, four European partner countries (Belgium, Denmark, the Netherlands, and Norway), now known as the European Accession Group, ordered 348 F-16As/Bs at the Paris Air Show for US$2,168 billion. Described as the sale of the century, this order was split among the European Participation Air Force (EPAF) as 116 F-16s for Belgium, 58 for Denmark, 102 for the Netherlands, and 72 for Norway. As part of this process, two production lines were established in Europe, one at the Fokker Schiphol-Oost plant in the Netherlands, and the other at SABCA's Gosselies plant in Belgium.

Starting from the initial design phase, the F-16 gained new capabilities over time. All significant changes on the F-16 fighters are displayed in Block numbers. As the block number increases, the aircraft's capabilities also increase. During its development, the F-16 gradually became heavier as if mocking its original production purpose and turned into a multirole fighter aircraft. More than 4,500 planes were manufactured under eight main models in 139 different configurations and were used by 29 countries. More than 3,000 operational F-16s are in service today in 25 countries. The first two YF-16 prototypes and eight Full-Scale Development (FSD) aircraft did not receive block numbers. These planes are called Block 0. Let's examine the development of the aircraft over time by taking a look at the notable blocks of the F-16.

F-16A/B Block 1, 5 and 10

After the prototype and FSD programs, the first Block 1 F-16 (78-0001) flew for the first time on August 16, 1978 and was delivered to the U.S. Air Force that same month. Most Block 1 and Block 5 aircraft were upgraded to Block 10 in 1982 under the Pacer Loft program. The new production Block 10 aircraft (312 in total) was manufactured until 1980. The differences between these early F-16 versions were relatively small. The Pratt & Whitney F100-PW-200 afterburning turbofan engine was used in the aircraft. It has a thrust of 12,240lb (dry thrust) and 23,830lb (129.7 kN) with afterburner. Starting with Block 1, all F-16s were equipped with the ACES II ejection seat. The Tactical Air Command officially named the F-16A the Fighting Falcon, but its pilots and crews commonly used Viper because it was quick, agile, and very deadly.

F-16A/B Block 15

The production of 983 Block 15s were manufactured in three production lines (America, Belgium, Netherlands) and spanned over fourteen years. Block 15s are the most produced model among F-16 aircraft. Many of them still fly in various Air Forces around the world. Its vertical stabilizer is 30% larger. This is the most apparent difference between Block 15 and

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Pakistani Air Force F-16B (MLU) during the Anatolian Eagle exercise

previous F-16 versions. The larger tail provides better balance and control, especially at higher attack angles. Block 15s gained new abilities with an Operational Capability Upgrade (OCU) such as the data transfer unit, the radar altimeter, the WAR (Wide Angle Reflective) HUD (Head-Up Display), the advanced Westinghouse AN/APG-66(V)2 radar with "track while-scan" mode and AIM-7 Sparrow and AIM-120 launch capability. One of the most significant improvements was the Pratt & Whitney F100-PW-220 engine, which was more powerful and reliable.

F-16A Block 15 ADF (AIR DEFENSE FIGHTER)

The ADF program was initiated to protect United States airspace and to replace the aging F-4 and F-106 aircraft. For air-to-air combat missions, the F-16A Block 15 OCU aircraft were equipped with additional systems, including the AN/APG-66A radar. The radar can provide continuous-wave illumination for beyond visual range missiles like the AIM-7 Sparrow. It also features improved small target detection and "look-down, shoot-down" capabilities. Block 15 aircraft were also equipped with the AN/APX-109 IFF transponder, AN/ARC-220 High-Frequency (HF) Airborne Radio Set, and a 150,000-candlepower spotlight fitted forward and below the cockpit. From the late 1980s to the early 1990s, 271 Block 15 aircraft were converted to ADF.

F-16A/B Block 20

Produced for the Taiwan Air Force (Republic of China Air Force) these aircraft, actually, are identical to Block 50/52 in capability. This was a purely political classification which aimed to avoid problems with China.

F-16AM/BM MLU

The top five F-16 user countries (Belgium, Denmark, Netherlands, Norway, and the United States) decided to modernize the avionics and improve their aircraft's structural integrity. Thus, the MLU (Mid Life Update) program started. With the "Falcon Up" program, the service life is extended to 8,000 hours. The most critical element of the MLU package is the Modular Mission Computer (MMC). The new computer's processing speed is 740 times faster than the old computer in the original F-16, and it has more than 180 times the memory. Other changes that came with the MLU included wide-angle HUD, full-color multifunction displays (MFD), Integrated Control Panel (ICP which are the buttons below the HUD), ring laser gyroscope (RLG) inertial navigation system (INS), miniaturized GPS receivers, Digital Terrain System (DTS), improved data modems, and the AN/APX-113 Advanced Identification Friend-or-Foe system (AIFF) transponder. The cockpit lights were made compatible with night vision systems. Helmet-Mounted Display (HMD) was also added to the aircraft. An Electronic Warfare Management System (EWMS) developed by the Danish defense and aerospace manufacturer Terma Elektronik A/S controls the entire EW package, including the radar warning receiver (RWR), electronic countermeasure (ECM) pods and advanced chaff/flare dispensers. Portugal, Jordan, and Pakistan later joined the MLU program.

F-16 C/D Block 25

The C/D models represent the second generation of F-16 planes. The fuselage is mostly the same. The most notable visual difference is the triangular-shaped part under the vertical stabilizer. This piece was enlarged in C/D models to accommodate the new communications antenna. Other changes include an improved fire control computer, an inertial navigation system (INS), multifunction displays (MFD), a new data transfer unit, a radar altimeter, and a jam-resistant UHF radio. The most significant change in C/Ds was the radar. The new AN/APG-68 radar offered greater range, anti-jamming capability, increased target resolution, and new operating modes.

F-16 C/D Block 30/32

The first F-16C Block 30/32 model flew on June 12, 1986. The most notable change in this block was the introduction of an alternative engine to the Pratt & Whitney F100. The General Electric F110-GE-100 started to be offered as a new engine alternative. The reason for this was to prevent PW from becoming a monopoly and to get better prices for the engines. The problems experienced in the first F100 engines were the most crucial reason behind this decision. Later, the Alternative Fighter Engine (AFE) program (also known as "The Great Engine War") was initiated. Now, two companies would compete to provide engines for the next blocks. If the Block number of the F-16 ends with "0" it indicates that it has a GE engine while "2" indicates that it has a PW engine. Block 30/32 was planned to have a common engine bay that accepts both engines. But in reality, that's not what happened, as a modification kit was needed to change the engines. Another situation that prevented the removal of the PW engine and the installation of the GE engine was the production of larger air intake for F-16 aircraft using GE engines. The large air intake is called the Modular Common Intake Duct (MCID) or bigmouth. MCID allows the GE engine to deliver full thrust even at low airspeeds. Additionally, radar warning receiver (RWR) antennas were installed on the leading-edge flaps. The previous blocks were also fitted with these antennas later.

USAFE (United States Air Forces in Europe) F-16C Block 50 with HARM Targeting System (HTS)

The F-16N model produced for the U.S. Navy was a variant of the F-16C Block 30. It was powered by the GE F110-GE-100 engine and had a Normal Shock Inlet (NSI) like the early production Block 30s. The F-16N was also equipped with the AN/PG-66 radar, as in the F-16A models. There were also minor structural differences to meet the Navy's requirements. The plane lacked an internal 20mm cannon. Twenty-two F-16N and four TF-16N were produced from 1987 to 1988. The aircraft flew at the Navy Fighter Weapons School (Top Gun).

F-16 C/D Block 40/42

With Block 40/42, the F-16 gained night/all-weather navigation and precision attack capabilities. Original analog flight controls were replaced with digital flight controls. The flight control system controls the aircraft digitally together with other avionics in the plane. This feature enabled the integration of the LANTIRN pods to the aircraft. Block 40/42 also introduced more capable AN/APG-68(V)3 or AN/APG-68(V)5 radar (depending on the user) and the new WAR (Wide Angle Reflective) HUD which is compatible with LANTIRN (Wide Angle Reflective) system. Two additional stations (5R and 5L) were added under the air intake. Consisting of two pods, the AAQ-13 Navigation pod of the LANTIRN system is carried on 5L, while the AAQ-14 targeting pod is carried on 5R. The navigation pod contains a forward-looking infrared (FLIR) camera and terrain-following radar. The image from FLIR can be displayed on the HUD. This allows the pilots to fly the plane without night-vision goggles. Using the information from the terrain-following radar, digital flight controls can automatically fly the aircraft at the desired altitude, following the landforms. The targeting pod consists of a forward-looking infrared (FLIR) camera and a laser designator. Thanks to the FLIR, the target can be detected and tracked in all weather conditions, day or night. Additionally, the main landing gear was extended to increase the height of the aircraft, and larger wheels started to be used due to the increased weight. As a result, the landing-gear doors feature a slight bulge to accommodate larger diameter wheels. Moreover, the landing lights on the main landing gear in Block 30 and earlier models were moved to the front landing gear door due to the LANTIRN integration. Thanks to the structural improvements made in Block 40/42, the take-off weight increased from 37,500 lbs. to 42,300 lbs. and the weight limit during 9-g maneuvers increased from 26,900 lbs. to 28,500 lbs.

F-16 C/D Block 50/52

With Block 50/52, F-16 fighters acquired AGM-88A HARM (High-speed Anti-Radiation Missiles) launch capability. Thus, the planes became capable of performing SEAD (Suppression of Enemy Air Defense) missions. The Block 50/52 planes use HARM missiles via the command launch computer interface. Additionally, the U.S. Air Force F-16s carry the HARM Targeting System (HTS). In this way, the location of enemy radars can be detected more precisely from longer distances. Block 50/52 jets are also equipped with AN/APG-68(V)5 or AN/APG-68(V)7 radars and advance IFF transponders.

Israeli Air Force F-16D Barak aircraft is the first model to feature an ADS (Avionics Dorsal Spine). The ECM antenna is visible in the "drag chute" housing

New munitions such as the AGM-84 Harpoon anti-ship guided missile and the AGM-154A/B Joint Stand-off Weapon (JSOW) were also introduced with this block upgrade. With the Block 50/52 Increased Performance Engines (IPE) program, Block 50s started to be powered by General Electric F110-GE-129 engines and Block 52s by Pratt & Whitney F100-PW-229 engines.

F-16 C/D Block 50/52+ "Plus"

The 'Plus' upgrade improved the air-to-air and air-to-ground capabilities of Block 50 planes with the AN/APG-68(V)9 radar. With the new radar, the mean time between failure (MTBF) was reduced %50, and the range was extended %33. Thanks to the added SAR/GMTI feature, it can detect the target's location precisely and destroy it with GPS-guided JDAM. In SAR mode, it can provide images with a resolution of 91.44cm (3ft) from a range of 75km. The IFF system was replaced with the AN/APX-113 Advanced Identification Friend or Foe (AIFF) System with 185km range. The most obvious physical difference of the aircraft is the CFT (Conformal Fuel Tanks) added on the body and added on the ADS (Avionics Dorsal Spine) with D models. The aircraft can carry 450 gallons of extra fuel in its CFTs and still pull 9-g maneuvers. CFT provides an approximate 1,650km operational radius with an approximately 50% increase in internal fuel. This means around 40% more range than F-16s without the CFT. The primary purpose of the ADS is to increase the avionic carrying capacity, which was decreased due to the rear cockpit in D models. This allowed F-16 aircraft to carry ECM and communication systems that they had not been able to carry internally before. Thanks to the ADS, D models can also be used in non-training missions as they received the same avionics suite of the C models. Thanks to these features and the presence of a weapon system officer in the rear seat, Block 50+ Ds gained the long-range precision strike capability. Other users, primarily Israel, bought these planes specifically for this purpose.

F-16I SUFA

Based on F-16D Block 52+, the maximum take-off weight of the F-16I was increased to 23,600kg, making it the heaviest Viper model ever produced. In the 1970s, the power-to-weight ratio of the original F-16A was 1.02, while in the F-16I, this ratio dropped to 0.56. While the power-weight ratio of the F-16, which was designed as a lightweight fighter at the beginning of the project, was above 1, this ratio started to decrease as the aircraft gained new abilities. This is the most apparent proof of the F-16's transformation into a multi-role fighter over time.

Roughly 50% of the F-16I's avionics are of Israeli origin. Elbit provided the mission computer, display processor, the advanced central interface unit, and the moving map display. Rafael provided the digital terrain system (DTS), central air data computer (CADC), data link, HF, VHF, and UHF band encrypted radio as well as multifunctional displays (MFD). While BAE Systems produced HUDs of the first 25 Sufa, the rest of the jets were equipped with Elbit El-Op HUD-DU. All Sufa's have a HUD repeater in the rear cockpit, which allows information sharing between the weapon system officer in the rear seat and the pilot. Both crew members can use the Elbit DASH IV helmet-mounted display. The primary sensor of the F-16I is the AN/APG-68(V)9 radar. Radar data and moving map information are combined with Rafael DTS data, enabling safe flight at low altitudes by using terrain features. This sensor fusion allows flying under radar coverage. The Elisra active and passive self-protection system forms the center of the Electronic Warfare (EW) suite of the F-16I. The system uses optical IR sensors to detect the heat generated by incoming missiles. Unlike other F-16s, Sufa jets are equipped with eight chaff/flare dispensers.

F-16 E/F Block 60

This version was developed to meet the UAE's need for a multi-role fighter with more air-to-ground strike capabilities.

UAE Air Force F-16E Block 60 with Pylon Integrated Dispenser System (PIDS). The Block 60 features an AN/APG-80 AESA (Active Electronically Scanned Array) radar

The aircraft needed to carry much heavier loads than standard F-16Cs and with an extended combat radius to reach Iran, which the UAE perceived as a threat. Based on the experience from the 1990-1991 Gulf War, more advanced sensors and systems were needed for self-protection and to carry out precision strikes, especially in adverse weather conditions. Deciding to invest in the new version of the F-16 to meet these needs, the UAE undertook the development costs of the aircraft. The contract for 80 aircraft, related equipment, and services (estimated to be US$6.4 billion) was signed in March 2000.

Since the structural integrity, avionics capability, and thrust power of the Block 60 configuration increased significantly; it received a new classification. The new generation Viper family F-16E/F was born. The UAE invested around US$3 billion for all the research and development costs of the Block 60.

Internally, Block 60 is a very different aircraft from the F-16C / D hull. The most critical system integrated on Block 60 is the AN/APG-80 AESA (Active Electronically Scanned Array) radar. The UAE became the first user of this new and revolutionary radar technology outside the USA. Compared to the mechanically scanned legacy radars, the stronger and more capable AN/APG-80 radar costs less to operate and maintain. The multifunctional (air-to-air, air-to-ground, terrain following, etc.) radar can continuously search and simultaneously track multiple targets. The AN/APG-80 can also generate high-resolution synthetic aperture radar (SAR) images. The installation of the AN/APG-80 and other avionic systems caused some structural changes. The pitot tube was removed from the front of the radome, and a new environmental control system (ECS) was installed for the avionics. New inlets and exhaust vents were placed in the tail section and under the fuselage to provide airflow for the ECS.

Other equipment specific to Block 60 includes the Northrop Grumman AN/AAQ-32 Internal FLIR Targeting System (IFTS) derived from the AN/AAQ-28 Litening. The system projects a view of where the aircraft is going on the HUD in the cockpit. The IFTS can passively detect and track air targets. Block 60 is also equipped with the Northrop Grumman Falcon Edge Integrated Electronic Warfare System.

F-16V 'VIPER' Block 70/72

Lockheed Martin started to work on Block 70/72 to provide F-16 users with the new capabilities that they need in the current combat environment. The "Mid-Life Update" (MLU) program, which will be applied to existing F-16 aircraft, is intended to be the same as the new aircraft. The Northrop Grumman ANAPG-83 SABR (Scalable Agile Beam Radar) radar forms the center of the program. Another important feature of the F-16V configuration is the CPD (Center Pedestal Display). With its high resolution 6 x 8-inch screen, it allows the pilot to take full advantage of the data from the radar and targeting pod. The Auto GCAS (Automatic Ground Collision Avoidance System) system has become standard with the Viper configuration. Thanks to this system, the aircraft performs a self-rescue maneuver without pilot intervention to prevent collisions if the pilot passes out as a result of high Gs or if the airplane gets out of control and loses altitude as a result of disorientation. With the new radar, avionics, secure data link, and electronic warfare systems, the Viper will have reached operation levels of a fifth-generation aircraft.

F-16 Fighting Falcon's Turkey Adventure

To establish the aviation industry in our country, three significant attempts were made in 1925, 1935, and 1939 and a total of 252 civil and military aircraft were manufactured, and some were even exported to foreign countries. Although factories were established and started production, these initiatives, which aimed to bring new and modern management systems to our country, had to stop their activities due to bottlenecks in production and management due to the lack of necessary support. Therefore, the Turkish Air Force Support Foundation was established on July 16, 1970, to meet the industry's investment and financing needs. To establish, preserve, and regulate the National Aviation Industry in light of previous initiatives, the Turkish Aircraft Industries Corporation "TUSAŞ" (55% owned by the Treasury and 45% by the Turkish Air Force Support Foundation) was established under the auspices of the Ministry of Industry and Technology by Law No. 1784, adopted on June 28, 1973. Turkish Aerospace worked on the co-production project of the evolutionary-close support aircraft needed by the Air Force Command between 1976 and 1977 and was stopped in October 1977 when the agreement phase of the project was reached. Later, a delegation consisting of Air Force Command officials and Turkish Aerospace personnel was established in March 1979 to identify the aircraft that met the qualifications at the directive of the General Staff. In April 1979, the Higher Planning Council decided to establish an aircraft factory in Ankara, and the expropriation of 5 million m2 of land started at the Mürted region. Negotiations were held with international aircraft manufacturers and their governments, and these negotiations continued for about three years. In the 1980s, General Muhsin Batur started the "Build Your Own Plane" project. As a result of the activities carried out in this context, the F-14, F-15, Viggen, Jaguar and Tornado aircraft were eliminated for performance and economic reasons, while the Mirage F1 and 2000 were eliminated due to France's anti-Turkey attitude. As an alternative, three American aircraft were left. These were the F-16C/D, F/A-18, and F-5G. All the manufacturers of these three aircraft also accepted the joint production requirement of Turkey. The F-16C/D and F/A-18A aircraft were selected for the final two in the tender and Turkey sent a Request for Proposal (RFP) to the US Government for the joint production of 160 aircraft in 10 years. In August 1983, General Dynamics F-16C/D aircraft were selected for joint production.

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Turkey's F-16 adventure started on December 9, 1983, with the signing of the Letter of Acceptance (LOA) between the Turkish Air Force and the U.S. Air Force for 160 F-16 aircraft. The total cost of this project, called PEACE ONYX, was US$4 billion. With the agreement, the first eight aircraft would be manufactured at General Dynamics Fort Worth facilities, while the remaining 152 (136 F-16C and 24 F-16D) would be manufactured at TUSAŞ facilities. In July 1984, General Electric's F110-GE-100 engine was chosen to be used on the F-16C/D aircraft. Turkish Aerospace Industries was established in 1984 with General Dynamics, with US$137 million in capital. 49% of this company was owned by TUSAŞ, 2% was owned by the Turkish Aeronautical Association and the Turkish Air Force Support Foundation, and 49% was owned by foreign shareholding.

Turkish Aerospace started its first F-16 production activities on February 2, 1987, including the front, middle, and rear fuselage assembly. The assembly activities of the F-16 aircraft continued with the production of the rear and middle fuselage in 1988 and the wing production in 1989. Aselsan manufactured the LN-39 INS system to be used in the aircraft under the Litton license. The first F-16 aircraft were delivered to the Turkish Air Force with a ceremony held at General Dynamics Fort Worth facilities on July 17, 1987. 4 of the eight planes flew to Turkey in 1987. The other four aircraft were delivered by cargo aircraft. The first F-16C Block 30 (86-0068) manufactured at Turkish Aerospace facilities made its first flight on October 14, 1987, under the control of test pilot Şener KOLTUK. Within the framework of the Peace Onyx program, the first 4 F-16D fighters were delivered on October 20, 1987, with a big ceremony. After completing its tests, the first F-16C aircraft manufactured by Turkish Aerospace was delivered to the Turkish Air Force on November 27, 1987. Until January 1990, 32 F-16C Block 30s and 3 F-16D Block 30s were manufactured. As of the 44th plane, Block 40 configuration planes started to be delivered. Initially, the production process only started as the assembly of parts, but later Turkish Aerospace started to manufacture 70% of the aircraft fuselage.

The Turkish F-16 aircraft Self Protection Electronic Warfare System (SPEWS) contract worth US$325 million was signed between MIKES and the Undersecretariat for Defence Industries (SSM) in September 1989. The AN/ALQ-178(V)3 system produced by the LORAL company was selected. A national threat library was also established with the project. The system

Turkish Air Force F-16C Block 50M aircraft were equipped with the AN/ALQ-178(V)5+ ECM system under the SPEWS-II project. The distinctive ECM antennas are an integral part of the formation lights

can warn in the C-J band and jam in the D-J band. The system displays the threats and alerts the pilot with an audible warning. It consists of two main parts, RWR and ECM. With the project, 160 RWR (Radar Warning Receiver) and 122 ECM (Electronic Countermeasures) systems would be installed on the aircraft. Since there wasn't enough room for the ECM system's avionics in F-16D jets, only the passive RWR system was installed. Within the framework of the project, an intense and challenging test program was carried out in the USA for over two years with a team of 30 members of the Turkish Air Force, two F-16 and accompanying pilots, technicians, and engineers. During the tests, various Eastern and Western radar sensors imitated different threats in various scenarios defined by the Turkish Air Force and detailed by MIKES. A total of 40 sorties were conducted. With this study, Turkey became the second country in the world to carry out its own EW test after Israel. Moreover, MIKES completed the engineering work on the compatibility of ALQ-178 and AIM-120 AMRAAM missiles in cooperation with Lockheed, Hughes, and Raytheon. Thus, Turkey verified that the ECM system could operate without jamming the seeker of the AIM-120 missile. The ALQ-178 Electronic Warfare Modification Program was combined with the "Falcon-Up" program to save time and costs.

The Turkish Air Force acquired the LANTIRN (Low-Altitude Navigation Targeting Infrared System for Night) system through the FMS channel under the Peace Moon program. Within the framework of the US$183 million Peace Moon contract, 40 navigation pods and 20 targeting pods would be delivered along with the necessary technical and tactical training, logistic support, and maintenance/repair capabilities. The LANTIRN pods and support equipment arrived in Turkey in June 1993. 6 pilots selected by the Turkish Air Force completed their receive combat readiness training in the USA. The "Bat (Yarasa)" LANTIRN Squadron was established with 2 US instructor pilots and six additional pilot trainees and was activated on 6 January 1994. During this period, all pilots received training, especially in AGM-65G and GBU-10/B firing tactics and techniques. In 1997, 20 more targeting pods were ordered.

The Peace Onyx-II program started on March 26, 1992, with the signing of the Letter of Acceptance (LOA) between the Turkish Air Force and the US Air Force, which included the purchase of 40 F-16C/D Block 50 and the 40 optional aircraft. Within the scope of the program, 96 F110-GE-129 were produced by TEI. The new engines have an increased thrust of 29,000lbs. (13,182kg). In return for Turkey's support after Operation Desert Storm, the Turkish Defense Fund (TDF) was established with the participation of Saudi Arabia, Kuwait, the United Arab Emirates, the US, and Turkey. This Fund was created primarily to finance the Peace Onyx II program. The related deliveries under the Peace Onyx/Öncel-I Project were completed in March 1994. Production of the aircraft started in July 1996 under the Peace Onyx-II program. With this project, Turkish Aerospace increased its aircraft manufacturing rate to 80% with the addition of the front fuselage parts and flaperons. The last plane of the PO-II program was delivered at a ceremony held on November 12, 1999. Thus, 60 F-16C Block 50 and 20 F-16D Block 50s entered the inventory of the Turkish Air Force. With the widespread use of BVR (Beyond Visual Range) missiles such as AIM-120 AMRAAM, the importance of IFF (Identification Friend or Foe) systems has increased. Using an IFF transponder is not enough to determine whether the target detected by radar is friend or foe, and an aircraft must be equipped with an interrogator system. Therefore, the AN/APX-109 IFF system was installed to Block 50 aircraft to allow the F-16s to safely fire AIM-120B missiles after interrogating targets detected with the APG-68(V)5 radar. Another addition is the AGM-88A HARM capability against enemy radars. In September 1998, the 151st

Squadron was activated at the 5th Main Jet Base with its Block 50 aircraft and AGM-88 missiles. Unfortunately, the PO-II planes flew without Electronic Warfare capability for many years. Due to the delayed electronic warfare system selection within the scope of the Öncel-I Project, the aircraft had to return to the factory again to receive the necessary modifications. In addition to the extra time spent, this cost about an additional US$25 million. Despite this experience, the electronic warfare system's selection process could not be completed in time as part of the Öncel-II Project. The US$223 million SPEWS-II contract to provide Electronic Warfare systems for a total of 80 Öncel-II F-16C/D Block 50 aircraft was signed on March 22, 1999. However, for various reasons, this contract was terminated on October 25, 1999, and on December 6, 1999, a new agreement was signed with Aselsan under the same project. The deal was canceled before coming into force due to both the political developments in France against Turkey, which affected Aselsan's partner in the project directly, and the USA's restrictions on the use of foreign electronic warfare systems on its own production platforms. As a result of the negotiations, Aselsan took over 72% of MIKES shares, and 3% of shares were transferred to the SSM (now the SSB). The process, which was turned into an unresolved mess, ended with a new tender on January 15, 2003. With

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the contract signed at the Undersecretariat for Defense Industries, it was decided to integrate the AN/ALQ-178(V)5+ system into F-16C Block 50 aircraft. Aselsan was selected as the main contractor with MIKES as the subcontractor. But the problems remained. The SPEWS-II project was completed in 2016 after the CCIP program.

With the PO-III program, studies began in 2003 for the mid-life upgrade of the F-16s, the leading combat aircraft of the Turkish Air Force. In this context, a program similar to the Common Configuration Implementation Program (CCIP) of the US Air Force was prepared for F-16 aircraft. The project aimed to modernize Block 40 and 50s to meet current needs and to eliminate the differences between the Blocks.

While the CCIP project was continuing, 30 F-16C/D Block 50+ were ordered under the PO-IV program to replace the planes lost due to accidents. With the CCIP program, the Turkish F-16s were upgraded to the level of Block 50+ jets. The first phase of the project covered the procurement of the necessary avionics for the modernization program. These were later integrated into ten prototype aircraft at Turkish Aerospace facilities under two steps, TVI (Trial Verification Installation) and LTF (Lead the Fleet). On July 2, 2007, the TVI phase started with the arrival of one F-16C Block 40, F-16D Block 40, F-16C Block 50, and F-16D Block 50 at Turkish Aerospace facilities. Turkish Aerospace completed the modification of these four planes as part of the TVI phase and then sent them to the USA for testing at Lockheed Martin's Forth Worth facilities. During the tests conducted at Fort Worth, 4 F-16C / D Block 40 and Block 50 aircraft carried out a series of test flights with JSOW, AIM-9X Sidewinder, AIM-120C AMRAAM and AGM-84K SLAM-ER missiles. The CCIP project serial modernization protocol was signed on January 19, 2010. With the project, a total of 165 F-16C/D Block 40 and Block 50 aircraft were modernized. The F-16C/D Block 30 jets also received a partial modernization. The 1st HIBM Command and Turkish Aerospace replaced the RIBs (Turkish Aerospace production) on the bulkheads and wings of the planes to extend the life of the Block 30 type F-16s. The PO-III aircraft had the same mission computer (MMC 7000) and Operational Flight Program (OFP) as the PO-IV aircraft. Source codes of Block 40 aircraft were taken from the USA before CCIP. The Block 40 System Integration Laboratory (SIL) was established at the 1st HIBM, and nationally developed ammunition started to be integrated into the aircraft. Turkey requested the source code of the MMC 7000 mission computer software, but the USA did not accept this request. Within the scope of Serial Modernization, Turkish Aerospace delivered the first aircraft to the Turkish Air Force on November 2, 2011. 149 of 165 aircraft were modernized at Turkish Aerospace facilities and the other 16 aircraft at 1st HIBM facilities under the main contractor Turkish Aerospace.

Under the project, F-16C/D Block 40 and 50 planes received the common configuration upgrades as follows:

- Advanced Modular Mission Computer
- Advanced AN/APG-68(V)9 radar
- AN/APX-113 AIFF
- LINK-16
- Self Protection Electronic Warfare System (SPEWS-II)
- LANTIRN-ER Navigation Pod
- SNIPER / ASELPOD Targeting Pod
- Joint Helmet Mounted Cueing System (JHMCS)
- Integrated GPS/INS System
- Full-color MFD
- Electronic Data Entry System

50 AGM-154A, 50 AGM-154C, 50 AGM-84K SLAM_ER, 50 CBU-105, 200 GBU-31, 200 GBU-38, 127 AIM-9X, 107 AIM-120C-7, 30 AN/AAQ-33 Sniper Targeting Pod, 30 AN/AAQ-13 LANTIRN ER navigation pod and 20 ASELPODs were also purchased for use on the PO-III and PO-IV aircraft.

The PO-III program was successfully completed on April 10, 2015, with the

F-16C Block-30TM (Turkish Modernization) aircraft with the DB-110 reconnaissance pod

delivery of the F-16D Block 40M (aircraft that received CCIP modernization are identified with M) with tail number 89-0044.

At the Defense Industry Executive Committee (SSIK) meeting held in December 2006 for the Peace Onyx-IV program, the Undersecretariat for Defense Industries (SSM) was authorized to procure 30 F-16 Block 50+ (16D and 14C) aircraft from Lockheed Martin via the Foreign Military Sales (FMS) channel. Accordingly, Turkish Aerospace signed a contract with the main contractor, Lockheed Martin, on December 5, 2008. The program ended with the last F-16D Block 50+ (07-1030) delivered on December 11, 2012. This aircraft is the 308th and last aircraft produced by Turkish Aerospace. Unlike the PO-III, the PO-IV aircraft are equipped with the AN/ALQ-211(V)4 Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS). These aircraft can carry a CFT. The F-16D Block 50+ aircraft also feature a Dorsal Spine. In this way, the AN/ALQ-211(V)4 can be carried internally, allowing the aircraft to be used for combat missions. Unlike other F-16C/D planes in the Turkish Air Force inventory, Block 50+ aircraft are painted with a special radar-absorbing (RAM) paint called Have Glass II, which reduces the plane's radar cross-section. Additionally, the liquid oxygen system in previous models was replaced with the On-Board Oxygen Generating System (OBOGS), which is safer and easier to maintain.

The Özgür Project, which started on December 15, 2010, at the request of the Air Force Command, aims to equip 35 F-16 Block 30 aircraft, which were not modernized under the CCIP project, with a national mission computer (OFP) and national avionics. With the nationalization of mission computers, the project aims to ensure the integration of national air-to-air and air-to-ground munitions. The experience will be used in the Hürjet and MMU projects. Aselsan will develop the hardware of the mission computer to be used in modernization, and Turkish Aerospace will develop the OFP software. An F-16C Block 30 (87-0019) was used as the prototype aircraft in the project. The cockpit of the plane was also updated, and a new full-color multifunction display (MFD), middle cockpit display and engine display have been added. Work on the first aircraft continue within the scope of the project.

For the 19 F-16D Block 50, 13 F-16D Block 40, and 8 F-16D Block 30 aircraft that are in the Turkish Air Force inventory and do not have an active Electronic Warfare system, a total of 42 (in two batches) Exelis AN/ALQ-211(V)9 Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS) pods were procured via the Foreign Military Sales (FMS) channel. The pods have an all-digital radar warning receiver, broadband digital radio frequency memory (DRFM), ALQ-213 Countermeasure Set (CMS), in-flight reprogramming, and both low (B, C, D) and high (J and K) Radio Frequency jamming capabilities.

On 24 December 2012, 4 DB-110 reconnaissance pods and 2 Image Analysis Stations (one fixed and one mobile) were ordered. Although the pods were initially planned to be integrated into F-16C/D Block 50+ planes, the contract was later renewed to integrate them into F-16C/D Block 30 planes. A new Operational Flight Program (OFP) was needed for integration into the F-16C Block 30s. F-16C Block-30TM (Turkish Modernization) planes in which the pods are integrated were modernized in the 1st HIBM before integration and some of their avionics, especially the mission computer, were upgraded. The old generation EFCC Mission Computer used in the aircraft was replaced with the GAC Mission Computer with national OFP, which was removed from the F-16C Block 40 aircraft modernized under the CCIP program, and the LN-39 INS/GPS was replaced by the more advanced LN-93 INS/GPS. This project was carried out by the 1st HIBM's Technology and Weapon System Development Command, using completely national capabilities. The integration of the pods was completed with the test flights of the 401st Test Squadron.

Under the F-16 Block 30 Structural Modernization Program contract signed on 10 August 2015, structural improvement work was started to increase the service life of 35 F-16C/D Block 30 aircraft. With this modernization, the service life of the F-16C/D Block 30 aircraft was planned to be extended to 12,000 hours from 8,000 hours.

Turkish Air Force F-16C Block 40M (Falcon-up) during aerial refueling. This particular F-16 (90-0011) is also the former aircraft of the "Solo Türk" Demo Team

The F-16 is one of the most upgraded aircraft in aviation history. There is a lot of difference between its original purpose and its current use. It reached a completely different level in terms of capability. It evolved from a lightweight day fighter to a deep strike aircraft in a few decades. It is more than enough to look at the production numbers and the number of users to understand how successful the design is. If we look at Turkey, the F-16 changed our aviation industry as much as it changed our military aviation. Thanks to the "Fighting Falcon," we now have an aviation industry that started with assembly and then continued on with production and modernization, and now we can design our own aircraft. "Build Your Own Plane" came true. As the main strike force of our Air Force for 33 years, F-16 fighters will continue to be our main strength in the skies for a long time to come thanks to our indigenous munitions, national modernization projects such as "Özgür" and the continuous development of our defense industry ■

F-16 "Özgür" Cockpit