International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 10 ǁ October 2023 ǁ PP. 388-393

Advantages Of Fıfty Generatıon Warplanes

Rüştü GÜNTÜRKÜN
Department of Aviation Electrics and Electronics, School of Civil Aviation, Selcuk University,
rustu.gunturkun@selcuk.edu.tr, Konya / Turkey

ABSTRACT: *The fifth generation fighter jet, which has been developed and continues to be developed today, has the capacity to operate effectively in combat environments against the most capable air and land threats and future threats. Fifth-generation fighter jets are defined by stealth, precision attack capabilities, speed, agility and situational awareness that make a huge difference on the battlefield. Fifth generation aircraft have a powerful software and infrastructure to collect, evaluate and present information to decision makers with appropriate tools. These aircraft also feature integrated avionics that autonomously combine and prioritize the aircraft's sensors and off-board data, informing the pilot accurately and in real time, and providing data for post-mission analysis.*

Date of Submission: 18-10-2023 Date of acceptance: 02-11-2023

I. INTRODUCTION

These aircraft also feature integrated avionics, which autonomously fuse and prioritize the aircraft's multi-spectral sensors and off board data, providing an accurate real-time operations picture for the pilot, and the ability to download data for post-mission analysis. This is a present-day example of 'man-machine teaming'[1]. The Chengdu J-20 is a fifth-generation twin-engine stealth fighter developed by Chengdu Aircraft Industry Group. J-20 made its first flight on January 11, 2011[2][3] and entered service in 2017.[4][5][6] The J-20 is the world's third operational fifth-generation stealth fighter aircraft, after the F-22 and F-35.[7].

II. 5th Generation Fighters, Stealthy & Lethal

Fifth-generation fighter aircraft are known for stealth, precision attack capabilities, speed, agility and situational awareness which makes a huge difference in the battle-space. Fighter aircraft are continuously evolving and there is already talk of 'sixth-generation', though they may not be up in the skies until the 2030s. Meanwhile, 'fifth-generation' aircraft are going strong, including those in the development stages. Presently, Lockheed Martin F-22 Raptor which entered service with the United States Air Force (USAF) in 2005, the Lockheed Martin F-35B Lightning II, which entered service with the US Marine Corps in 2015. the Lockheed Martin F-35A Lightning II, which entered service with the USAF in 2016 and the Chinese Chengdu J-20 which entered service with the People's Liberation Army Air Force (PLAAF) in March this year, are already showing their prowess in different kinds of deployment. Meanwhile, the Lockheed Martin F-35C Lightning II, Sukhoi PAK FA, Hindustan Aeronautics Limited (HAL) Advanced Medium Combat Aircraft (AMCA), Shenyang J-31 and Mitsubishi X-2 Shinshin, are under various stages of development[8].

III. 5th Generation aircraft

5th Generation aircraft are multi-role warplanes that can successfully perform all kinds of missions, including new tasks that other aircraft cannot do, with the advanced technology they use. In operational areas where 4th Generation aircraft have difficulty adapting, 5th Generation aircraft change the power dynamics, creating a battlefield where their opponents must adapt. "Network Based Talent NBC" stands out as one of the most critical talents here. NBC is defined as a concept based on the creation of capability packages in which 5th Generation air platforms will actively operate with all command and control components and provides a force structure accordingly.

Collecting, evaluating and presenting information to decision makers with appropriate tools on today's 5th Generation platforms requires very powerful software and infrastructure. The National Combat Aircraft (MMU), on which the software of more than 20 million lines and the software consisting of hundreds of modules will work together, is defined as a "flying computer" because it is a 5th Generation aircraft and performs the functions mentioned above [9].

III.I. 5th Generation aircraft Characteristics

The emerging generation of advanced fighter aircraft in the first decades of the 21st century has come to be known as the fifth generation. The defining characteristics of such a fifth-generation fighter are not universally agreed upon, and not every fifth-generation type necessarily has them all. Some generation counts include more than five

leading up to the emerging new generation. Whereas previous fourth-generation fighters emphasized maneuverability and close-range dogfighting, typical fifth-generation characteristics include:
Stealth, with munitions stored internally.
High maneuverability, which tends to include short-field capabilities.
Supercruise, i.e. prolonged supersonic cruise without the use of reheat.
Advanced avionics, including low-probability-of-intercept radar (LPIR).
Networked data fusion, enabling situation awareness on the battlefield.
Multirole capabilities, such as battlefield C3 (command, control and communications).
In order to minimize their radar cross-section (RCS), most fifth-generation fighters use chines instead of standard leading edge extensions and lack canards, though the Sukhoi T-50 has engine intake extensions that seem to function somewhat like canards, and the Chengdu J-20 designers have chosen the agility enhancements of canards in spite of their poor stealth characteristics. They all have twin canted vertical tails (similar to a V-tail) also to minimize side RCS. Most fifth-generation fighters with supermaneuverability achieve it through thrust vectoring[10].

IV. Fifth Generation Fighters 2000 to Present

V.1. F-22 Raptor First Off the Block

The F-22 Raptor was the first of the fifth-generation to showcase air superiority platform. It has a unique combination of stealth, speed, agility and situational awareness, combined with lethal long-range air-to-air and air-to-ground weaponry. The aircraft has demonstrated precision attack capabilities, decimating both air and ground-based targets with unparalleled lethality and survivability. The F-22 is leading US AF transformation efforts. Its ability to penetrate airspace, while finding, tracking and targeting enemy air and ground-based threats, helps all joint forces. The Raptor's unique combination of advanced stealth, super cruise, advanced maneuverability and integrated avionics allows it to "kick down the door," and then follow up with 24-hour stealth operations and freedom of movement for all followon forces fully leveraging the Raptor's technological advantages[11].

V.1.1. Full-scale development

Aside from advances in air vehicle and propulsion technology, the F-22's avionics and software were unprecedented in terms of complexity and scale, with the fusion of multiple sensors systems and software integration of 1.7 million lines of code.[12] To enable early looks and troubleshooting for mission software development, the software was flight-tested on a Boeing 757 modified with F-22 mission systems to serve as the Flying Test Bed avionics laboratory[13]
The F-22 program is developing the next-generation air superiority fighter for the Air Force to counter emerging worldwide threats. It is designed to penetrate enemy airspace and achieve a first-look, first-kill capability against multiple targets. The F-22 is characterized by a low-observable, highly maneuverable airframe; advanced integrated avionics; and aerodynamic performance allowing supersonic cruise without afterburner[14].
Stealth: Greatly increases survivability and lethality by denying the enemy critical information required to successfully attack the F-22
Integrated Avionics: Allows F-22 pilots unprecedented awareness of enemy forces through the fusion of on- and off-board information
Supercruise: Enhances weapons effectiveness; allows rapid transit through the battlespace; reduces the enemy's time to counter attack[14].

Figure 1. F-22, Raptor 4001(Two F-22 during flight testing)

V.II. F 35A Fighter

The F-35A model is designed to take off from standard runways and is the model to be used by most countries. The F-35B model is designed specifically for use on aircraft carriers that can perform Vertical Landing and take-off and landing (STOVL) in short pits. The F-35C model was designed for the American Navy. It prefers

the CATOBAR system as a landing and take-off system. It is based on the principle that as the plane lands, the hook on the plane catches the rope on the ship and releases all its kinetic energy to the rope. When taking off, the aircraft is accelerated by steam pressure (electromagnetic in new ships) and lifted from a very short distance[15].

The F-35's low observable stealth allows it to safely enter areas without being seen by radars that 4th generation fighters cannot evade. The combination of the stealth features, the F-35's active electronically scanned array (AESA) radar technology, and the aircraft's ability to carry weapons internally means the F-35 can engage ground targets at long ranges without detection and use precision weapons to successfully complete air-to-ground missions[16].

Figure 2. Structure of F 35A Lightning II[17].

V. Sukhoi Su-57

The Su-57 is a twin-engine stealth multirole fighter designed in the 1970s. Development was halted due to the fall of the Soviet Union, but an upgraded version has slowly started to make its way into Russian service. In 2020, Russia's Defence Ministry said that the Felon had entered its fleet with the delivery of the first production aircraft to an aviation regiment of the Southern Military District. The ministry plans to have an entire Su-57 regiment of 24 aircraft ready by 2025. The Felon's avionics are also a step up from other fighters in Russian service with an advanced onboard computer. The avionics package includes active electronically scanned array (AESA) radar and ELINT systems. The aircraft is armed with air-to-surface missiles, air-to-air missiles, and 30mm guns for close combat[18].

Figure 3. Su-57 (T-50-4) multirole fighter

VI. Chengdu J 20

The J-20 is designed as a multi-role aircraft capable of performing air superiority, air defense and ground attack missions. It is equipped with a number of advanced systems, including an Active Phased Array (AESA) radar, an advanced cockpit display, and a high-capacity data link.[19]

The J-20 made its first flight in 2011 and its first low-rate production started in 2015. It was officially accepted by the Chinese air force in 2017 and 570 units were planned to be produced. The J-20 has a canard-delta configuration, blended fuselage with low radar cross-section, large canted twin tails, and internal weapons bays for long- and short-range missiles to reduce radar cross-section. It also has large fuel tanks for long-range missions and can perform high-speed operations[20]. Two Chengdu J-20s made their public debut at Airshow China 2016. It has three variants: the initial production model J-20A, the thrust-vectored J-20B, and the twin-seat aircraft süite capable J-20S1.

Figure 4. Chengdu J 20

This is why many fifth gen fighters have much straighter lines than fighters from previous generations: it's about reflecting those signals in any direction that's not directly back at the radar. In addition to this, many are painted with radar-absorbing paint, so that those radar signals that do get reflected back at the radar (remember: "stealth" doesn't mean "invisible" it just means "less visible") are considerably weaker, and thus "spoof" the radar.

A few famous (or should I say infamous?) fifth gen fighters include the F-35 Lightning, Sukhoi Su-57, Shenyang FC-31, F-22 Raptor and Chengdu J-20. There are presently several fifth generation fighters under development, such as the TAI TFX in Turkey and Sukhoi Su-75 in Russia[21].

VII. KAAN(Fifth Generation Fighter Aircraft)

The TAI Kaan,[22][23] (formerly known as TF-X) alternatively named TF ("Turkish Fighter"),[24] in Turkish as Milli Muharip Uçak (National Combat Aircraft),[6] abbreviated as MMU,[25] is a stealth, twin-engine,[26] all-weather air superiority fighter[27] in development by Turkish Aerospace Industries (TAI) and BAE Systems as its sub-contractor.[28][29] TAI Kaan is planned to replace the F-16 Fighting Falcon aircraft of the Turkish Air Force and to be exported to foreign states.[30] It was officially announced that the TF-X's prototype would be rolled out on 18 March 2023, and make its first flight by the end of 2023.[31][32][33][34][35][36] The taxiing and ground running tests of the prototype began two days before the scheduled roll-out, on March 16, 2023.[37][38][39][40] Its maiden flight is scheduled to take place in 2023.[22][23] It was officially given the name "Kaan" on May 1, 2023[41][42]. The fifth-generation aircraft has been developed by TAI with an aim to replace the F-16 aircraft in the inventory of the Air Forces Command, which is planned to be phased out starting in the 2030s. With this aircraft, Türkiye becomes one of the few countries with the infrastructure and technology to produce a fifth-generation combat aircraft.

Kaan is able to reach a maximum speed of 1.8 Mach thanks to its twin engines. With its high-performance radar, electronic warfare, electro-optics, communication, navigation and identification capability, it will achieve increased combat power with precision and accurate firing from internal weapon slots at high/supersonic speed. It also has automatic target recognition and detection, multiple data fusion and artificial intelligence capabilities. The project helped Türkiye advance in technology areas such as low visibility, internal weapons slots, high maneuverability, increased situational awareness and sensor fusion, all features that are required for a new generation aircraft[44].

Figure 5. 5th-generation-fighter[43]

VIII. CONCLUSION

In order to guarantee their sovereignty, countries want to ensure air superiority in combat that can perform multiple missions simultaneously. Thanks to artificial intelligence, fifth-generation fighter jets provide the pilot with instant situational awareness and support well-informed tactical decisions. The advantages of fifth generation warplanes over previous generations are that they have low visibility, they carry their ammunition in their pockets, their avionic systems are very advanced, they can rotate 360° against threats from the ground and air, and they use the EASE (Active Electronically Scanned Array Radar), radar, which can not be detected by enemy radars because the frequency and wavelength of each module used in the form of modules are different. It can be said as. The FSO(Front Sector Optronics) used in this aircraft is integrated into the aircraft body and can detect and identify targets in the air, at sea and on land separately from a long distance with high-resolution angular targeting and laser telemetry.

As a result, the United States, China, Russia and Turkey are making great efforts to realize the production of 5th Generation fighter jets.

REFERENCES

[1]. By General Jeffrey L. Harrigian , US AF, By Colonel Max M. Marosko III , US AF, Published: July 2017 in Journal Edition 24. https://www.japcc.org/articles/fifth-generation-air-combat/
[2]. "Chinese Stealth Fighter Makes First Flight". Fox News. 11 Ocak 2011. 16 Mart 2015 tarihinde kaynağından arşivlendi. Erişim tarihi: 1 Ekim 2015.
[3]. Sweetman, William (3 Ocak 2011). "China's J-20 Stealth Fighter In Taxi Tests". Aviation Week. 20 Kasım 2011 tarihinde kaynağından arşivlendi. Erişim tarihi: 1 Ekim 2015.
[4].《面对面》 对话何为荣： 中国正在研制第四代战机" (Çince). Xinhua. 2 Şubat 2013. 10 Temmuz 2017 tarihinde kaynağından arşivlendi. Erişim tarihi: 1 Ekim 2015.
[5]. "第四代战机，中国等不了十年！" (Çince). China Daily. 12 Mayıs 2015 tarihinde kaynağından arşivlendi. Erişim tarihi: 1 Ekim 2015.
[6]. "编号78272：第二架五位数编号歼-20曝光 部署沧州". news.ifeng.com. 12 Aralık 2016. 1 Mayıs 2017 tarihinde kaynağından arşivlendi. Erişim tarihi: 12 Mayıs 2017.
[7]. Seidel, Jamie (20 Ekim 2017). "With the J20 stealth fighter in fully operation service, China leaps ahead in Asian arms race". Australian News (İngilizce). 26 Şubat 2018 tarihinde kaynağından arşivlendi. Erişim tarihi: 14 Temmuz 2022.
[8]. By R. Chandrakanth, SP's aviation, https://www.sps-aviation.com/story/?id=2102, Issue: 08-2017
[9]. https://www.turkishdefencenews.com/mam-l-smart-micro-munition/
[10]. https://www.wikiwand.com/en/Fifth-generation_fighter, 02/10/2023
[11]. https://www.sps-aviation.com/story/?id=2102, 05/10/2023
[12]. "F-22 aircraft No. 4005 completes successful first flight." Archived 29 June 2017 at the Wayback Machine Federation of American Scientists. Retrieved 23 July 2009.
[13]. Kohn, Lt. Col. Allen E. and Lt. Col. Steven M. Rainey. "F-22 Flight Test Program Update." 9 April 1999. Archived from original.
[14]. https://man.fas.org/dod-101/sys/ac/f-22.htm, 09/10/2023
[15]. 18/04/2021, https://m5dergi.com/one-cikan/25305/, 10/10/2023
[16]. https://www.military.com/equipment/f-35b-lightning-ii, 10/10/2023
[17]. https://aerocorner.com/blog/the-five-generations-of-fighter-planes/, 2/10/2023
[18]. Sascha Brodsky, "Russia's Next-Generation Fighter Jet, the Felon, Is Now Bionic", Science and Technology, Feb 15, 2023.
[19]. "plarealtalk.com". ww1.plarealtalk.com. 22 Aralık 2022 tarihinde kaynağından arşivlendi. Erişim tarihi: 22 Aralık 2022.
[20]. "Chengdu J-20 Stealthy Air Superiority Fighter | Military-Today.com". www.military-today.com. 22 Aralık 2022 tarihinde kaynağından arşivlendi. Erişim tarihi: 22 Aralık 2022.
[21].https://aerocorner.com/blog/the-five-generations-of-fighter-planes/, 2/10/2023
[22]. "TF | Turkish Aerospace". www.tusas.com. Archived from the original on 9 August 2020. Retrieved 29 July 2020.
[23]. Joseph Trevithick (17 March 2023). "Our First Full Look At Turkey's New TF-X Stealthy Fighter". thedrive.com. Archived from the original on 18 March 2023. Retrieved 19 March 2023.
[24]. "Turkey advances TFX fighter project, orders new rifles, more F-35s, CH-47s", Jane's 360, archived from the original on 12 January 2015, retrieved 9 January 2015
[25]. "IDEF 2013: TAI reveals fifth generation fighter designs". Jane's Defence Weekly. IHS. 8 May 2013. Archived from the original on 27 March 2023. Retrieved 11 May 2013.
[26]. "BAE Systems signs Heads of Agreement for a future contract with Turkish Aerospace Industries for TF-X Programme". BAE Systems. 28 January 2017. Archived from the original on 20 June 2018. Retrieved 25 June 2018.
[27]. "Rolls-Royce and Kale Group create defence aero engine joint venture". Rolls-Royce. 8 May 2017.
[28]."Turkey to Replace F-16s With Local Jets". Hürriyet daily news. TR: Hürriyet Gazetecilik ve Matbaacılık. 29 March 2013. Archived from the original on 9 May 2015. Retrieved 29 March 2013.
[29]. "Temel Kotil CNN TÜRK'e açıkladı: Milli Muharip Uçak ne zaman uçacak?" (in Turkish). 9 January 2023. Archived from the original on 16 January 2023. Retrieved 9 January 2023.
[30]. Gareth Jennings (24 November 2022). "Turkish future fighter comes together ahead of 'victory day' roll-out". janes.com. Archived from the original on 17 February 2023. Retrieved 12 January 2023.
[31]. "Turkey's Domestic 5th Generation TF-X Fighter Jet Is On The Final Assembly Line". overtdefense.com. 25 November 2022. Archived from the original on 4 December 2022. Retrieved 12 January 2023.
[32]. "Image of the TF-X/MMU released by the Turkish Defence Industry Agency (SSB) on 8 January 2023". stargazete.com. 8 January 2023. Archived from the original on 13 January 2023. Retrieved 9 January 2023.
[33]. Gastón Dubois (8 January 2023). "TF-X/MMU: Turkey's future fifth-generation fighter is taking shape". aviacionline.com. Aviacionline. Archived from the original on 23 January 2023. Retrieved 9 January 2023.
]34]. Joseph Trevithick (10 January 2023). "Unique Sensor Setup Emerges On Turkey's Stealthy New Fighter". thedrive.com. Archived from the original on 14 March 2023. Retrieved 12 January 2023.

[35]. Anıl Şahin (17 March 2023). "Milli Muharip Uçak'ın piste çıktığı anlar". SavunmaSanayiST. Archived from the original on 18 March 2023. Retrieved 18 March 2023.
[36]. "SSB Başkanı Demir'den '18 Mart' mesajı: "MMU bugün pistin başında"". CNN Türk. 17 March 2023. Archived from the original on 20 March 2023. Retrieved 18 March 2023.
[37]. "Milli Muharip Uçak ilk kez piste çıktı". NTV. 17 March 2023. Archived from the original on 17 March 2023. Retrieved 18 March 2023.
[38]. "Images from the second day of the taxiing and ground running tests of the TAI TF-X (MMU) on 17 March 2023, released by Prof. Dr. İsmail Demir, President of the Turkish Defence Industry Agency". 17 March 2023. Archived from the original on 18 March 2023. Retrieved 18 March 2023.
[39]. "İlk uçuşa ilerleyen Milli Muharip Uçak sürprize hazırlanıyor". Anadolu Agency. 27 April 2023.
[40]. "Image of the TF-X (MMU) released by the Anadolu Agency (AA) on 27 April 2023". star.com.tr. 27 April 2023.
[41]. "Turkish Stealth KAAN Fighter will Replace American F-16 Fighter jets". The Military Curiosity. 2 May 2023.
[42]. https://en.wikipedia.org/wiki/Fifth-generation_fighter, 02/10/2023
[43]. https://www.turkishdefencenews.com/5th-generation-fighter-mmu/
[44]. By Daily Sabah, May 01, 2023, https://www.dailysabah.com/business/defense/turkiyes-homegrown-5th-generation-fighter-jet-named-kaan.