

5th Generation Fighter Jets and Their Role in 21st Century Military Strategy

Kamil Aykotalp GÜNDÜZ*

Department of Electronics and Automation / Selçuk University Kadınhanı Faik İcıl Vocational School, Turkey

**(aykotalp@selcuk.edu.tr) Email of the corresponding author*

(ORCID: <https://orcid.org/0000-0002-2290-5447>)

(Received: 11 July 2025, Accepted: 21 July 2025)

(5th International Conference on Scientific and Innovative Studies ICSIS 2025, July 15-16, 2025)

ATIF/REFERENCE: Gündüz, K. A. (2025). 5th Generation Fighter Jets and Their Role in 21st Century Military Strategy, *International Journal of Advanced Natural Sciences and Engineering Researches*, 9(7), 201-206.

Abstract – Fifth-generation fighter jets are revolutionary aircraft that represent the cutting edge of modern aviation technology. These aircraft have made a huge leap forward compared to previous generations with technological innovations that have fundamentally changed the paradigms of traditional air warfare. Features such as stealth technology, advanced sensor fusion, network-centric warfare capabilities, and high situational awareness have transformed these aircraft into not only air superiority platforms but also critical elements of information warfare. The most distinctive feature of this generation of aircraft is their low radar signature, achieved through exterior coatings that minimize radar wave reflection and internal weapon bays. Artificial intelligence-enabled mission computers, advanced electronic warfare and countermeasure systems, and software that integrates data from multiple sensors to reduce pilot workload make these aircraft truly intelligent systems. The number of countries with this technology is quite limited worldwide. While the United States maintains its leadership with the F-22 Raptor and F-35 Lightning II, China's Chengdu J-20, Russia's Su-57, and Turkey's KAAN (TF-X) project are significant developments in this field. Turkey has taken a significant step toward becoming the fourth country to possess this technology with its successful first flight in 2023.

Keywords – Advanced Sensor, Fifth-Generation Fighter Aircraft, Stealth, Warfare Systems, KAAN.

I. INTRODUCTION

The dynamics of today's air warfare have undergone radical changes with technological developments. In this context, 5th generation fighter aircraft have gone beyond being mere attack platforms and have become intelligent systems that provide information superiority on the battlefield. 5th generation aircraft offer effective solutions against contemporary threats, especially with their low stealth, advanced avionics, sensor fusion, supercruise and high environmental awareness. At the same time, thanks to their networked warfare capability, these aircraft create a force multiplier effect by working integrated with other elements.

5. generation aircraft are usually defined by the following technological criteria:

- External surface coating that deflects and absorbs radar waves
- Low radar signature thanks to internal weapon mounts

- Artificial intelligence-powered task computers
- Advanced electronic warfare and countermeasures systems
- Software that reduces pilot workload by combining data from multiple sensors

The best-known examples of this generation of aircraft include the US F-22 Raptor, F-35 Lightning II, China's Chengdu J-20, Russia's Sukhoi Su-57 and Turkey's KAAN (TF-X) [1].

The dynamics of modern air warfare have undergone a radical transformation with technological advances. Traditional concepts of air warfare have given way to new concepts of warfare based on multidimensional, network-based, and information superiority. At the heart of this transformation are fifth-generation fighter jets, which have evolved from mere munitions-carrying platforms into integrated systems that provide information superiority on the battlefield.

The development of 5th generation aircraft has emerged from the need to respond to a changing threat environment. The advancement of modern air defense systems, the increase in electronic warfare capabilities, and the diversification of asymmetric threats have rendered traditional 4th generation aircraft inadequate. This situation has necessitated the development of new generation aircraft that minimize radar visibility, possess highly advanced sensor fusion capabilities, and adopt a network-centric warfare concept [2].

The development of this technology is not only an engineering achievement but also a strategic necessity. Possessing 5th generation aircraft is of critical importance for a country to maintain air superiority and effectively defend against modern threats. Additionally, this technology is as significant for national security as it is for diplomatic power projection and technological prestige.

The steps Turkey has taken in this area, especially following its exclusion from the F-35 program, have gained great importance in terms of its independent defense industry goals. The KAAN project represents one of the most significant steps toward achieving independence in aviation technology.

II. MATERIALS AND METHOD

5. The countries that develop and produce 5th generation fighter aircraft are those that have advanced technology, large defense budgets and have generally established their own aviation industry. These countries and the 5th generation fighter jets they have developed are as follows:

Table 1. 5th Generation Fighter Producing Countries:

Country	Airplane Model	Status
USA	F-22 Raptor, F-35 Lightning II	In mass production, operational
Russia	Su-57 Felon	Limited edition, operational
China	Chengdu J-20 Mighty Dragon	In mass production, operational
South Korea	KF-21 Boramae	Prototype in flight, mass production in preparation (5+ generation candidate)
India	AMCA (Advanced Medium Combat Aircraft)	In development
Turkey	KAAN (TF-X)	Prototype flown (2023), testing underway

Turkey's Place in the Ranking:

Turkey aims to be among the top five countries producing 5th generation fighter jets and is one of the few countries to have reached the advanced prototype stage. KAAN's successful first flight in March 2023 puts Turkey among the few countries that currently possess this technology.

Location:

1. USA (leader, two different 5th generation aircraft)
2. China
3. Russia
4. TurkeyTR (prototype successfully flown, testing in progress)
5. South Korea / India (not yet operational)

With KAAN, Turkey is a strong candidate to become the fourth country to develop an independent 5th generation aircraft. If the development process is successfully completed and mass production begins, Turkey will be positioned as one of the leading countries in this field [3].

Table 2. Vehicle Features

Feature	Description
Stealth	Radar signature-reducing design and special coating
High Maneuverability	Dual-engine construction, advanced aerodynamics
Super Cruise	Ability to fly above the speed of sound for long periods of time (targeted)
Sensor Fusion	Combines information from all sensors and presents it to the pilot
Network Centric Warfare	UAV, UCAV can share data with other jets
Indigenous Weapon Systems	Compatible with GÖKTUG missiles, SOM-J, indigenous guided munitions

Key Technical Specifications (Targeted):

- Length: ~21 meters
- Wingspan ~14 meters
- Maximum speed: Mach 1.8+
- Maximum altitude: 55,000 ft
- Weapon Carrying Capacity: 10+ tons (internal and external weapon stations)
- Body Structure: Composite + design for low radar signature

Target achievements:

- 2023: First ground tests
- 2024: First flight
- 2028: Target to start mass production
- 2030s: Entered into Turkish Air Force inventory

Strategic Importance:

- Turkey's most important indigenous fighter jet project after being removed from the F-35 program.
- It will gradually renew the Turkish Air Force's aging F-4 and F-16 fleet.
- There is potential for export not only to Turkey but also to friendly and allied countries in the future [4].

III. RESULTS

5th generation fighter jets are a revolutionary step for air forces, reshaping the dynamics of modern warfare. With their technological superiority, these aircraft play a critical role not only in air combat, but also in global strategic superiority. Innovative features such as stealth, high maneuverability, super cruise and advanced sensor fusion make them not only air superiority tools, but also important elements in information warfare.

Table 3. Advantages

Feature	Description
Low Radar Visibility (Stealth)	Makes the aircraft difficult to detect by radar. Enables the neutralization of enemy air defense systems.
Advanced Sensor Fusion	Data from systems such as radar, IR (infrared) and electro-optics are combined to provide the pilot with simple and meaningful information.
Network Centric Warfare Capability	It can share real-time data with other air, land and naval assets. Airplanes behave as if they are "connected to the internet".
High Situational Awareness	The pilot perceives threats and targets much more clearly and quickly. This speeds up the decision-making process.
Supercruise Capability	The ability to fly above the speed of sound for long periods without the use of afterburners provides both stealth and fuel savings.

However, in addition to the advantages these aircraft offer, there are also serious disadvantages such as high costs, maintenance difficulties and technological dependencies. The sophisticated maintenance required by their stealth features and sensor systems complicate the operational continuity of these aircraft, and their development processes are also very long and expensive.

While only a few countries in the world have the capacity to develop this technology, Turkey has taken an important step towards becoming an independent power in this field with the KAAN (National Fighter Aircraft) project. These developments could enable Turkey's defense industry to become a competitive player in the global market [5].

Table 4. Disadvantages

Difficulty	Description
High Cost	Both development and production are very expensive. For example, the unit cost of the F-35 is around 80-100 million dollars.
Maintenance Difficulty	Stealth coatings are sensitive, aircraft maintenance costs are very high. Aircraft require advanced support for operational continuity.
Technological Dependence	Advanced sensors, software and engines are often foreign-dependent. Not all countries can produce all systems themselves.
Long Development Time	It may take 15-20 years to develop such aircraft. Technologies may also change in the process.
Pilot Training Difficulty	5th generation aircraft have very complex systems and pilot training is time-consuming and costly.
Internal Weapon Limitation	Weapons are hidden inside the hull for stealth, which limits the number of portable ammunition. The stealth feature is broken when external weapons are installed.

In conclusion, 5th generation fighter aircraft will continue to be the most powerful tools of the future in terms of war strategies and air superiority. They are of great importance not only as a military force, but also as a demonstration of national security and diplomatic power. However, for these technologies to be widely deployed, countries need to have strong defense budgets and technological infrastructures [6].

With the development of generation aircraft, not only physical power, but also information and technological superiority will come to the fore in air battles. This will make future wars multidimensional and more complex.

IV. DISCUSSION

5th generation aircraft are a significant evolution in modern warfare technologies and offer major advantages over previous generation aircraft in terms of radar visibility, maneuverability and battle management. Their stealth technology reduces the likelihood of detection by radars and other detection

systems, while their supercruise capability allows them to exceed the speed of sound. It also offers the ability to overcome enemy defenses and rapidly change position with its high maneuverability.

5th generation aircraft also stand out with their advanced sensor fusion and network-centric warfare features. These features enable the aircraft to share data with other platforms on the battlefield, enabling rapid threat detection and more effective targeting [7].

Prominent 5th generation fighter jets include models such as the F-22 Raptor and F-35 Lightning II (USA), Chengdu J-20 (China). Turkey's development of the National Combat Aircraft (KAAN) is also an important step for the domestic defense industry.

The reasons for the development of these aircraft include countering evolving air defense systems, adapting to the rapidly changing conditions of war and more effective battle management. However, they also have disadvantages such as high costs and maintenance difficulties. Nevertheless, 5th generation aircraft continue to play a critical role in warfighting strategies.

V. CONCLUSION

Fifth-generation fighter jets are revolutionary platforms that are shaping the future of modern air power. These aircraft have fundamentally changed traditional air combat paradigms and significantly enhanced the operational capabilities of air forces thanks to their technological superiority. Stealth technology, supercruise capability, advanced sensor fusion, and network-centric warfare features have transformed these aircraft from mere air superiority tools into critical elements of information warfare.

However, the cost of this technological superiority is also quite high. The lengthy development process, which takes 15-20 years, unit costs of 80-100 million dollars, operational constraints caused by maintenance difficulties, and risks of technological dependency are factors that limit the widespread use of these aircraft. Additionally, the sophisticated maintenance requirements needed to preserve their stealth capabilities and the complexity of pilot training make it challenging to ensure the operational continuity of these systems.

The limited number of countries worldwide that possess this technology demonstrates how complex and advanced 5th generation aircraft are. The leadership maintained by the United States in this field, the alternative platforms developed by China and Russia, and Turkey's success with the KAAAN project highlight the intensity of the technological competition in this area.

Turkey's progress toward becoming the fourth country to possess 5th generation aircraft technology with its KAAAN project represents a historic achievement for the country's defense industry. The successful first flight in 2023 was a concrete demonstration of Turkey's determination to develop independent capabilities in this field. With series production targeted to begin in 2028 and the KAAAN expected to enter the Turkish Air Force inventory in the 2030s, it will be a critical platform shaping Turkey's air power in the coming decades.

In the future, the role of 5th generation aircraft in warfare strategies will grow even further. These aircraft will no longer be merely a physical force but will become the fundamental tools of information and technological superiority. With the advancement of artificial intelligence technologies, the enhancement of autonomous system capabilities, and the further development of network-centric warfare concepts, future air battles will evolve into a multi-dimensional and complex structure.

In conclusion, fifth-generation fighter jets have solidified their position as indispensable elements of modern air power. Possessing this technology has become one of the cornerstones of countries' national security strategies, while also carrying critical importance in terms of technological independence and strategic freedom. Turkey's progress in this area should be regarded as an extremely important step toward realizing the country's defense industry vision.

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