CENTRE FOR JOINT WARFARE STUDIES

CENJOWS

STEALTH FIGHTERS – CHINA'S J-20

EVALUATION OF THE BLACK EAGLE (J20's) POTENTIAL

1. J 20 is one of the two stealth fighters developed by China. The other, FC-31, a smaller twin engine multirole stealth fighter is being developed by the Shenyang Aircraft Corporation and is being marketed for the international customers. It first flew in 2012 and later a modified version in 2016 but, has been rejected by People Liberation Army Air Force (PLAAF) in favour of J 20.[1] Chengdu J-20 is a single-seat, twinjet, all-weather, stealth, fifth-generation fighter aircraft developed by China's Chengdu Aerospace Corporation for the People's Liberation Army Air Force is a multirole stealth fighter which is can carry out both offensive and defensive operation. It flew the maiden flight in Jan 2011 and entered in service in 2017-18. It has been officially endorsed by China and as per media reports it holds nearly 150 air craft in its inventory. It can fly up to the maximum speed of 2100 km, has a maximum range of 3400km and service ceiling of 18000m.[2] Its multirole performance, weapons and radii of action has prompted the analysts to assert that it has given China a potential to project power beyond its shores.[3] However, there remain questions on its stealth, ability to carry out sustained high speed and capacity to carry the armament load in comparison to the other operational 5th generation fighters. J 20 also faces criticism for being a copy and product of reverse engineering. Its front airframe resembles F 22 (Raptor) and the rear section with Sukhoi T 50.[4] This criticism may be unjustified as there remains not much variety

---

[1] ***www.aninews.in/news/world/asia/chinas-j-20 fighter-turns -ten***
[2] ***https://www.airforce-technology.com/projects/chengdu-j20/***
[3] ***https://chinapower.csis.org/china-chengdu-j-20/***
[4] ***https://www.wionews.com/photos/in-dogfight-over-himalayas-between rafale=-vs-chinas-j-20-stealth-fighter-who-wins-326656\j-20-aircraft-blackeagle-326643***

in stealth air frame designs. The dual seat version under development/testing is specific to J20 since F22 /F35/ SU57 do not have dual pilot versions. Chinese two crew aircraft is meant provide better ability to exploit the enormous information from sensors and networking and also enable manned and unmanned teaming. The aircraft will perform roles for the PLAAF, it would as well be operated from the aircraft Carrier of the People Liberation Army Navy (PLAN).

2. **Characteristics of 5th Generation Aircraft.** The characteristics of 5th generation are not universally accepted but what makes a so-called "fifth-gen" fighter is a combination of:-

(a) Stealth.

(b) High maneuverability, super-cruise.

(c) Advanced avionics.

(d) Networked data fusion from sensors and avionics.

(e) Ability to assume multiple roles.

3. Most of these features are present in the J 20. As per estimate till date 150 units[5] of J 20 are manufactured and it figures prominently amongst the operational four 5thgeneration aircraft i.e. F22 and F 35 (America), SU 57(Russia). A critical evaluation of the aircraft as a 5th generation fighter with 5th generation attributes will help in impartial assessment of the aircraft potential.

4. **Stealth.** Some analysts do not agree with the stealth feature being a major qualification of fifth generation aircraft. It is contended that low radar cross-section and use of radar-absorbent surface coatings may make the radar less detectable, but these do not make it invisible. The fighter will eventually become visible on switching of its air borne radar which is something like turning on a flashlight in a dark room. The aircraft is detectable due to IR emission of the exhaust by the adversary's Infrared Scan and Track (IRST) facility. Secondly, this aircraft has a good frontal stealth feature but, not side plane and rear view. The emphasis on frontal stealth makes it an effective long-

---

[5]www.eurasiantimes.com/chinese-j-20-miles-to-go-before-it-can-counter-us-f-35s-dominance/?amp

range interceptor, meant for mid-air engagements of particularly of AWACS and fuel Tankers using its BVR capability. Others opine that J-20 as a long-range strike aircraft, best suited for penetrating enemy air defenses and damaging critical infrastructure on the ground. Such high-value targets would include airfields, command bases, and other military installations.[6] How J 20 will be eventually utilized by the Chinese is a matter of speculation but undoubtedly the stealth feature is a big advantage against the Active Air Defences.

5. The stealth features while makes the aircraft less discernible to high frequency surveillance radar, is not as stealthy to the radars operating on low frequency. Therefore, defended areas must necessarily have complement of low and high frequency radars to detect stealth aircraft threats and also to tackle incidence of jamming unleashed by them. It is expected that stealth feature of J 20 will improve in the later upgrades.[7] In comparison both F22 and F-35 have lower radar cross section than J 20 in all planes of view and are therefore, more stealthy.

6. **High Maneuverability/Super-cruise.** As a principle, the combination of stealth and super cruise will yield high lethality and survivability as well as provide capacity to cover large range. The presence of a canard-delta configuration will eventually provide both efficient supersonic cruise, and good supersonic and transonic manoeuvre performance when fitted with engines of sufficient thrust rating. The high manoeuvrability/super cruise is dependent on the thrust generated by the engines. It is an open secret that J-20 with its current interim engines (Russian Al-31FN and indigenously developed WS-10C) till replaced with powerful engine can perform limited degree of super cruise. The WS10C is the modified version of WS10 which is already being used in Chinese fourth generation aircrafts J10 and J11. An upgrade with indigenous WS-15 engine is planned which will help in exploitation of its intended kinematic potential in terms of manoeuvrability and super cruise.[8] Shenyang Aero-engine Research Institute has been already manufactured WS15 engine as developed by the Xian Aero engine corporation.[9] But, air force is not happy and wants changes. PLAAF long term goal is to have engine matching the F119 engine used by the American F22 Raptor.[10] Its modification process has been delayed due to the pandemic but, the Chinese are confident that WS15 after modifications will meet the specifications allow full exploitation of the operational potential of the aircraft. The aircraft is designed with canard which allows better kinematic performance even at the higher speeds, which is positively an advantage and fits is role as an air superiority fighter.[11]

7. **Armament/Stores**. The aircraft has eight hard points and a large belly weapon bay to carry armament stores (as visible in a photo in Zhuhai Air show in 2018). Each fighter carried a one PL-10 short-range air-to-air missile in each side bay plus four

---

[6]https://chinapower.csis.org/china-chengdu-j-20/
[7]http://www.ausairpower.net/APA-NOTAM-090111-1.html
[8]https://thediplomat.com/2021/01/j-20-the-stealth-fighter-that-changed-pla-watching-forever/
[9]www.flightglobal.com/an analysis-can -china-break the militar-aircraft-engine-bottleneck/116887.article
[10]www.thedefencepost.com/202109/30/j-20-upgrade-domestic engine/
[11]https://thediplomat.com/2021/01/j20the- stealth- fighter-that changed- pla- watching- for- ever/

long-range PL-15/PL21 missiles in the centerline bay. A staggered arrangement with six PL-15s may be possible in the future.[12] The PL-10E is roughly equivalent to the U.S. Sidewinder missile. The PL-15 is similar to the American Advanced Medium-Range Air-to-Air Missile (AMRAAM) and has the range of 200km while, PL10E is short range heat seeking missile meant for launch within visual bubble in combat. These are stored in small side-bays but, can be rotated outside prior to launch. While US F22 too has three bays but, its central bay holds six BVRs compared to four carried by J 20. By contrast US F 35 can carry two BVRs in the central Bay. Unlike US's F22 and F 35, J 20 does not carry guns which mean that aircraft will avoid close engagements. The significant benefit of using a gun is that it does not rely on the aircraft's radar system. Radar missiles must work in concert with the aircraft's radar, which are very susceptible to enemy aircraft manoeuvres and countermeasures.[13] The aircraft has not been designed to carry PL-X missile (range up to 400 km), may eventually get integrated. Carriage of PL-X would have given positive advantage in its air superiority role.[14] There are four hard points for carrying external tanks which would help extend its ferrying range but, are not likely to be used in the combat role since these will compromise the stealth of the aircraft.

15

8. Precision guided ammunition comprising bombs / missiles are carried for the strike role. Development and integration of strike weapons will allow the J-20 to serve in a strike and limited maritime strike role if required, while newer air to air weapons will further enhance its primary air superiority mission[16] Presently, J20 do not carry internal guns like F22/F35/SU57. Eventually the air craft may be modified to carry internal guns.

9. Chinese believe that dogfights are not relevant with engagements taking place at beyond visual range; hence investment in guns is unnecessary. Moreover, the use of guns in highly maneuverable platforms is a challenge. But in congested and contested environments, the use of guns helps, as Americans learnt after the Vietnam War. Both F22 and F35 have internal guns while Marine F35 has detachable gun pod. Enemy

---

[12]https://www.thedrive.com/the-war-zone/24841/chinas-j-20-stealth-fighter-stuns-by-brandishing-full-load-of-missiles-at-zhuhai-air-show

[13]https://nationalinterest.org/blog/reboot/chinas-stealth-j-20-has-problem-it-doesnt-have-gun-179034

[14]https://thediplomat.com/2021/01/j-20-the-stealth-fighter-that-changed-pla-watching-forever/

[15]https://www.thedrive.com/the-war-zone/24841/chinas-j-20-stealth-fighter-stuns-by-brandishing-full-load-of-missiles-at-zhuhai-air-show

[16]https://thediplomat.com/2021/01/j-20-the-stealth-fighter-that-changed-pla-watching-forever/

aircraft cannot jam the gun nor can the flares, chaff deceive it. As per the assessment of US analysts with absence of guns, J 20 most likely cannot succeed against even against F 15 air craft in combat.

10. A two pilot version of J20 is in offing. This development is based on the Chinese perception that extent of information is for beyond the capacity of single pilot to manage. [17]

11. **Advanced Avionics.** J20 has arrays of electro-optical and infrared sensors to obtain 360-degree coverage; it has the facility to fuse sensor data to form a common "picture" which it shares with friendly forces via a data-link. Such sensors could be particularly useful for detecting radar-eluding stealth aircraft.

12. Aircraft is equipped with an Active Electronically Scanned Array (AESA) radar, Electro-optical Targeting system (EOTS), Electro-optical Distributed Aperture System (EODAS), Data-link to transmit and receive digital data from other friendly platforms and drones if needed.

13. AESA radar which allows transmission and reception of array of frequencies in multiple beams is electronically steered at the target thus, allows stealth engagement and protection from jamming compared to passive electronically steered array (PESA) radar which transmits a single beam hence, suffers obvious disadvantages.

14. EODAS comprises six infrared sensors, flush mounted around the aircraft to provide 360 degree coverage for the pilot with sensor fusion combining the AESA radar signal with IR image to provide better situation awareness and supports the target detection and identification function of the EOTS.[18]

15. J-20 pilots also are equipped with helmet-mounted sights that allow them to target high-off-bore sight PL-10E heat-seeking missiles within a 90-degree angle of the plane's nose simply by *looking* at the target.[19]

16. **Engine.** J-20 still doesn't yet have the high-thrust WS-15 turbofans the PLAAF envisioned for them, and are currently using Russian AL-31FN or indigenously developed WS 10 C engines with both being deficient in performance. The WS-15 generates 23 percent more thrust than the AL-31FN, and would enable the J-20 to have sustained supersonic speeds without resorting to fuel-gulping afterburners. Thus, certain more aggressive projections of J-20 performance, such as a top speed of Mach 2.5, may be premised on engines that have yet to be fully developed. Chinese designers have also expressed interest in incorporating vector-thrust engines in the J-20. These have moving exhaust nozzles to assist in pulling off tight manoeuvres.[20]

---

[17]www.buisnessinsider.com.au

[18]www.aviationtoday.com/2008/08/01/industry-scan-59/

[19]https://nationalinterest.org/blog/reboot/just-how-dangerous-and-how-stealthy-chinas-j-20-plane-179964

[20]https://nationalinterest.org/blog/reboot/just-how-dangerous-and-how-stealthy-chinas-j-20-plane-179964

17. **Roles.** On a larger level, the J-20 works as an Anti access/Area denial (A2/AD) weapon, which aims to deny an opposing, force the ability to operate in vicinity of the Chinese mainland—far enough that many of the enemy's offensive military capabilities are automatically nullified. But executing long-range combat air patrols or stalking an enemy's vulnerable force multiplier assets are not the only ways such an aircraft could be put to use.[21] Possible secondary roles include air-to-ground, air-to-surface and suppression/destruction of enemy air defences. In addition, the J-20's advanced avionics can be leveraged to benefit lesser platforms within the air-to-air realm.

18. **Radii of Action.** J-20's range is expected to be between 1,200 and 2,700 kilometers. Regardless of this, the J-20's combat radius is likely to extend well-beyond the Chinese mainland. As per the global times report of November 14, 2018, the J-20 is now capable of aerial refueling, this could thus even extend its operational range across the Indo-Pacific.

19. **Strategic Impact of J 20.** Most Air defence weapon systems, land based, ship-based radars and AWACS/AEWs predominately operate in X, S and L bands. These are heavily constrained against stealth air threats both in terms of acquisition by radar, guidance of missiles and kinetic intercept by aircraft or missile. Compared these, the low frequency radars in V/UHF while would give better performance and could detect stealth threats but at the cost some precision hence, not employed with the weapon radars and are primarily used for an early warning. Hence Active Air Defences should use U/VHF radars along with other detection radars to detect the stealth threats like J20 aircraft.

20. The West in particular has focused on high frequency based theatre ballistic missile defences which are heavily constrained against J 20. Russian on the other hand has developed low frequency detection system which would continue to detect stealth threats. Chinese have followed the Russian example and lay stress on the low frequency radars.

21. In strategic terms, J-20 will present a challenge to nearly all of the Integrated Air Defence Systems (IADS), air defence fighter fleets and weapons inventories deployed and operated by the United States and Asian countries, in any conflict involving China.[22]

22. The aircraft's size makes it a natural candidate for "lateral evolution" into other roles. J20 thus could be employed for range of roles namely Long Range Interceptor, air combat and escort role, theatre strike fighter using guided munitions, long-range theatre reconnaissance, as well as an electronic attack platform and even to launch air launched anti-satellite missile just as USAF used in 1980's to hit a satellite in LEO. In any conflict involving China, a well sized fleet of mature production J-20 would have significant freedom of action to attack and destroy aerial and surface targets throughout

---

[21]https://www.thedrive.com/the-war-zone/7806/chinas-j-20-stealth-fighter-photographed-toting-massive-external-fuel-tanks

[22]http://www.ausairpower.net/APA-NOTAM-090111-1.html

the geography up to the Second Island Chain. Thus may carry forward their agenda to exercise control till the second region.[23]

[24]

23. **Comparison with Contemporary Stealth Aircraft and AMCA.** As on date, there are four 5th generation operational jets in the world. Two of these F22 and F35 belong to the United States and others one each J20 and SU 57 are from China and Russia respectively**.** Comparison between these jets is inconsequential as these have been developed with different objectives and speciality in mind but, cursory focus on few collective features which define the generation of the aircraft including stealth and data fusion capabilities can be considered. In that, America's F22 is best in the category which J20 may match once planned more powerful engine WS15 is provided. F35, a joint strike fighter, though has less combat range, is an incredible sneaky flying computer range which can make other platforms more lethal. SU 57 is least stealthy but with thrust vectoring, is able to do tighter turns hence, versatile in manoeuvrability at higher speeds. J20B, a twin pilot version of J20 under development may also have thrust vectoring which will enhance its performance.[25]

24. **F22 (Raptor) V/S J20 (Black Eagle).** In US assessment, J 20 is no match to F22 or F 35. F22 (Raptor) has better stealth attribute, ability of sustained super-cruise and carries more ordnance than J20. F22 can carry 6xAIM120 AMRAM or 2xAIM120 AMRAM + two 1000lbs Joint Direct Attack Munitions (JDAM) in the central bay and two AIM9M or AIM9X sidewinder all aspect short range air to air missiles in the side bays. F22 can also carry 4xNon-stealth Aim9 side winders or two 600 gallons external fuel tanks on external hard points but, these naturally compromise the stealth characteristics of the aircraft. Stealth pods are being developed for stealthy carriage of ordnance.[26,27] F22 is also more manoeuvrable with its streamlined fuselage than J20 which has larger air frame. Besides, it also carries 20mm Guns which enhances its lethality in close combat. In comparison J20 can carry 4x PL12C/D and PL 21 AAM

---

[23]Ibid
[24]http://www.ausairpower.net/APA-NOTAM-090111-1.html
[25]www.buisnessinsider.com/russia-su57canot compete- us- chinese-5th-gen-fighetr-jets-2021-6?IR=T
[26]www.airforce-technolgy.com/projects/f22a-raptor/
[27]www.militaryfactory.com/aircraft/compare-aircraft

BVRs in the central bay with 2 x PL10 short range air to air missiles in the side bays. It has four hard external points for carrying fuel pods during ferry and has no guns. F22 ability of sustained super-cruise without using after burners enables raptor to pursue longer and more attack missions without having to return to refuel. However, this advantage would not be available once J 20 engine WS10C is replaced with more powerful WS15 which is already claimed to be developed and will provide J20 too with capability of super cruise matching F22. While not much is known about J20 avionics but, it is expected that it is provided matching types of avionics whose performances are not known. US experts are sceptical of the J20 performance. It is believed that weapon integration, sensor range, electronic warfare and targeting are F22 positive attributes. It estimated that it will outperform J20 in air to air engagement, out manoeuvre, and achieve better targeting with superior sensor fidelity.[28]

25. **J20 V/S F35 Lightening II**. F 35 was developed to replace United State's most fighter jets variants, is a single engine stealth air superiority fighter with ground attack capability and unlike F22, was developed in cooperation with several foreign partners and is intended for exports. It is much smaller in size has lesser speed (max1.6 mach compared to 2.1 mach of J 20) lesser range and operational ceiling but, it can carry large variety of armament including nuclear bombs for various roles, not much is known about the J20 except its standard armament as viewed from photographs, it positively less stealthy than both F22 and F35. Though, Chinese aircraft is equipped with comparable avionics but, American believes that these are very basic. American aircraft have pilot friendly cockpit displays that can indicate to the pilot various angles and ranges from which their aircraft can be detected by various enemy radars. Former US Air force chief Gen, David Goldfien commenting on J 20 performance told the media reporter, "Comparison between J20 and F35 is irrelevant. We apply 5th generation technology. It is no longer about the platforms but, about the family of systems. It is about networks that gives asymmetric advantage. The focus is on family of system approach where sharing of data is the key instead of fixating on the performance of individual platforms".[29]

26. **J20 and SU 57.** Just like J 20, not much is known about the Russian SU57 5th generation aircraft. However, Knowing Russian experience in aircraft designing, SU57 is expected to be better as air superiority fighter and as a ground attack platform which assisted by stealth design is meant to penetrate sophisticated air defences undetected and attack adversary's critical infrastructure and military assets. Like J 20, SU 57 is planning to upgrade its current AL41F1 engine with more powerful Saturnizdeliye 30 engines for better kinematic performance including supersonic cruise and manoeuvrability roughly at par with Raptor.[30] Russian fighter is assessed as less stealthy than its peers.

27. **J20 and Futuristic Advanced Medium Combat Aircraft (AMCA).** It is probably too early to compare operational J20 with futuristic AMCA which is still at the

---

[28]www.cnn,com

[29]https://nationalinterest.org/blog/repboot/stealth-fighter-death-dance-chinas-j-2--vs-f-35-stealth fighter- who- dies

[30]https://eurasiantimes.com-su-57-or- -j-20- who- will- emerge –winner- between- the- Russian-super-maneuverable- su-57-or- chinas- mighty- -j-20?

development stage. As per the recent media reports, its design has been frozen and development on air craft has commenced .AMCA will be single seat twin stealth all weather multirole fighter aircraft, The multirole design will cater for air superiority, ground attack, bombing , strike and other roles. The first flight is expected in year 2024-25 with an aim to start production from 2028 onwards. Supporting Indigenous development, Former air chief has told that air force strongly supports the development of fifth generation aircraft which even will have sixth generation characteristics.[31]

Will J20Pose any Major Threat to India?

28. Rafale, the newer aircraft in IAF inventory is a versatile aircraft. Rafale is 4.5 generation and lacks stealth characteristics but, in performance it is more than match to J20. While J20 can carry one mission at a time, Rafale in comparison can carry out several roles in a single sortie. However, armed with powerful sensors long range missiles, J20 could pose a serious threat to air refuelling, Airborne Early Warning Aircraft and critical support infrastructure. For this, J20 would rely on its BVR capabilities. J 20 design provides good high speed manoeuvring but, in absence of guns it will avoid air combat with even with fourth generation aircraft like Rafale which has led operations in Afghanistan, Iraq and Syria encompassing different terrain which gives it edge over J 20 which is largely untested. Rafale has 12 hard points and carry ordnance 1.5 times than weight. Which means it can carry weapons and fuel more than J20. It can carry Meteor, a BVR missile with range of 150 km and Scalp a long range cruise missile with a range of 200km. In present power configuration, J20 cannot super-cruise while Rafale can give sustained super-cruise with four missiles and underbelly fuel drop tank.[32] India's acquisition of Rafale has caused concerns with the Chinese. This is evident with their organisation of its Air Defences. Once, J20's WS10C engines are replaced with WS15engines, it is claimed that J20 would be able to fly at sustained super-cruise speeds. Assisted with stealth design J20 probably will be employed for high speed ingress to target AWACS, Refuelling aircraft and critical defence and civil assets with BVR/ARM/precision weapons. S400 deployment at suitable locations will plug J20's advantage.[33] In our defence calculations J20 long range, high speed approaches and its widespread dispersion at some well hardened deep underground locations in Tibet must be considered along with strategy to bypass/ neutralize Chinese dense air defences.

Conclusion

29. There are four 5th generation operational jets in the world and many more under development such as India, Turkey, Korea and Indonesia. Indian 5th generation aircraft's (AMCA) prototype is likely to roll out by 2024 with serial production by 2028. Hopefully, it will fill in capability gap with the Chinese J20 which is already operational and China has sizeable strength. J 20 is still underpowered and incapable of sustained high speed which is a vital performance parameter of 5th generation aircraft. Amongst

---

[31]www,economic times .indiatimes.com/news/defence

[32]https://defenceview.in/which-fighter= can supercruise-there-are- only- four/

[33]https://www.himdustantimes.com/india-news/iaf-saysitcan tackle- chinese-j-20=stealth- jets-with- s-400-missile/

the present list of four 5th generation aircraft the analysts rate F22 is the best. J20 aircraft would probably attain near comparative performance with F22 after replacement with more powerful engines which as reports is already developed and awaiting some modifications.

30. F35 Lightening II though single engine with lower speeds and lower ceiling is truly a multirole and versatile air superiority/attack aircraft. Unlike J20, It can carry large variety of armament including nuclear bombs for various roles. On the other hand, SU 57 is least stealthy but, versatile in manoeuvrability at higher speeds. A point for consideration is while other aircraft have been tested including SU57 which was deployed at Syria, J20 is still untested and much of the information is deducted from the aircraft photographs, air shows and state media leaks much of which is not reliable.