# CHINA'S AVIATION INDUSTRY PULLING AHEAD, YET CRITICAL TECHNOLOGY CHALLENGES

## ANIL CHOPRA

China conducted its biggest ever military parade on October 1, 2019, as part of its celebrations for 70 years of Communist Party rule. Some 580 pieces of military equipment and 160 aircraft participated.<sup>1</sup> These included the 5th Generation (Gen) fighter, the J-20, the latest strategic bomber-cumaerial refueller, the H6-N, and the Z-20 medium lift helicopter, similar to the US UH-60 Black Hawk. A new advanced radar system that could 'detect jets and missiles', and the latest HQ-9B surface-to-air missiles capable of intercepting multiple air strike weapons in a complex electro-magnetic environment were showcased, among many others.

China's massive military modernisation is being matched by an equally phenomenal growth of its military industrial base. The clear focus is to counter the primacy of the US military in the region. For long, China was accused of acquiring technology by reverse engineering Russian systems<sup>2</sup> in clear

- "China Celebrated 70 Years of Communist Party Rule", Zee News, October 1, 2019 at https:// zeenews.india.com/world/china-unveils-dongfeng-41-missiles-that-can-strike-us-in-30minutes-2237836.html.
- Wendell Minnick, "Russia-China Su-35 Deal Raises Reverse Engineering Issue", *Defense News*, November 20, 2015 at https://www.defensenews.com/air/2015/11/20/russia-china-su-35-dealraises-reverse-engineering-issue/.
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China's usurping of the South China Sea, by reclaiming islands and turning them into military bases was a part of the grand strategy to extend its zone of economic and military influence. Air is the preferred means of extending reach with lethality, and even among the ships, the crown jewels are the aircraft carriers. violation of intellectual property rights, or by acquiring top-end technology through cyber attacks, and espionage operations against Western firms. However, ever since it became an economic powerhouse, it has been in a position to invest in research and development. It has clearly focussed on platforms that will help it dominate the Western Pacific, military aviation and naval ship building. China's usurping of the South China Sea, by reclaiming islands and turning them into military bases was a part of the grand strategy to extend its zone of economic and military influence.

Air is the preferred means of extending reach with lethality, and even among the ships, the crown jewels are the aircraft carriers. As per the London-based International Institute for Strategic Studies, "Since 2014, China has launched more submarines, warships, principal amphibious vessels and auxiliaries than the total number of ships currently serving in the navies of Germany, India, Spain, Taiwan and the United Kingdom".<sup>3</sup>

China's aviation industry has also been leaping ahead. The People's Liberation Army Air Force (PLAAF) is still dominated by the Chengdu J-10 and Shenyang J-11/15/16 derivatives of the Russian Sukhoi Flanker family, although they have significant local avionics and weapons. The Y-9 turboprop and Y-20 jet airlifter are in serial production. Despite virtual disappearance from the media, China's FC-31 second stealth fighter jet is claimed to be proceeding smoothly and on schedule. Chinese armed drones have great potential to dig into Western markets. The Chinese military claims to have tested an unmanned single-engine biplane transport aircraft that successfully delivered cargo at a designated area.<sup>4</sup>

Nick Childs, "China's Naval Shipbuilding: Delivering on its Ambition in a Big Way", IISS Military Balance, Blog, May 1, 2018 at https://www.iiss.org/blogs/military-balance/2018/05/ china-naval-shipbuilding.

 <sup>&</sup>quot;Chinese Military Tests Long-Range, Heavy Aerial Delivery Transport Aircraft", Global Times, June 23, 2019 at http://eng.chinamil.com.cn/view/2019-06/23/content\_9536409.htm.

Despite great efforts and investments, the Chinese aircraft industry continues to struggle with critical technologies. China is still struggling to build reliable aircraft engines. It has been researching to develop thrust-vectoring aircraft engines for nearly two decades. At the 12th Zhuhai Air Show in November 2018, a J-10B, equipped reportedly with the indigenous thrust vectoring control nozzle, flew and performed aerobatic manoeuvres.<sup>5</sup> China is China has been pushing hard for arms exports, albeit mostly to relatively poor developing countries by offering price concessions, and attaching some political strings.

scouting to acquire or support cash-strapped engine companies around the world. The Ukrainian aircraft engine factory, Motor Sich, is a contender. This huge Soviet-era company is one of the advanced military aircraft engine manufacturers in the world. Thirty-five per cent of the company's \$450 million in sales in 2018 went to China, making China the company's biggest destination for its aircraft engines. China is interested in Ukrainian technology beyond Motor Sich. It is hiring Ukrainian engineers also in the missile and aircraft-building sectors and taking them to China. There are still question marks on the airborne radar and stealth technologies. However, significant research is going on in state-owned universities and research institutes. Also, China has been pushing hard for arms exports, albeit mostly to relatively poor developing countries by offering price concessions, and attaching some political strings.

## AVIATION INDUSTRY OF CHINA

## Aviation Industry Corporation of China

The Aviation Industry Corporation of China (AVIC) Ltd is a state owned aerospace and defence conglomerate ranked 151st in the Fortune Global 500

Kyle Mizokami, "The J-10 Fighter Plane Gets Thrust Vector Control", *Popular Mechanics*, November 7, 2018 at https://www.popularmechanics.com/military/a24742661/chinas-j-10thrust-vector-control/.

list.<sup>6</sup> It has over 100 subsidiaries, 27 listed companies and 446,613 employees across the globe. Established on April 1, 1951, during the Korean War as the Aviation Industry Administration Commission, after many systemic reforms, it got its current designation. AVIC was founded in November 2008 through the restructuring and consolidation of the China Aviation Industry Corporations I and II. Centred on aviation, its business units cover defence, transport aircraft, helicopters, avionics and systems, general aviation, research and development, flight testing, trade and logistics, assets management, finance services, engineering and construction, automobiles and more. AVIC purchased the American aircraft engine manufacturer Continental Motors in 2010, American aircraft manufacturer Cirrus in 2011, and American specialised parts supplier Align Aerospace in 2015. The major focus of AVIC is to efficiently develop indigenous military technologies, and to eventually compete with Airbus and Boeing in the civilian airline industry.

# Chengdu Aerospace Corporation

The Chengdu Aerospace Corporation (CAC) is a subsidiary of AVIC. It was founded in 1958 in Chengdu, Sichuan province. It designed and now produces the J-10 lightweight multi-role fighter and the J-20 5th Gen jet fighter, both of which are considered the most advanced platforms in China's inventory. It also produces the CAC/PAC JF-17 Thunder lightweight multi-role fighter in cooperation with Pakistan. China is credited for being the second country in the world, and the first in Asia, to possess 5th Gen and stealth technology. CAC employs 20,000 workers. CAC earlier produced the FT-5 trainer, J-7, and the McDonnell Douglas MD-80 parts, and later began producing the Airbus A320 and Boeing 757 components, such as vertical and horizontal tails. The first flight of the Chengdu J-10 fighter in 1998 gave the company the ability to produce 3rd Gen aircraft. The plant also produced the WP6 turbojet LM WP13 turbojet (a Chinese version of the Tumansky R-13 engine), and components for the Pratt & Whitney

<sup>6.</sup> Aviation Industry Corporation Of China, Fortune Global 500, https://fortune.com/global500/ 2019/aviation-industry-corp-of-china/

JT8D turbofan engines. CAC also manufactures the top end Pterodactyl 1 and Xianglong Unmanned Aerial Vehicles (UAVs).<sup>7</sup>

# Xi'an Aircraft Industrial Corporation

The Xi'an Aircraft Industrial Corporation was established at Xi'an in 1958. It employs 20,000 personnel. Its main products are the MA-60, MA 600 and under development M700 turboprop airliners. It also built the JH-7 Flying Leopard twin-engine fighter-bomber, and the H-6 twin engine bomber (a Chinese upgraded variant of the Tu-16 Badger). Currently, the H-20 strategic bomber is under development. It also manufactures the Y-7H trainer and wings and fuselage of the ARJ21. The twin engine turboprop transports, the Y-7 and Y-14, and the four engine Y-20s are also manufactured here. It specialises in transport aircraft and has built many variants of the Y-8. The Y-9 was a stretched variant of the Y-8, with greater payload and was China's attempt to build a C 130 J class transport aircraft.

# Changhe Aircraft Industries Corporation

The Changhe Aircraft Industries Corporation (CAIC) is the helicopter manufacturer based in the city of Jingdezhen in Jiangxi province. Changhe employs 4,300 employees in two production facilities. It has a joint venture with Agusta Helicopters and a working relationship with the Sikorsky Aircraft Corporation. A subsidiary factory is a major automobile company in China. Established in 1969, CAIC manufactures the WZ-10 attack helicopter, Z-8 heavy transport helicopter, and a few light utility helicopters. It also makes tail rotor pylons for the Sikorsky S-92 and fuselage for the Sikorsky S-76.

# Hongdu Aviation Industry Group

The Hongdu Aviation Industry Group Ltd., based at Nanchang, was established in 1951 and employs 20,000 personnel. It built the Q-5 'Fantan' (exported under the designation A-5) single-seat dual-engine supersonic

 <sup>&</sup>quot;Chengdu (AVIC) Wing-Loong (Pterodactyl)", Military Factory, September 11, 2018 at https:// www.militaryfactory.com/aircraft/detail.asp?aircraft\_id=1030.

attack aircraft based on the MiG-19. The Q-6 was a variable sweep-winged attacker, similar to the MiG-23BN but was cancelled later. Also, it built the prototype of the J-12, a 1970 Chinese lightweight supersonic fighter that was abandoned. The group builds most of the Chinese trainers, including the JL-8 and L-15. It has also built the multi-use agriculture and forest aircraft, the N-5 and many multi-purpose helicopters of the MD series.

# **Guizhou Aircraft Industry Corporation**

The Guizhou Aircraft Industry Corporation products include trainers, turbojets, UAVs, missiles and launchers. The JL-9 is a trainer based on the MiG-21U. The JJ-7 is the upgraded variant of the same. It also built the WZ-2000, Soar Dragon, and Harrier Hawk UAVs. Guizhou is also the plant to manufacture the WS-13 jet engine, used in the JF-17 and J-31 fighters.

# Harbin Aircraft Industry Group

The Harbin Aircraft Industry Group (HAIG), was founded in 1952 at Harbin. It has 6,700 employees, and was set up to manufacture domestic civil planes. Initially, the plant made the Mi-4 Russian helicopters and H-5 light bomber, a copy of the IL-28. Later, it started making the indigenously designed Y-11 light twin-engine utility aircraft and Y-12 utility Short Take Off and Landing (STOL) transport variant of the Y-11. Harbin has also been producing the Legacy 650 and ERJ 145 regional jets in a joint venture with Embraer. It also manufactures the BZK-005 high-altitude, long-range UAV designed by Beijing University of Aeronautics & Astronautics, for use by the Chinese Navy.

# Shanghai Aircraft Manufacturing Company

The Shanghai Aircraft Manufacturing Company is into manufacturing aircraft, parts and components, repair and overhaul, and many non-aerospace products. It is now part of the Commercial Aircraft Corporation of China (COMAC) which was established in 2008. It produced the ARJ21, Shanghai Y-10, MD-82, MD-83, MD-90 jet liners. It also manufactures the Airbus single

aisle family cargo door frame, Boeing 737 tail section assembly and Boeing 777 vertical stabilisers. It also makes the C919, a locally developed narrowbody twinjet airliner. The C919 was rolled out on November 2, 2015, and the aircraft's maiden flight was on May 5, 2017.<sup>8</sup> The fourth prototype made its maiden flight in August 2019. Its first commercial deliveries are expected in 2021. The aircraft is to be powered by either the CFM International LEAP or ACAE CJ-1000 turbofan engines, and will be able to carry 156 to 168 passengers. It is intended to compete primarily with the Boeing 737 MAX and Airbus A320neo. As of August 31, 2018, COMAC reportedly had 1,008 commitments, including 305 firm orders, mostly from Chinese leasing companies or airlines. The Shanghai Vantage Airship Manufacturing Company has been making non-rigid airships; the Shenyang Sailplane Factory makes sailplanes and training gliders, including motorised ones. China has also been making light electric aircraft and motor gliders.

## Aircraft Nomenclature

Chinese aircraft are prefixed with an alphabet donating the type of aircraft in the Chinese language (Fig 1).

	51
Prefix Alphabet	Aircraft Type
Н	Bomber
J	Fighter
JH	Fighter Bomber
JJ	Fighter Trainer
JZ	Reconnaissance Fighter
Q	Ground Attack Aircraft
L/JL	Trainer
Y	Transport Aircraft
Ζ	Helicopter
Е	Electric Aircraft

Fig 1: Chinese Aircraft Type Prefix

 The C919 was rolled out on November 2, 2015, and the aircraft's maiden flight was on May 5, 2017 at https://airlinerwatch.com/the-fourth-comac-c919-prototype-makes-its-maiden-flight/ AVIC built the Chinese indigenous fighters J-8 and J-10 by reverse engineering or cut and paste designs from Russian aircraft. The J-11 was an Su-27 variant. The J-15 is a Chinese multi-role 4th Gen naval aircraft, and the J-16 is a 4th Gen strike aircraft.

#### **Bombers**

Among the bombers manufactured by China were the H-5, a copy of the Il-28, since retired. The H-6, a copy of the Tu-16, had many variants and the aircraft is still flying with the PLAAF. The H-6K is the cruise missile carrying modernised bomber variant. The H-20 is the Chinese stealth bomber under development. The JH-7 Flying Leopard is a two-seat, twinengine fighter bomber in service with the PLAAF and PLA Navy Air Force (PLANAF). The latest variant, the JH-7E, was shown at the 2018 Zhuhai Air Show.

## Fighter Aircraft

The Chinese started their fighter aircraft production with the MiG-9 and MiG-15 (J-2). Subsequently, they built many Chinese variants of Russian aircraft, the J-5 (MiG-17), J-6 (MiG-19), and J-7 (MiG-21). They developed the FC-1(JF-17) multi-role light fighter jointly with Pakistan. The Q-5 was a ground attack aircraft based on the MiG-19. AVIC built the Chinese indigenous fighters J-8 and J-10 by reverse engineering or cut and paste designs from Russian aircraft. The J-11 was an Su-27 variant. The J-15 is a Chinese multi-role 4th Gen naval aircraft, and the J-16 is a 4th Gen strike aircraft. The J-20 is a 5th Gen fighter and the J-31 is a 5th Gen stealth fighter under development.

## Transport Aircraft

The Chinese have built many transport and passenger/communication duty aircraft. They initially license built the Yak-12 aircraft and Y-6 (II-14). Thereafter, they made many on their own by reverse engineering. The Y-5 was a copy of the Russian An-2, Y-7 (An-24 copy), Y-8 (An-12 copy). The Y-9 was a multi-purpose variant of the Y-8. The Y-10 and Y-11 were small utility

aircraft. The Y-20 is a large multi-purpose transport aircraft (66 tons payload) which first flew on January 26, 2013, and was inducted into service in 2016. The Y-30 is a four-engine turboprop military transport aircraft under development, with a planned load of 30 tons. China is also building many mid-sized turboprop and jet airliners, and business jets. It is working on developing larger airliners with up to 400 seats like the C-939. Some sources suggest that the Z-20 is a copy of the Black Hawk and link the design to the Black Hawk that was abandoned by the US Special Forces in Pakistan during the operation to kill Osama bin Laden on May 1, 2011.

#### Helicopters

Chinese helicopter production began with the Z-5, a copy of the Mi-4. The Z-6 was a turbo shaft engine variant of the Z-5. The Z-8 was a license built variant of the Aérospatiale SA 321 Super Frelon, and the Z-9, a license built variant of the Eurocopter Dauphin. The Z-9WA was a utility-cumreconnaissance variant. The WZ-10 is a Chinese attack helicopter. The Z-11 is a license built Eurocopter AS350, a single engine light utility helicopter. The Z-11WB is the reconnaissance variant. The EC-120 is a light utility helicopter through a joint venture with Eurocopter. The Z-12/15 is a medium transport helicopter of the 5/6-ton class for a range of military and civil requirements, built with Eurocopter's support. The Z-18 is a single-rotor helicopter with a tail rotor and non-retractable landing gear, based on the Avicopter AC313. It can carry 27 troops or 5 tons (11,000 lb) of cargo. The WZ-19 is a Chinese 4,250 kg, reconnaissance/attack helicopter variant of the Z-9, in service since 2012. China also operates the Sikorsky S70 medium utility helicopter. The Z-20 is a medium lift helicopter produced in China. It first flew on December 23, 2013. The 10 ton class helicopter can also operate from the Chinese aircraft carrier, the Liaoning. It is thought to be comparable to the US Sikorsky UH-60 Black Hawk helicopter, the civilian S-70 variant of which has been used by the People's Liberation Army (PLA) since 1984. Some sources suggest that the Z-20 is a copy of the Black Hawk and link

the design to the Black Hawk that was abandoned by the US Special Forces in Pakistan during the operation to kill Osama bin Laden on May 1, 2011. China also makes many civil helicopters.

# Trainers

China began making basic propeller trainers with the CJ-5 and CJ-6. It also made trainers for fighter aircraft like the J-5, J-6, and J-7. The JL-8 was the basic jet trainer-cum-attack aircraft developed with Pakistan. The JL-9 was the upgraded version of the J-7 trainer. The Xi'an-built specialised version of the Chinese Y-7, the HYJ-7 multi-purpose trainer is designed to provide training to the PLAAF pilots before transferring them to the bomber or transport units. The same aircraft is used to train the pilots and crew of the H-6 long range bombers. The Hongdu-Yakovlev CJ-7 (L-7) is a two-seat piston engine trainer aircraft jointly developed with Russia from the Yak-152. The L-15 Falcon is a supersonic advanced training and light combat aircraft built for the PLAAF and PLANAF as a Lead-In Fighter Trainer (LIFT).

# MILITARY AVIATION: NEW DEVELOPMENTS

China's military aviation industry has advanced at an impressive pace over the past decade. Aircraft manufacturing has switched from poor middle quality reverse-engineered copies to conceptually good home-grown products. The Chinese military aircraft are not the best in their class, and the Chinese are conscious of that. They have come a long way in flight performance, though they are still catching up, rather than leading with new designs. However, they are good enough considering the PLA's military doctrine and mission requirements. China is clear that it has no alternative but to research and develop its own. Chinese systems can be classified as high average in capability, but average in reliability.

# Current Developments: PL-15 Missile

The J-11B fighter jet became the latest user of China's self-developed world-

class PL-15 air-to-air missile.<sup>9</sup> The J-20 stealth fighter jet had carried the same type of missile and made a public display at the Chinese Air Show 2018 in Zhuhai. Wei Dongxu, a Beijing-based military analyst, compared the PL-15 with the USA's latest AIM-120 missile.<sup>10</sup> The US media outlet, the *National Interest*, claims that the PL-15's effective range could be much higher than the AIM-120's 180 km, but that could be an exaggeration, according to Wei. The PL-15 is also equipped with an Active Electronically Scanned Array (AESA) radar, which makes evasion very difficult. Wei suggests that the technology of the PL-15 has matured, so it can now be put on a variety of platforms. Equipped with the missile, the J-11B's aerial combat capability can be greatly boosted, the report said. Dubbed by Chinese military observers as the "aerial trident," the J-20, J-16 and J-10C fighter jets can all carry the PL-15 missiles.

## Advances in JF-17

The Pakistan Air Force (PAF) has over a 100 JF-17 'Thunder' aircraft. The development and production of the JF-17 Block 3 is underway, according to Yang Wei, a Chinese legislator and chief designer of the China-Pakistan codeveloped fighter jet, as he aims to enhance the jet's informatised warfare capability and weapons.<sup>11</sup> The JF-17 Block 3 is expected to be fitted with an AESA radar, and a helmet-mounted display and sight system. Pakistan, the main user of the JF-17, could further share information between the fighter and other platforms. China claims that with the new upgrade, the JF-17 Block 3 could match an improved version of the F-16 fighter jet. The upgrades like the new AESA radar are still under development, but the airframe, which remains roughly the same, has been given the production go-ahead. The JF-17 is often described by its manufacturer and military observers as an

 <sup>&</sup>quot;China's Most Powerful Air-to-Air Missile Equipped on Warplanes", *Defense Aerospace*, April
1, 2019 at http://www.defense-aerospace.com/articles-view/release/3/201268/china%27smost-powerful-air\_to\_air-missile-equipped-on-warplanes.html.

<sup>10.</sup> Chen Zhuo, "China's Most Powerful Air-to-Air Missile", *Global Times*, March 26, 2019 at http://english.chinamil.com.cn/view/2019-03/26/content\_9459759.htm.

<sup>11.</sup> Liu Xuanzun, "JF-17 Block 3 jet Expected to be Fitted with Active Electronically Scanned Array Radar", *Global Times*, March 11, 2019 at http://www.globaltimes.cn/content/1141710.shtml.

advanced cost-effective fighter. It was contending with India's Tejas and South Korea's FA-50 in Malaysia's new fighter jet purchase plan. Myanmar and Nigeria have reportedly purchased the Chinese-Pakistani warplane.

# J 20: Further Developments

China has plans to develop its most advanced stealth fighter jet, the J-20, into a bomber, Electric Warfare (EW) aircraft and a carrier-based variant. Reports suggest that a two-seat version of the warplane is under development. All current stealth fighter jets feature a single seat, so the potential J-20 variant might become the first two-seat stealth fighter jet in the world. On a highly digitalised future battlefield, large amounts of information can easily overflow the entire control panel of an aircraft. Having a second pilot and a second panel sharing part of the work will be advantageous, the Chinese feel. The People's Daily reported that in March 2018, Yang Wei, the chief designer of the J-20 said that the aircraft will be serialised and its combat capability will be constantly upgraded.<sup>12</sup> The current J-20 is a basic version, and it is by design highly customisable. Song Zhongping, a military expert and TV commentator, has claimed, "Outfitting the warplane with a second seat allows it to play multiple roles in addition to winning air superiority", adding, "The two-seat version can be further developed into a tactical bomber or EW aircraft".<sup>13</sup> Although the FC-31, another Chinese stealth fighter jet, is widely expected to become China's next generation carrier-borne fighter jet, Song believes the J-20 can also be modified to fulfil the role. An upgraded J-20 will have improved avionics and fire control systems, more powerful engines and more weapons payload.

# Advances in J-16

China's multi-role fighter jet, the J-16, is now covered by a coating that can provide near stealth capability and the jet is now confirmed to be able to

Liu Xuanzun, "J-20 Variant May be World's First Two-Seat Stealth Fighter", Global times, January 16, 2019 at http://www.globaltimes.cn/content/1135957.shtml.

<sup>13. &</sup>quot;China's Most Advanced Stealth Fighter Jet J-20" at https://www.sinodefenceforum.com/j-20-5th-gen-fighter-thread-vi.t8169/page-459#post-539691.

carry all types of air-to-surface weapons in precision strikes, China's state broadcaster revealed on March 18, 2018.<sup>14</sup> Brigade Commander Jiang Jiaji, a PLAAF pilot, told China Central Television (CCTV) that the silver-gray paint covering the J-16 is a kind of cloaking coating that gives the warplane a certain stealth capability, making it nearly invisible to the naked eye and electromagnetic devices. The jet's camouflaged colour scheme makes the aircraft blend with the sky and sea. Jiang also revealed that all types of Chinese air-to-surface weapons currently in service can be installed on the J-16. The J-16 is reportedly capable of carrying at least eight tons of weapons. Although the J-20 is China's more advanced fighter jet, the PLAAF still needs the J-16 as the two types of fighter jets can complement each other.

# J-10B Upgrade

The J-10B is being equipped with an engine capable of thrust vectoring control, thus, allowing extreme manoeuvrability. The manufacturer of the J-10B, AVIC, said in a statement at the 2018 Zhuhai Air Show that the thrust vectoring control technology used on the aircraft was an independently developed innovation, making China one of the few countries in the world to master this key technology.<sup>15</sup> The engine for the aircraft was widely regarded as a weakness in China's military development, but the country seems to be catching up, and the state-owned Aero Engine Corporation of China is continuing to work on the engines to provide more thrust and prolong the life span. Despite impressive displays at the air show, China is still 20 to 30 years behind the US in the overall design of engines, the experts said. The J-20's chief designer Yang Wei said in a CCTV programme that the thrust vectoring control engine used on the J-10B can be installed on any fighter jet any time, if needed, including the J-20.<sup>16</sup> Much like the

<sup>14.</sup> Li Jiayao, "J-16 Fighter Jet Stealth-Capable, Able to Carry all Types of Chinese Weapons", *Global Times* at http://eng.chinamil.com.cn/view/2019-01/30/content\_9416890.htm.

Kyle Mizokami, "The J-10 Fighter Plane Gets Thrust Vector Control", *Popular Mechanics*, November 7, 2018 at https://www.popularmechanics.com/military/a24742661/chinas-j-10thrust-vector-control/.

Huang Panyue, "Chinese People Amazed by Countries Rapid Development in Fighter Jets", *Global Times*, November 26, 2018 at http://eng.chinamil.com.cn/view/2018-11/26/ content\_9355534.htm.

Pakistan has shown interest in China's J-10 fighter jets and the Pakistan Chief of Army Staff Qamar Javed Bajwa sat in a J-10C during the "Shaheen-VII" China-Pakistan joint air exercise at the end of 2018. However, the final decision on the purchase of the J-10 by Pakistan is still to be taken. US Air Force (USAF), with its mix of stealthy and non-stealthy fighters, the PLAAF is developing a two-tier fighter fleet. Alongside a handful of radar-evading J-20s, Beijing is acquiring hundreds of more-conventional J-10s. The single-engine, single-seat J-10 first flew in 1998 and entered frontline service in 2003. Featuring a tailless delta wing and canards, the 51-ft-long J-10 externally is similar to the defunct Israeli Lavi fighter. The 2018 edition of the Pentagon's annual report on Chinese military capabilities describes the latest J-10C variant as an "advanced fourth generation fighter armed

with the latest weapons".<sup>17</sup> As of late 2017, the Chinese Air Force possessed around 260 J-10s, according to Flight Global's annual survey of world air arms. The J-10s account for 15 percent of Chinese combat aircraft and nearly half of the roughly 600 Chinese warplanes that, in 2018, the US Defence Department considered modern. The new J-10C model, which reportedly entered frontline service in 2018, has a new engine inlet that apparently reduces the plane's radar signature. It may also have an active electronically scanned array radar. In 2018, the US military possessed no fewer than 2,800 fighters, including more than 900 F-16s and hundreds of F-22 and F-35 stealth fighters.

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<sup>17.</sup> David Axe, "Forget Stealth Fighters and Aircraft Carriers: America Should Fear China's J-10 Fighter", *The National Interest*, August 25, 2019 at https://nationalinterest.org/blog/buzz/ forget-stealth-fighters-and-aircraft-carriers-america-should-fear-chinas-j-10-fighter.

happens, the orders are likely to be small. Europe's Typhoon and Rafale fighters are considered expensive. In this context, the Chinese feel that the J-10C fighter jets could be attractive.

#### Next Generation Fighter

After the successful J-20 fighter, China does not want to fall behind in the global race towards the 6th Gen fighter jets and is expected to build its own next-generation fighter jets by 2035, Wang Haifeng, chief architect at Chengdu Aircraft Research and Design Institute, who also participated in the development of the J-20 and J-10, said Some of the new features of a 6th Gen fighter jet would include the ability to command drones, artificial intelligence and even higher stealth capability through aerodynamic design, the periodical reported. New technologies, such as laser, adaptive engines, hypersonic weapons and swarm warfare, might also be part of the new aircraft.

in a periodical.<sup>18</sup> Some of the new features of a 6th Gen fighter jet would include the ability to command drones, artificial intelligence and even higher stealth capability through aerodynamic design, the periodical reported. New technologies, such as laser, adaptive engines, hypersonic weapons and swarm warfare, might also be part of the new aircraft, Wang said, noting that China will choose some of these features and add others that best suit China's needs. France and Germany announced that they will jointly build a next-generation combat jet system, which is expected to be operational by 2040. The UK unveiled its 6th Gen fighter jet development programme named Tempest in July 2018, and will invite India to join its co-development aircraft programme, as reported in the media. Other countries including the US, Russia and Japan are also reportedly developing their own 6th Gen fighter jets. Although they remain in the concept stage, the new fighters are likely to emerge in the 2030s or 2040s. China has yet to officially reveal a plan on its next-generation fighter jet, which hardly comes as a surprise as the country seldom announces any in-development weaponry; it may have

Liu Xuanzun, "China Eyes Building Next-Generation Fighter Jets by 2035", Global Times, February 11, 2019 at http://www.globaltimes.cn/content/1138454.shtml.

already started related research and development. China believes in having one generation in service, a new one in development and a next-generation under study. Now that the J-20 is already in service, the development for a new aircraft is also underway. The generational standards for fighter jets have been defined mainly by the Western countries but not future standards, said the J-20's chief designer Yang Wei, noting that China will design very different aircraft in the future through true innovation. China has also constructed a 6,620-ton, 17,000-cubic-metre FL-62 continuous transonic wind tunnel that will be critical in "shaping China's future fighter jet," said a statement released by the Aviation Industry Corporation of China in September 2018.

# Y-20, The New 'Heavy'

"The Y-20 can serve as a general platform from which a variety of variants can be derived," Tang Changhong, a Chinese political advisor and chief designer of the Y-20, said at a press conference on March 12, 2019.<sup>19</sup> Tang's remarks came amid reports and predictions made by military experts since 2018 that China was developing the Y-20 variants, including an aerial tanker and an early warning aircraft. According to Feng Wei, a Chinese legislator and Y-20 pilot, "It will be refreshing to see the Y-20 this year and people won't be disappointed". With a take-off weight of 200 tons, the Y-20 can stay aloft for extended periods, making it a great basic platform for tanker and early warning aircraft. Possible variants may also include a mobile hospital and an electronic warfare aircraft. There is speculation that the Y-20 might also replace its current Russian engines with domestically made WS-20 engines in 2019. "The Y-20 has now entered the formal mass production stage, and intensive regular training with the military is going according to plan," Tang said.

China is in urgent need of an aerial refuelling tanker that has a larger fuel capacity than the HU-6, a tanker developed from the H-6 bomber, for its air force to become a strategic one. Although China also operates

<sup>19.</sup> Liu Xuanzun, "China's Y-20 Large Transport Plane to Spawn Several Variants", *Global Times*, March 12, 2019 at http://www.globaltimes.cn/content/1141794.shtml.

a few Russian II-78 tankers, which are much larger than the HU-6, Russia was reluctant to sell more at a reasonable price, leading China to decide to develop its own large tanker. The Y-20 is of similar size to the Russian II-76 transport aircraft, on which the II-78 is based. The Y-20 began service in the PLAAF in 2016.

## Heavy Helicopters

The 40-ton class heavy helicopter, jointly developed by China and Russia, is expected to be delivered by 2032, said Wu Ximing, a Chinese political advisor and chief designer of helicopters for the AVIC.<sup>20</sup> "Russia is more experienced in the transmission system when it comes to 40-ton class helicopters, as Russia's Mi-26 is of the 56-ton class. Our goal in the cooperation is to learn from Russia's strong points and close the gap," Wu said. Wu accepted that China lacks experience in technologies related to the transmission system. After four years of negotiations, Russia's state corporation, Rostec, has agreed to sign the contract. Under the contract, at least 200 heavy helicopters will be built in China. China would be acting as a technical partner. Dubbed the advanced heavy lift helicopter, it would carry a payload of 15 tons, have a range of 630 km and a top speed of 300 km an hour. China will have a complete helicopter family ranging from the 500-kg class to the 40-ton class, Wu said.

## **Unmanned Aerial Systems**

China's domestically developed, made-for-export Wing Loong series of drones have fired more than 3,000 rounds of live munitions with an overall accuracy higher than 90 per cent, the Chinese media has reported.<sup>21</sup> Wing Loong is an armed reconnaissance drone capable of delivering precision

Aishwarya Rakesh, "China-Russia Heavy Helicopter To Fly By 2032", Defence World Net, August 29, 2019 at https://www.defenseworld.net/news/25369/China\_Russia\_Heavy\_ Helicopter\_to\_Fly\_by\_2032\_\_Deal\_Signed\_at\_MAKS\_2019#.Xa740pIzbIU.

<sup>21. &</sup>quot;Chinese-Built Armed Drones have Fired 3,000 Rounds of Weaponry", *The Week*, April 2, 2019 at https://www.theweek.in/news/world/2019/04/02/china-armed-drones-weapons.html.

strikes using air-to-ground missiles, often likened to the US' MQ-1 Predator and MQ-9 Reaper drones. As of December 2018, 100 Wing Loong series drones had been delivered for export.<sup>22</sup>

A video featuring China's flying saucer-like stealth drone, the Sky Hawk, was shown for the first time on CCTV in January 2019.<sup>23</sup> It has been developed by the China Aerospace Science and Industry Corporation. Featuring a "flying wing" aerodynamic design similar to the US B-2 stealth bomber, the Sky Hawk is a high-altitude, long-range and high-speed unmanned aerial vehicle capable of conducting reconnaissance and patrol missions in hostile environments. Another Chinese stealth drone with a 'flying wing' design, the CH-7, developed by the China Aerospace Science and Technology Corporation, was also on display at the last Zhuhai Air Show. Its 22-metre wingspan makes it significantly larger than the Sky Hawk, providing another choice for domestic and international users. The US has developed the X-47B stealth drone and run tests on aircraft carriers. The Sky Hawk will also operate on China's future aircraft carriers that will use electromagnetic catapults. China's new strategic bomber, the H-20, is expected to also use a 'flying wing' aerodynamic design to gain stealth capability and other benefits.

Capable of delivering precision bombardment, the weirdly shaped Chinese helicopter drone Blowfish A2 sparked interest from many countries' militaries following its flight demonstration at the 15th Langkawi International Maritime and Aerospace Exhibition (LIMA) in Malaysia held in March 2019.<sup>24</sup> The 1.87-metre-long, 0.62-metre, tall helicopter drone has a maximum take-off weight of 38 kg and is capable of carrying a 12 kg payload, says the Guangdong-based Zhuhai Ziyan UAV company, the manufacturer of the drone. The Blowfish A2 can carry radar, jamming devices, guns or

 <sup>&</sup>quot;China Delivered 100th Wing Loong Unmanned Aerial System for Export", Defence Blog, December 26, 2018 at https://defence-blog.com/news/china-delivered-100th-wing-loongunmanned-aerial-system-for-export.html.

Jesse Johnson, "China Releases First Video of a Sky Hawk, its Latest Stealth Drone, in Flight", The Japan Times, January 6, 2019 at https://www.japantimes.co.jp/news/2019/01/06/asia-pacific/china-releases-first-video-sky-hawk-latest-stealth-drone-flight/#.Xa7785IzbIU.

Liu Xuanzun, "Oddly Shaped Chinese Combat-Ready Helicopter Drone", by *Global Times*, April 2, 2019 at http://www.globaltimes.cn/content/1144390.shtml.

bombs under its spine, and has a maximum speed of 130 km per hour. A video shows the drone dropping four bombs, which detonated some metres above the target, as the guided explosions accurately scorched a wide area. The drone is available for export, and many countries, including Pakistan, have reportedly shown interest. Combat-ready helicopter drones made by Ziyan now operate in four countries in the Middle East, Southeast Asia and Africa, the representative said, without naming the clients. AVIC is also developing helicopter drones including the missile-carrying AV500.

AVIC expects to produce 100 high-end drones per year by 2025. AVIC also announced that it has established a new subsidiary AVIC (Chengdu) Unmanned Aerial Vehicle System Company, focussing on the drone business, which Chinese military experts believe will help AVIC become even more competitive on the international market. AVIC now offers products like the Wing Loong armed reconnaissance drone, the Cloud Shadow high-altitude drone, the AV500 unmanned helicopter, and the Yaoying remote sensing drone. The establishment of the subsidiary shows that AVIC takes the drone business very seriously, and the move is also motivated by the strong demand from the international market. "The US' General Atomics is the market leader in the international drone industry. I hope that our new company can surpass it," Lai Zhiyong, an employee at AVIC (Chengdu) Unmanned Aerial Vehicle System Co. Ltd., says.<sup>25</sup> He notes that the reason behind the success of the Chinese drone on the international market is its high quality and low pricing, and that China continues to make rapid progress in related technologies. Countries like Egypt, Indonesia and Serbia are operating the Wing Loong I drone. The Wing Loong I-D, the new Wing Loong series drone, uses an all composite material structure, and made its maiden flight in January 2019.

#### **Electronic Warfare**

China has also reportedly developed a new type of electronic warfare aircraft with extra antenna installations. The aircraft appears to have been

<sup>25.</sup> Yao Jianing, *Global Times*, December 27, 2018 at http://eng.chinamil.com.cn/view/2018-12/27/content\_9389500.htm.

The Type-002 aircraft carrier has reportedly been fitted with a new generation of phased array radar system, optimised air traffic command room and flight deck. Its carrier aircraft will also be a new generation of the shipborne J-15 fighter jet, equipped with the phased array radar. That translates into considerably enhanced combat capability. developed from the Y-9, says Wei Dongxu, a Beijing-based military analyst.<sup>26</sup> The Y-9, a medium-sized tactical transport plane has been modified, including as an early warning aircraft, reconnaissance plane and anti-submarine aircraft. The new variant visibly has a hemispheric radar dome under its chin, two large antennas on each side of the plane, an antenna on each side of the tailfin and an electronic warfare pod on top of the tailfin. It could effectively monitor the enemies' radio communication and intercept their radar signals. It can also deliver electronic suppression, supporting China's aerial

strike formations by jamming and paralysing hostile air defence systems. However, more aggressive missions would be supported by the fighter class of EW aircraft. The aircraft is likely to be designated the GX-11.

# Aircraft Carriers

The Type-002 aircraft carrier has reportedly completed several sea trials. Resembling the *Liaoning*, the new aircraft carrier has also been fitted with a skijump assisted short take-off system. The Type-002 aircraft carrier has reportedly been fitted with a new generation of phased array radar system, optimised air traffic command room and flight deck. Its carrier aircraft will also be a new generation of the ship-borne J-15 fighter jet, equipped with the phased array radar. That translates into considerably enhanced combat capability.

Having already designed China's current aircraft carrier-borne fighter jet J-15, Shenyang Aircraft Design Institute is developing a new carrier-based warplane based on the FC-31.The FC-31 is a 4th Gen medium-sized stealth fighter jet originally intended for export. The FC-31 made its public debut

<sup>26.</sup> Chen Zhuo, "New Aircraft Together Intel in S. China Sea", *Global Times*, March 7, 2019 at http://eng.chinamil.com.cn/view/2019-03/07/content\_9444106.htm.

flight at the Zhuhai Air Show in 2014, but went relatively quiet after that. Multiple changes and upgrades are being made to the FC-31, allowing it to be used on an aircraft carrier. China's third aircraft carrier is widely expected to be equipped with an electromagnetic catapult, and likely to house the stealth fighter jet.

## Su-30 MK2: Anti: Shipping Role

China unveiled a set of photos of the Chinese People's Liberation Army The PLAN deployed a new Vertical Take-off and Landing (VTOL) fixed-wing drone on a guided missile destroyer in an exercise in the South China Sea in late February 2019. The drone is likely to carry out reconnaissance and search missions at longer ranges for destroyers and frigates.

Navy's (PLAN's) Su-30MKK fighter jets' on January 6, 2019.<sup>27</sup> These photos 'inadvertently' revealed a Su-30 MK2 fighter preparing to take off; the aircraft was mounted with a Chinese PL-12 air-to-air missile. The structure of its total payload has been enhanced to 12 tonnes. This indicates that China has already been able to modify the Su-30MKK's fire control system to give it the capability to use China's indigenous weapons. The next would be the Su-30 MK2 fighter jet carrying the YJ-12 and YJ-18 anti-ship cruise missiles. The Su-30MKK's maximum take-off weight has also been increased. Its maximum range is almost 4,000 km, and, therefore, it can patrol the entire South China Sea with the support of tanker aircraft. The Su-30MKK fighter jet, H-6 strategic bomber and JH-7 fighter-bomber together shoulder the responsibility of China's long-range anti-ship attack tasks. The Su-30MKK fighter jet has three 2-ton heavy hanging points and, therefore, can mount three YJ-12 supersonic anti-shipping cruise missiles.

## PLAN's New VTOL Drone

The PLAN deployed a new Vertical Takeoff and Landing (VTOL) fixed-wing drone on a guided missile destroyer in an exercise in the South China Sea in

Huang Panyue, "With Modified Fire Control System, China's Su-30", China military online, February 1, 2019 at http://eng.chinamil.com.cn/view/2019-02/01/content\_9420175.htm.

late February 2019 for the first time.<sup>28</sup> The drone took off from the helicopter deck of the *Lanzhou*, a Type 052C destroyer. The drone has a triple-fuselage design. The left and right fuselages each have four propellers: two on top, two at the bottom. A larger propeller is installed at the rear of the aircraft. "The eight smaller propellers can provide the lift needed for VTOL, and the larger propeller provides thrust", it was reported. The new drone has combined the advantage of a rotorcraft and a fixed-wing aircraft. The drone appears to have a wing span of about 4 metres, allowing it to be stored in a helicopter hangar. The drone is likely to carry out reconnaissance and search missions at longer ranges for destroyers and frigates. The drone could also guide artillery fire from warships and conduct damage assessment during an amphibious landing operation.

## Multiple Terahertz Radiation Radar

Chinese arms companies recently made multiple terahertz radiation radar systems with a technology seen by experts as an efficient air-toground reconnaissance tool and a potential counter to stealth aircraft. The prototype radar was successfully developed by the China Electronics Technology Group Corporation (CETC), and a second-generation prototype is already in development.<sup>29</sup> The CCTV report said that terahertz radiation has wavelengths between those of infrared rays and microwaves, a wide spectrum that would render current stealth technologies obsolete, making the radar able to detect stealth aircraft. Stealth aircraft usually use composite materials and radar wave-absorbing coatings, so normal radars cannot effectively detect them. Terahertz radiation, on the other hand, could penetrate those materials and expose metallic parts within the aircraft, as per Wei Dongxu. Experts point out that the terahertz radiation decays very fast in the air, meaning that the effective range of the radar is likely low and not sufficient for detecting an advanced stealth fighter jet in time

Li Jiayao, "Rare VTOL Drone Deployed on PLA Destroyer", *Global Times*. February 28, 2019 at http://english.chinamil.com.cn/view/2019-02/28/content\_9435911.htm.

<sup>29. &</sup>quot;China Develops New Electronic Warfare Aircraft", Defence World Net, March 11, 2019 at https://www.defenseworld.net/news/24435/China\_Develops\_New\_Electronic\_Warfare\_Aircraft#.XbEci1UzbIU.

before it launches attacks from beyond visual range. The China Aerospace Science and Industry Corporation (CASIC) had earlier developed China's first terahertz radiation video synthetic aperture radar, the Beijing-based newspaper *Science and Technology Daily* reported in December 2018. The CASIC radar can see through complicated environments like smoke, smog and dim lights, and can efficiently detect ground infantry targets in camouflage and disguise, and deliver precision strikes.

# Early Warning Radar Technology

The editor of the China Daily Li Jiayao wrote on March 18, 2019, "China is a major arms exporter, but its image in the international weapons market has long been linked to old, second-tier products sold at relatively low prices".<sup>30</sup> Domestic defence technology companies have been sparing no effort over the past several years to improve their reputation by promoting modern, advanced products featuring the latest technology. One recent effort is an airborne early-warning and control aircraft. Hu Mingchun, head of the Nanjing Research Institute of Electronics Technology in Jiangsu province, notes that there are only a few nations including China, the United States and Israel, that can design, build and export such cutting-edge hardware as early-warning planes. The KLC-7 Silk Road Eye developed by his institute was a generation ahead of its rivals in the global market, he has claimed. According to Hu, the KLC-7 integrates a mechanical scanning system with active electronically scanned arrays and features the latest digital technology and processing capacity. The system boasts better anti-jamming functions and a longer detection range. The Electronics Institute in Nanjing, which is part of the state-owned defence giant China Electronics Technology Group Corp, is the country's top developer of military surveillance radars. Its products have been sold to more than 20 nations in Africa and Asia, it said. It designed and manufactured the radars mounted on the ZDK-03 early-warning aircraft that China exported to Pakistan. In a picture released by China Electronics Technology Group Corp, the Silk Road Eye appears

<sup>30.</sup> Li Jiayao, "World Class Military Plane to be Exported", *China Daily*, March 18, 2019 at http://english.chinamil.com.cn/view/2019-03/18/content\_9452128.htm.

similar to the ZDK-03, which means it is also mounted on the Y-9 turboprop transport plane built by AVIC.

#### AVIATION INDUSTRY COMES OF AGE

The Chinese defence industry is growing rapidly, with a handful of Chinese firms displacing Western defence powerhouses, Hu writes. The appearance of eight Chinese defence firms among the top 25 comes as China invests heavily to upgrade its military and build a world-class fighting force. Till 2018, not a single Chinese company had even cracked the world's top 100 defence firms, according to a list published annually by *Defense News*. In 2019, six Chinese defence firms were among the world's top 15, with Chinese companies occupying eight of the top 25 spots. AVIC, with its annual defence revenue close to US\$ 25 billion, ranks fifth, outpacing US and UK defence giants General Dynamics and BAE Systems. AVIC, the top Chinese company on the list, trails closely behind Raytheon and Northrop Grumman, the two leading US defence firms. AVIC is responsible for the development of China's 5th Gen J-20 fighter and the new H-20 stealth bomber, among other projects.

"AVIC has been developing Wingman drones and an unnamed flying wing stealth drone was showcased at the 2018 Zhuhai Air Show", reported Liu Xuanzun.<sup>31</sup> The USA and Russia already have drones that will accompany manned fighters and China is conscious that it must not get left behind. The USAF will induct the XQ-58 Valkyrie drones to fly in formation with the F-15EX and F-35 by end 2019. Similarly, Russia has just released footage of the first flight of the S-70 Okhotnik stealth assault drone to be paired with the Su-57 for joint missions. AVIC has already developed the Dark Sword stealth drone of the size of a fighter aircraft. The Sky Hawk and Sharp Sword are other stealth drones.

#### 'MADE IN CHINA 2025' GOALS

"China wants its commercial aircraft to supply 10 per cent of the domestic

<sup>31.</sup> Ryan Pickrell, "China's Defense Industry is Exploding Onto the Scene as its Top Arms Makers Push Past Western Powerhouses", *Business Insider*, July 23, 2019 at https://www.businessinsider.nl/6-of-the-worlds-top-15-defense-firms-are-chinese-2019-7/?jwsource=cl.

market and its jetliners to account for up to 20 per cent of the global market by 2025", writes Amanda Lee.<sup>32</sup> When the C919, China's indigenous longhaul airliner, successfully completed its maiden flight in May 2017, officials were quick to announce that the country was edging closer to clinching the "crown jewels" of the modern aircraft manufacturing industry, and was also carrying the weight of the nation's ambition to be a major player in the global aviation industry. China's aviation market is expected to overtake that of the US as the world's largest by 2022, and the country is estimated to need over 7,000 planes in the next 20 years. Being able to make its own would not only help disentangle Beijing from the political complications of having to deal with the global manufacturing duopoly of Boeing and Airbus, but would also be a statement that it had the technological prowess to match its economic might. "China is playing the long game, it's not about the 2020s. China is looking at the next 20, 30 or 40 years." says Kevin Michaels, managing director of AeroDynamic Advisory, an aerospace and aviation consultancy. China's aviation industry has received over 800 orders and options to buy the C919 as of June 2019, despite the fact that it is not expected to enter operation until at least 2021 and that only 50 per cent of the components are currently domestically produced. Among the obstacles the country faces in becoming an aviation power are its lack of expertise in avionics, materials technology and aerodynamics, and, most crucially, engines. Experts have estimated that China's jet engine technology is about 20-to-30 years behind its competitors. The C919 currently runs on engines from CFM International, a joint venture between GE Aviation of the US and France's Safran Aircraft Engines. Beijing has invested Yuan 100 billion (US\$ 14.4 billion) in 2016 under the 'Made in China 2025' (MIC2025) plan to establish the Aero Engine Corporation of China (AECC), which will build the CJ-1000A turbofan jet engine to power the C919. The USA has put brakes on the transfer of critical technologies. In fact, China has spent less than US\$ 1 billion on 12 aviation-related acquisitions in the US over

Liu Xuanzun, "Wingman Drones Become New Trend for Fighter Jets", Global Times, August 11, 2019, http://www.globaltimes.cn/content/1161030.shtml

However, China's induction of its own 5th Gen air superiority fighter, the Chengdu J-20 in 2017, which preceded the entry of the Su-57 into service, marked the first aircraft of its generation to complete development outside the United States. the decade up to 2017, according to estimates by the US think-tank Rand Corporation. Meanwhile, COMAC has 16 joint ventures with foreign firms, including GE Aviation, Honeywell, Parker Aerospace and Liebherr, and is also building a larger twin-aisle plane, the C929, with a Russian company, but it remains an uphill task as a whole in the form of a new-found US hostility to it. COMAC is yet to apply for certification for the C919 from the US Federal Aviation Administration, without which it cannot access the US market.

# Further Russia Fighter Offers

Since the Soviet Union's collapse, China has been a leading client for highend Russian military hardware. Such imports had played a key role in revolutionising China's aerial warfare capabilities, in particular during the 1990s, with acquisition of the most capable Russian air defence systems, air-to-air missiles and air superiority fighters available, but by the 2010s the reliance on high-end Russian equipment was reduced considerably. Russia's inability to market more than two dozen of its latest Su-35 fighter jets in 2015 was despite an offer for these to be accompanied by generous technology transfers. Upon announcing plans for the export of Russia's Su-57 5th Gen air superiority fighter at the 2019 LIMA exhibition in Malaysia, Kladov Viktor of Rostec, the Russian state conglomerate for arms exports, mentioned the aircraft's potential export destinations.<sup>33</sup> In the next two years, China will make a decision to either procure additional 4th Gen ++ Su-35s, or build the Su-35 within China, or, alternatively, procure the Su-57E, he said.

Amanda Lee, "China's Aviation Industry has a Steep Climb to 'Made in China 2025' Goals", South China Morning Post, October 29, 2018, https://www.scmp.com/business/article/2170746/ chinas-aviation-industry-has-steep-climb-made-china-2025-goals

However, China's induction of its own 5th Gen air superiority fighter, the Chengdu J-20 in 2017, which preceded the entry of the Su-57 into service, marked the first aircraft of its generation to complete development outside the United States. China also preceded Russia in its deployment of aircraft with active electronically scanned array radars, which are currently mounted on its J-20 and J-10C fighters, as well as its deployment of next generation air-to-air munitions with the entry into service of the PL-15. While the Su-35 did field a number of technologies that China's

China's defence industrial base is working to modernise its military to build a world-class force that can fight and win wars, an ambition repeatedly stressed by the Chinese leadership.

own defence sector had yet to develop, including the three-dimensional thrust vectoring AL-41F-1S engines, these technologies are expected to have been mastered by the Chinese military aviation by 2022 and deployed on the upcoming J-11D. Should the J-11D programme succeed, China would have little reason to purchase further Su-35 aircraft or seek to establish production of the platform domestically, as Director Kladov has suggested. The Su-57's internal weapons payload is much larger than that of the J-20, deploying eight long range K-77 or R-37 long range air-to-air missiles. That also gives the Su-57 a considerably longer air-to-air engagement range compared to the J-20, with the K-77 missile retaining a range of over 193 km. The Su-57's internal missile bays can also deploy the R-37 with a 400 km rangedesigned specifically to target tankers, Airborne Warning and Control Systems (AWACS), and other vital support systems. The Su-57 can also fire modulated laser beams at incoming missiles' seekers to blind them. These are all capabilities that existing Chinese fighters, including the J-20, lack entirely. The Russians claim that the Su-57 outclasses the J-20 across the spectrum. With a large scale production plan of the indigenous J-20, the Su-57 may be ruled out. At best, a few Su-57 fighters could be bought for considerable technology transfers.

#### China's Emerging Aviation Superiority

China's defence industrial base is working to modernise its military to build a world-class force that can fight and win wars, an ambition repeatedly stressed by the Chinese leadership. "The Soviets were never able to match, much less overcome, America's technological superiority. The same may not be true for China," former Deputy US Defence Secretary Robert Work and his colleague Greg Grant wrote in a recent report.<sup>34</sup> China's economic power makes it highly unlikely that the US will be able to spend its way to victory in its strategic competition with China, the authors contend. The US has not faced a competitor with a Gross Domestic Product (GDP) greater than 40 per cent of its own in more than a century. China's GDP is currently around 63 per cent that of the US, and the country is projected to eventually have the world's largest economy. "China also has the political will and fiscal strength to sustain a steady increase in defense spending during the next decade," the Department of Defence explained in its 2019 report on China's military might, noting that these increases "will help support PLA modernization, develop an integrated military-civilian defense industry, and explore new technologies with defense applications." The Pentagon has identified the key elements of China's military modernisation as investments in domestic defence, the development of the defence industrial complex, a growing science and technology research and development base, civilmilitary integration, and acquisition of foreign technology. "The result of this multifaceted approach to technology acquisition is a PLA on the verge of fielding some of the most modern weapon systems in the world.," Lt. Gen. Robert Ashley, the director of the Defence Intelligence Agency (DIA), wrote in a letter prefacing a 2019 DIA report on China's military modernisation.<sup>35</sup> "In some areas," he added, "it already leads the world."

<sup>34. &</sup>quot;Russia Reveals Export Version of Su-57 Stealth Fighter Jet, to Target Middle East", Defense World.Net, March 28, 2019, https://www.defenseworld.net/news/24540/Russia\_Reveals\_Export\_Version\_of\_Su\_57\_Stealth\_Fighter\_jet\_\_to\_Target\_Middle\_East#.XbEjTFUzbIU

 <sup>&</sup>quot;DIA Chinese Military Power Report", USNI News, January 15, 2019, https://news.usni. org/2019/01/15/dia-chinese-military-power-report

#### **OPTIONS FOR INDIA**

As China has set a target of becoming a leading superpower by the year 2049, it is in competition with the US, the current superpower, which it wants to replace. The size of its economy is growing at a fast rate. It is already ahead of America's GDP in Purchasing Power Parity (PPP) terms and well on track to overtake it even in nominal terms. In a recent parade, it displayed its military might. It is trying to persuade nations to accept its new position by enticing them with financial help, using its massive economic clout, to accept its extra-territorial claims willingly, or if necessary, with its threatening posture, and with nations which do not succumb to the pressures, then by being overtly friendly with them. India falls in the last category. After the Doklam standoff, India has stuck to its position. This approach helped both India and China to keep peaceful borders despite the lingering boundary issue. Indian Prime Minister Modi and Chinese President Xi Jinping concentrated mostly on trade and terrorism issues at the Mahabalipuram Summit in October 2019.

Make in India defence production has finally started showing initial results. India is way behind, but all national energies need to remain focussed on the aim for India to take its place at the global high table. Aviation technologies are much tougher to master. India needs to take foreign help to master them. It also needs to invest much more on research and development. Also, defence production needs to be released from bureaucratic control as has been successfully done for India's space and nuclear programmes.