IAF Modernization: Issues and Options for Pakistan

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Abstract

When India gets its 36 Rafales, it will have a combination of technologically advanced Rafale, a capable and large fleet of Su-30MKI, and a good number of locally developed HAL Tejas in the future. Along with the procurement of other major weapon systems, India may then feel comfortable with the idea of another Balakot type event where it tries to project its military muscle and score a point after its failure to respond effectively against Pakistan after the Rajouri strikes. Pakistan's response strategy therefore would become complex not only to take into account the numerical and technological strength of the Indian air-force but also Indian leadership's perception regarding the capabilities of major weapon systems and the belligerent posture of its leadership towards Pakistan.

Keywords

Rafale, Surgical Strike, Su-30MKI, JF-17, Modernization, Balakot, BJP, Perception, Deterrence

Introduction

With the territorial disputes, ideological differences, volatile political environment, and military postures between the two nuclear-armed countries in South Asia, peace in the region remains uncertain. India also enjoys a conventional military superiority over Pakistan in terms of numbers as well as technology. There is a third additional element of Indian perception of superiority of its weapons over their Pakistani equivalents. For India, Pakistan's Chinese origin weapons are not up

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to the mark as compared to its own Russian or recently acquired Western origin weapons.

Besides, after Prime Minister Narendra Modi coming into power in India, its policy towards Pakistan has become more militarized, aggressive, and belligerent. It has sought to create a space for a limited conventional military action against Pakistan. This posturing was manifested in what is presented to the world as a surgical strike after Uri in 2016, which was denied by Pakistan, and the Balakot strike in February 2019. India's conventional military advantage, major defense procurements, diplomatic clout, hawkish foreign policy, growing extremism, and nationalism in domestic politics all have added to the belligerent Indian military posture. Strategic restraint as the guiding principle has no importance under the Modi government.[1] This trend is likely to continue in the future as the Indian military is constantly acquiring state-of-the-art weapons and signaling their intent of using them.

French-made Dassault Rafale multi-role combat fighter aircraft is one such acquisition. The aircraft has advanced weapons, powerful radar, sensors, long-range, and an advanced electronic warfare system. It has already gained much hype in the Indian military, politics, and media that have made it a game-changing platform in the region. So hyped is the aircraft that Indian PM Modi regretted not having Rafale during the PAF's retaliatory strike in 2019.

The capabilities of Rafale and Indian confidence in those capabilities particularly shall make PAF scrutinize its options and plans more closely. Failure to do so can put it in a disadvantageous position in the future if a Balakot like event happens again. Pakistan will have to look not only at Rafales but their deployment in combination with the other aircraft by IAF, especially the Su-30 MKI, Tejas Mk-1/MK-2, and the S-400 air defense system. Pakistan will endeavor to change the perception India may build of Pakistan as an easy walkover through the acquisition of advanced and effective weapon systems.

Balakot Strike: Connecting Past and Future

The February 2019 events are important to conceive of a future scenario where India may violate the territorial sovereignty of Pakistan again after making a terrorist attack as an excuse, but in fact, motivated by strategic, political, and domestic political factors. After the Pulwama terrorist attack by a Kashmiri youth on 14th February 2019, India blamed Pakistan-based outfits and tried to target an alleged terrorist training camp near Balakot in Khyber Pakhtunkhwa province of Pakistan with stand-off weapons using Mirage 2000 jets. Although Indian jets failed to strike their intended target, they had violated the sovereignty of Pakistan by launching their stand-off weapons on the Pakistani side of the international border. The next morning, Pakistan Air Force conducted airstrikes and dropped bombs in the Indian-occupied Kashmir, during operation Swift-Retort. During the ensuing dogfight, Pakistan downed an Indian Mig-21 Bison and caught its pilot, Abhinandhan Varthaman. An Indian Mi-17 helicopter was also shot in a friendly fire carrying six Indian Air Force personnel. India on its part claimed to have shot down a Pakistani F-16 jet but could not provide any proof and independent observers rejected Indian claims.

The catalyst behind the Balakot strike apparently was the Pulwama attack (by a Kashmiri youth in Indian Occupied Kashmir) but other strategic objectives may have motivated the decision to carry out the strike. These factors are likely to remain relevant to the future as well keeping in mind the Indian strategic trajectory.

India drew some lessons from the event according to Tanvi Kulkarni.[2] Through this violation of Pakistani airspace, it had sent a message to Pakistan of a conventional Indian response to a sub-conventional terrorist attack inside India.[3] Mild international opposition to such Indian actions as its diplomatic victory and Indian military strike inside mainland Pakistan as a message to the international community of its military superiority over Pakistan. For security

analyst Sylvia Mishra, the Balakot strike showed India's craving for escalation and a room for conventional response under the nuclear threshold.[4] Indian Air Vice Marshal (Dr) Arjun Subramaniam while writing for Observer Researcher Foundation (ORF) said that India has created a new normal by hitting targets in Pakistan and calling its nuclear bluff.[5] Lessons drawn by India gave it confidence for such actions in the future, especially the absence of condemnation of Indian violation of Pakistan sovereignty by major powers.

For Pakistan, retaliation after Balakot showed Pakistan's resolve and readiness to respond to Indian aggression. These events underscored the importance of possessing credible conventional capabilities and established the fact that Pakistan's conventional deterrence was working, and the use of nuclear capabilities are not the default response to conventional belligerence from India at any level.

The problem with the lessons drawn by India, as mentioned above, is that they simply ignore the following retaliatory strike by Pakistan Air Force and the losses Indian Air Force had to bear. They also ignore the escalatory risks attached to such actions. Another important factor is the element of surprise which has gone for any such future action. Pakistan might not have expected India to strike targets in mainland Pakistan during the Balakot episode. However, it will be better prepared in the future for such eventualities.

Balakot action by India brought South Asia to the brink of a major war. There were moments where the crisis could have escalated. The situation could have escalated if the IAF attack had caused a loss of life at a large scale as it claimed if more Indian or a Pakistani jet had been shot down, if Wing Commander Abinandhan had died or if Pakistan had not returned Abinandhan to India. These scenarios could have led the region towards devastation and war. To avoid such eventualities, PAF's force planning and future response must take into account the likely lessons Indian might have learned from the Balakot event as well as IAF's current and future induction plans, and the Indian political environment. Indian actions in Kashmir such as unilateral

abrogation of the special status of Kashmir, bringing in more forces, and turning it in an open jail are all part of India's continuation of belligerent policies towards Pakistan.

IAF and PAF's Aircrafts

It is important to look at the types and characteristics of the aircraft that both PAF and IAF are operating or likely to operate in the future to assess their impact on a possible crisis in a subsequent crisis. There are several roles aircraft play and are designed to perform those specific roles. Aircraft according to their major roles can be fighters, bombers, ground-attack aircraft, electronic warfare, and reconnaissance aircraft. Fighter aircraft's role is to perform air-to-air combat or gain air-superiority against the enemy. Bombers are heavier and fly at high altitude and carry bombs and missiles, ground-attack aircraft fly, on the contrary, at a lower altitude to strike ground targets such as military formations and tanks. To maintain numerical strength and economizing on the cost of maintaining air forces, multi-role aircraft started replacing the single role dedicated aircraft.[6] Today, most of the aircraft from third and subsequent generations can perform more than one function.[7] Multi-role combat aircraft perform air-superiority, ground attack/support, anti-ship, electronic warfare capability, and reconnaissance roles. Improvements in airframe have led to the flexibility of roles an aircraft can perform. More than one mission can be performed by multirole fighters in a few sorties.[8]

Both India and Pakistan have new and old aircraft. Newer aircraft such as Pakistan's JF-17 Thunder and F-16 Fighting Falcon and Indian Su-30 MKI and Mirage 2000 are multi-role aircraft. Pakistan's Mirage 5 and Mirage III are also multi-role aircraft with special capabilities in the ground-attack role. Their avionics and electric systems have been enhanced under Project ROSE. India also has MiG-29 as dedicated air-superiority fighters, MiG-27 and SEPECAT Jaguar as close-support/ground-attack aircraft, and a fleet of old MiG-21. Almost all

the current and future fighter aircraft in the world as noted before can perform a variety of roles further reducing the trend of a specific aircraft for a specific task.

Aircraft have also several types of hardware, software, and other operational features that make their performance different from each other. Speed, operational range, design, engine thrust, radars and sensors, weapons, etc. are some of the important performance characteristics of an aircraft.

Most modern aircraft are getting airframe designs with low radar cross-section (RCS) to avoid detection by enemy radars. Reduction in RCS can be achieved by shaping, using radar absorbing materials, active cancellations, and passive cancellations.[9] However, reduced RCS comes at the cost of operational limitations due to shape, the material used, and less fuel, and weapons carrying capacity.[10] Service ceiling and speed of an aircraft proves helpful in defeating surface to air missiles (SAMs). Ferry and combat ranges are important for carrying out long-range operations. Range depends on the capacity of the engine, fuel, and the load of ordnance an aircraft is carrying. Additionally, external drop tanks are added to enhance the range of an aircraft. Another important aspect of performance is the g limit which adds to the dog-fighting capacity of an aircraft. Thrust-to-weight ratio is basic for climbing and accelerating. Aspect Ratio and Wing Loading are critical in a turning fight.

The intangible factors also impact the operational performance of an aircraft. These are training and experience of a pilot, service history of an aircraft in an air force, upgrades maintenance of an aircraft, integration of an aircraft with other support systems such as air defense systems, sortie generation rate, electronic warfare systems, and secure data links.

Tangible factors like the physical presence of a platform and its capabilities are very easy to see and determine, however, intangible factors can only be seen during exercises or an actual engagement

with the enemy. This was shown during the dog fight after PAF struck targets in Indian Occupied Kashmir during the Balakot-Pulwama crisis. Having capable aircraft like Su-30 MKI, India was confident of its technological and numerical strength over Pakistan. This confidence led it to strike targets across the international border in Pakistan. What it did not foresee, perhaps, were the intangible factors.[11]

Credibility of Capabilities

Another important element after technology, capability, and numbers is one's perception of the credibility of its own and adversary's capabilities. A rational actor is supposed to correctly analyze what the other side possesses and what it is trying to signal. An irrational actor on the other hand can overlook or under-perceive the credibility of an adversary's capabilities.

The leadership of the ruling Bhartiya Janata Party (BJP) sets its strategic objective of elevating India as a regional hegemon. Other political parties in India as well had this vision for India but BJP is more aggressive in its pursuit. For achieving this goal, it has tried to test the limits of its power and made efforts to restrain Pakistan within a bracket by using diplomatic pressure, coercion, and even military aggression. The use of conflict and violence with Pakistan as a tool to strengthen political domestic gains has also increased during the BJP government.

With these strategic objectives, political motivations, and access to the latest hardware India has acquired a notion of technological superiority over Pakistan.

For political leaders, it is easy to perceive the superiority of a weapon system when the seller country assures it of its capabilities. Military procurement programs also sometimes overestimate certain platforms and systems to get government approval and funding. These factors contributed to the development of the Indian perception

of superiority vis-à-vis Pakistan. While better training and morale of PAF pilots is an advantage, the widening of the technological gap between IAF and PAF is not going to be helpful.[12]

Current Shape of IAF and PAF

Indian Air Force has five regional air commands Western, Southwestern, Eastern, Central, and Southern Command with two support commands for maintenance and training. These regional commands are further divided into wings, stations, and squadrons. IAF has 36.5 squadron units as of 2016 and desires to have 42-45 squadron units by 2027.[13] One squadron normally consists of 16-18 aircraft.[14] As of 2020, IAF has 30 fighter squadrons against the 42 sanctioned fighter squadrons.[15] This has reduced the combat strength of IAF.

Currently, IAF has 776 combat capable aircraft.[16] It has three squadrons with MiG-29 Fulcrum, six with MiG-21 Bison, five with Jaguars, one with MiG-27 ML, three with Mirage 2000, ten with Su-30MKI Flanker, and one squadron with Tejas. It is also forming one squadron with Rafale.[17]

IAF is proceeding with the acquisition of 36 Rafale aircraft from France. It is also set to get 123 Light Combat Aircraft (LCA) developed by Hindustan Aeronautics Limited (HAL). IAF also floated a request for information (RFI) in 2018 to get 110 medium weight multirole combat aircraft manufactured locally by international aircraft manufacturers.[18] The more capable and larger LCA Mk-2 is already under development. Another indigenous fifth-generation advanced medium combat aircraft (AMCA) is also under-development and set to make the flight by 2032.[19]

Additionally, all aircrafts in IAF's inventory are being upgraded. These include Jaguar, MiG-29, Mirage-2000, and Su-30MKI. It is possible that in the coming years, IAF would have significantly reduced its technical and numerical shortcomings.

PAF on the other hand has three regional commands: Northern headquartered in Peshawar, Central in Sargodha, and Southern at Karachi.[20] It has a total of 404 combat-capable aircraft.[21] It has three squadrons with different versions of F-7, four with different versions of F-16 Fighting Falcon, five with JF-17 Thunders, one with Mirage III, and four with Mirage 5.[22] Acquisition of more F-16 aircraft may not be on cards mainly due to political reasons. PAF's energies are therefore directed towards developing the Block III of JF-17 Thunders. Moreover, an interest to get another advanced fighter is also reported. Pakistan Aeronautical complex is also working on the R&D on fifth-generation fighter aircraft under Project Azm.[23]

IAF and PAF Modernization

IAF plans to become a more effective force in the coming years by inducting 36 Rafale, another 114 multirole aircraft, inducting LCA Tejas, upgrading Su-30MKI, and developing a next-generation aircraft. If they go according to the plans, IAF may have good strength in the future.

Rafale: Rafale is a 4.5 generation medium weight multirole aircraft developed by the French manufacturer, Dassault. Rafale is an advanced aircraft with state of art electronic warfare system, less visible airframe, and long-range air-to-air missile, Meteor. Rafale is touted as an "omni role" fighter capable of performing four types of missions in one sortie.

Capabilities that the Rafale brings to IAF and impact the Indian perception of capabilities vis-à-vis PAF are particularly the advanced airframe, SPECTRA electronic warfare suite, and ramjet-powered Meteor long-range beyond-visual-range (BVR) missile and MICA air-to-air missile. SPECTRA suite provides an enhanced situational awareness to the pilot by detecting, identifying, and localization of threat.[24] Rafale can fly with a better net-centric capability with a secured data link including Link 16.[25]

Su-30 MKI Upgradation: Su-30MKI heavyweight multirole fighter is already a capable aircraft. It is a dual-engine aircraft just like Rafale. With a fleet of around 260 aircraft, it is presently the mainstay of IAF. India has also ordered additional 12 Su-30MKIs to account for attrition over the years.

Su-30MKI fighters are highly maneuverable in a visual dogfight, however, they have shortcomings in the network-centric and BVR combat warfare as evident during the February 27, 2019 exchange with PAF. During the Balakot episode, Su-30 could not establish a datalink and were of no use to each other.[26] Plugging these gaps can make them formidable in both visual and beyond visual range combat.

India is developing the Astra Advanced Medium-Range Air-to-Air Missile (BVRAAM) with a range of 100km to neutralize Pakistan's edge of AIM-120 C-5 AMRAAM.[27] ASTRA can be deployed on Su-30 MKI, Tejas, and MiG-29 and is likely to replace the Russian made R-77s. The IAF also plans to upgrade all Su-30MKIs with a new engine and weaponry, however, this has long been delayed.[28]

Tejas Mark1/Mark-2: Tejas is an indigenously developed lightweight combat aircraft by the Hindustan Aeronautics Limited (HAL). A total of 40 Mark-1 version aircraft have been produced including eight trainers, 16 Initial Operational Clearance (IOC), and 16 Final Operational Clearance (FOC). An order for 83 improved MK-1A is also going to be placed. MK-1A will carry Israeli made Active Electronically Scanned Array (AESA) radar.[29]

After the Mk-1A version, the MK-2 is planned to be developed which will be heavier than the MK-1. It will have a more powerful engine, and better electronic warfare system, and avionics. It will also have an infrared search and track system and a missile approach warning system. General Electric F414-GE-INS6 engine will power the MK-2 as the indigenous development of the Kaveri engine has been facing delays for the last few decades. Nevertheless, F414-GE-INS6 will be

more powerful and reliable than the Kaveri. Tejas armament include Israeli Derby medium-range air-to-air missile,

In total, IAF will have 40+83 Tejas Mk I/IA and around six squadrons of Tejas Mk II.[30] IAF is likely to have 18 squadrons i.e. 324 Tejas of different versions in the future.[31] To replenish the depleting squadron strength of IAF, India has also ordered additional 21 Russian MiG-29UPGs to raise a new squadron.[32] It is also going to retain Jaguars well beyond 2035 after engine and avionics upgrades.[33]

During the year 2020, while India has faced budget issues due to the COVID-19 pandemic and mismanagement of the economy, it has also gone through a stand-off with China in the north. IAF's annual budget was also marginally cut down.[34] While IAF is facing issues to maintain a potent squadron strength, it has access to technology abroad and local efforts are also underway. The problem mainly lies in the bureaucratic red tape and financing issues which may be circumvented if an urgency arises.

On the other hand, for PAF, the JF-17 seems to be an effective system in the short term. JF-17 is an evolving platform. It has progressed from Block I to Block II. Currently, Block III of the JF-17 is set to roll out. It is an advanced version of the earlier blocks. According to Air Chief Marshal Sohail Aman, Block III is going to fulfill the requirements of a high-tech aircraft for the PAF.[35] The latest version is touted to incorporate many advanced features such as Chinese-made KLJ-7A AESA radars, a helmet-mounted display (HMD), integrated electronic warfare (EW), a self-protection suite, and a new sensor package.[36] The speed in Block III will also increase from Mach 1.8 to Mach 2. It is also going to give its pilots an enhanced situational awareness and increase potency in the BVR warfare by employing the Chinese PL-15 air-to-air missile. Like the Rafale, an advanced infrared missile approach warning system is also incorporated in the advanced version of JF-17 thunder.

PAF operates 49 Block-I and 62 Block-II jets. It plans to add 50 Block-IIIs by 2024.[37] With the production of 12 Block-III per year, PAF will receive all 50 in the next four years.[38]

India's S-400 Air Defense System

Surface to Air Missiles (SAMs) are becoming increasingly important due to the growing increase in the stand-off ranges of modern munitions. SAMs complement the aircraft or air-to-air missiles by providing another option to take down adversary aircraft. Air defense systems can target not only a fighter or bomber aircraft but also enabler aircraft like aerial refueling tankers and airborne early warning and radar systems thereby limiting the operational potential of fighters and bombers.

An air defense system typically consists of a radar, autonomous detection, and targeting systems, anti-aircraft missile systems, launchers, and command and control center.

The most advanced air defense system in the South Asian region will be the Russian S-400 Triumph Air Defence Missile System with deliveries starting in 2021 to India. India will get five regiments of the air defense system and each regiment will have two battalions.[39] Each battalion is equipped with eight launchers to launch 32 missiles, radar, and a control center. This means that India will have a total of 10 battalions consisting of 80 launchers.

The system can launch missiles of four ranges or types to create a layered defense with a coverage of 300km radius and 30km altitude. These are 400km, 250km, 120km, and 40km. Therefore, when deployed and used alongside aircraft, S-400 will pose an additional challenge to the PAF.

Operational Challenges Faced by IAF

There are operational factors involved that an air force must take into account to have a maximum number of combat-ready aircraft.

Other than the low number of fighter squadrons than the envisioned total, IAF is facing a low pilot to aircraft ratio. IAF has 1:0.81 pilots per aircraft ratio while PAF has 1: 2.5 pilots per aircraft.[40] An aircraft can have more sorties in a day if fresh and rested pilots are available. However, IAF has a numerical edge of 1.4:1 over PAF in terms of total aircraft. With a total of 42 sanctioned squadrons, the ratio increases to 2:1.[41]

The serviceability rate of aircraft for combat roles is another operational challenge. The desired serviceability rate is generally considered to be 75%. However, according to reports, the serviceability rate of Su-30MKI is 55-60%. Issues in its engine, flight control system, and defensive avionics have reduced its flying hours and thus the combat availability.[42] Similarly, according to a report, the serviceability rate of Rafale in the French Air Force was 48.5% which is a significantly low rate. Dassault has assured India a 75% availability rate meaning that 27 out of 36 aircraft will be combat-ready at any given time.[43]

IAF has to cover the Northern, Southern, Eastern, and Western front of India. The Western and Northern fronts are more important hence they get more deployment especially against Pakistan. The Northern sector is also catching up due to the enhanced capabilities of the People Liberation Army Air Force (PLAAF) deployed in the area and the brewing of tensions between India and China in recent years. India is enhancing deployment on an urgent basis along this Line of Actual Control (LAC).[44] PLAAF is also strengthening its combat ability in this important sector. Overall, PLAAF is a much bigger force than the IAF. According to Kennedy School's Belfer Center for Science and International Affairs, PLAAF has created bases in Hotan, Lhasa / Gongagar, Nagri-Gunassa, and Jigz and has stationed its jets there.[45] It also says, however, China has fewer shelters for jets on its bases as compared to the IAF bases in the East and West.[46]

The greater the variety of aircrafts operated by an Air Force the greater are its maintenance and logistic costs. Rafale is the seventh type of aircraft in the IAF inventory. The maintenance costs of these diverse types and origins of aircraft are likely to be significantly higher.

Comptroller and Auditor General (CAG) and defense parliamentary committee reports have raised concerns over the low operational availability, limited flying hours, and higher aircraft on the ground ratio of IAF platforms.[47]

However, these operational challenges will not be new to a future conflict if India tries another aerial strike in Pakistan. These were already present during the IAF February 26, 2019 strike in Balakot. Indian leadership might have not thought of them as determinantal factors when planning the Balakot strike, and wouldn't continue doing so.

Numbers Matter

Pakistan will have around 200+ JF-17s of different blocks including the dual seat version in the coming years along with retaining the 76 F-16 jets, Mirage 5, Mirage III. The F-7 will be replaced with the JF-17s. Without considering the other unknown but possible inductions by PAF, the JF-17 and F-16 are expected to be the mainstay of PAF's fourth-generation fleet.

The IAF on the other hand is likely to have around 500+ fourth-generation aircraft consisting of Su-30MKI, Rafales, Mirage 2000, and LCA Tejas.

It is said that Pakistan can counter the Rafale threat by a numerical strength of JF-17s. However, PAF should also take into account the other fourth-generation aircraft including Su-30 and Tejas of the Indian Air Force while devising a strategy based on numbers. IAF can also plan on a similar basis to counter JF-17s with the numerical strength of Su-30 and Tejas. After the February 2019 events, IAF is

likely to address the shortcomings of Su-30 like the BVR capability and electronic countermeasures (ECMs) and electronic counter-countermeasures (ECCMs). It is not likely to dump the ten squadrons of Su-30 for two squadrons of Rafale.

Although it can also be argued that LCA is long-delayed and procurement of 114 jets may also take a longer time to materialize, therefore, PAF will not be in a rush to develop the capability to counter them. The production rate of JF-17 can go up to 25 aircraft per year. In the next five years, for example, If PAF has no other confirmed acquisition other than the JF-17 Block III. It is also developing 26 dual seater version JF-17Bs. These are for training purposes but have full operational capability.[48]

During Operation Swift Retort, the PAF strike package consisted of 2 JF-17+2 Mirage 5+ 2 Mirage III. Additionally, 12-18 JF-17s and F-16s provided them backup and support. That makes up to 24 aircraft committed for the mission with one Falcon 20 EW/ECM jet and one Saab 2000 AEW&C.[49] If the number of simultaneous missions increases to more than one then it can be challenging for PAF's limited inventory. With the S-400 system activated, Rafale deployed improvements in Su-30 MKI and plugging gaps in IAF's EW/ECM shortcomings, the tactical environment may not be as favorable to PAF as it was during Operation Swift Retort. This requires PAF to prepare for a technically and numerically more advanced adversary.

Options for Pakistan

The international political environment is in India's favor presently. India is making the best of the opportunity available to it and has embarked on the acquisition of advanced military equipment from Russia as well as from the West. Another factor is the resources of which Pakistan has severe constraints while India has less of that issue.

To counter India's Rafale, Su-30MKI, Tejas, other possible aircraft acquisition, and S-400 air defense system, Pakistan can work on a number of options. Most importantly, work on the upgradation and improvement of JF-17 should continue in the future by incorporating new subsystems. The earlier Block-I and II can be upgraded on Block-III standards. Maintenance, upgrades, and overhauling of the jet domestically are more cost-effective and more reliable than depending on the other countries as would be in the case of Rafale. Pakistan can adjust and tweak JF-17 according to its needs and situational demands.

Secondly, the induction of medium and long-range air defense systems has become a necessity after similar developments on the other side of the border. Air defense systems share the aircraft's role of taking down the intruding enemy aircraft. Pakistan has inducted an HQ-16 air defense system which is not enough. The option of inducting Chinese HQ-9 is available which is based on the Russian S-300.[50]

Acquisition of combat-ready UAVs is another logical step to counter missile defenses and make for low aircraft numbers. Other than the intelligence, surveillance, and reconnaissance (ISR), the combat capabilities of UCAVs are also improving. Recently, we have seen Turkish UCAVs have progressed in numbers, technology, and combat power.[51] Pakistan has developed Burraq UCAVs locally and reportedly signed a deal with China for co-production of 48 Wing Loong II UCAVs.[52] The development of UCAVs in good numbers can play an important role for PAF.

Pakistan currently has few Falcon-20F electronic warfare/electronic intelligence aircraft and six Saab-2000 Erieye and four ZDK-03 AEW&C aircraft. An increase in the number of these platforms is crucial to ensure a survivable number.

Having a good availability ratio of aircraft for combat and sortie generation rate are important operational factors. Sortie generation

means how many take-offs and landings an aircraft can make in a day or a given period. Increasing the serviceability and sortie generation rate can make up for the low number of aircraft. A sortie generation rate with a large number of aircraft may be good. PAF also enjoys a good pilot to aircraft ratio as compared to IAF which it should continue to maintain. This allows it to generate more sorties than the IAF.

Pakistan is developing a fifth-generation aircraft under Project Azm. However, building a next-generation aircraft from scratch is a time-consuming effort and it may take a decade for the aircraft to develop. To increase the pace, however, a partnership can be sought with China or Turkey who had developed or are developing a fifth-generation fighter aircraft.

The most important and credible development in terms of India's perception of PAF capabilities will be the acquisition of an advanced aircraft with equal or better performance and weapons package than the Rafale. There would also be a need in the coming years to procure a next-generation aircraft with stealth features due to the upgradation of the IAF fleet with advanced platforms and systems.[53] While western options may not be available, PAF should be looking at and evaluating the options available in China and Russia.

Conclusion

Operation Swift Retort has highlighted the gaps in the technology, integration, planning, and performance in the IAF platforms and systems. IAF, therefore, will most certainly work on those shortcomings in the future. These include the upgradation of existing platforms like Su-30MKI, Jaguars, and MiG-29, increasing the induction of locally built Tejas, and acquisition of advanced jets in addition to the Rafale.

At the same, the trajectory of India's strategic thinking, tense regional political environment, and tensions with Pakistan and China provide

Indian leadership impetus for military growth. With its growing military power, India may again make an attempt like the one in February 2019. The chances of a Balakot type crisis cannot be ruled out owing to tense India-Pakistan relations and persistence of the anti-Pakistan environment in Indian domestic politics and strategic thinking.

Pakistan's military especially the air force will certainly take into account the advancement and upgradation in the IAF fleet. To deter the Indian air force from repeating something like the Balakot episode, Pakistan may signal the credibility of its systems and platforms. For that purpose, the acquisition of an advanced platform along with the production of good numbers of JF-17s would be a strong signal.

Endnotes

[1] Sameer P. Lalwani, Elizabeth Threlkeld, and others, "From Kargil to Balakot: Southern Asian Crisis Dynamics and Future Trajectories," *Stimson Center*, 18.

[2] Tanvi Kulkarni, Sylvia Mishra, "The Pulwama Aftermath: Making Sense of India's Response," *South Asian Voices*, March 5, 2019. https://southasianvoices.org/the-pulwama-aftermath-making-sense-of-indias-response-%ef%bb%bf/

[3] Kulkarni, Mishra, "The Pulwama Aftermath".

[4] Kulkarni, Mishra, "The Pulwama Aftermath".

[5] Arjun Subramaniam, "The Indian Air Force, Sub-Conventional Operations and Balakot: A Practitioner's Perspective", ORF Issue Brief No. 294, May 2019, *Observer Research Foundation*, 9.

[6] Sanu Kainikara, A Case for Multirole Combat Aircraft, Air Power Development Centre Bulletin, Issue 337, August 2019. https://airpower.airforce.gov.au/APDC/media/PDF-Files/Pathfinder/PF337-A-Case-For-Multi-Role-Combat-Aircraft.pdf

[7] "Five Generation of Jet Fighter Aircraft," *Air Power Development Centre*, Issue 170, January 2012. https://airpower.airforce.gov.au/APDC/media/PDF-Files/Pathfinder/PF170-Five-Generations-of-Jet-Fighter-Aircraft.pdf

[8] A sortie of an aircraft includes taking off, performing assigned task, and returning to base. An aircraft with most sortie generation is considered more effective than the opposite.

[9] Konstantinos Zikidis, Alexios Skondras, Charisios Tokas, Low Observable Principles, Stealth Aircraft and Anti-Stealth Technologies, Journal of Computations & Modelling, vol.4, no.1, 2014, 129-165 ISSN: 1792-7625 (print), 1792-8850 (online) Scienpress Ltd, 2014, 137.

[10] Konstantinos Zikidis, Alexios Skondras, Charisios Tokas, Low Observable Principles, Stealth Aircraft and Anti-Stealth Technologies, Journal of Computations & Modelling, vol.4, no.1, 2014, 129-165 ISSN: 1792-7625 (print), 1792-8850 (online) Scienpress Ltd, 2014, 131.

[11] Indian Air Force reportedly lacked a data link, and its aircrafts were blinded by Pakistan Air Force using electronic warfare measures.

[12] Jamal Hussain, "The Rafale Factor and Options for the PAF," *Pakistan Politico*, February 19, 2020. http://pakistanpolitico.com/the-rafale-factor-and-options-for-the-paf/

[13] Ashley J. Tellis, "Troubles, They Come in Battalions: The Manifold Travails of the Indian Air Force," *Carnegie Endowment for International Peace,* 2016, 17.

[14] Tellis, "Troubles, They Come in Battalions", 11.

[15] Chapter Six: Asia, The Military Balance 2020, 120:1, p. 273

[16] The Military Balance 2020, 273.

[17] The Military Balance 2020, 273.

[18] Pradip R Sagar, "Process to buy 110 fighters is rerun of UPA-era tender, with few tweaks," *The Week*, April 7, 2018. https://www.theweek.in/news/india/2018/04/07/110-fighter-iaf-mmrca-upa-modi-126.html

[19] Rohan Ramesh, "Shot in the Arm," *Force Magazine*. http://forceindia.net/feature-report/shot-in-the-arm/

[20] Chapter Six: Asia, The Military Balance 2020, 120:1 p. 302

[21] The Military Balance 2020, 302.

[22] The Military Balance 2020, 302.

[23] "Pakistan announces 5th-gen fighter and medium altitude long range UAV programs," *Quwa*, July 6, 2017. https://quwa.org/2017/07/06/pakistan-announces-5th-gen-fighter-male-uav-programs/

[24] "A Wide Range of Smart and Discrete Sensors," *Dassault Aviation*. https://www.dassault-aviation.com/en/defense/rafale/a-wide-range-of-smart-and-discrete-sensors/

[25] Aviation, "A Wide Range".

[26] Kaiser Tufail, "Rafale's Impact on IAF's Air Power Capabilities," *Pakistan Politico,* September 10, 2020. http://pakistanpolitico.com/rafales-impact-on-iafs-air-power-capabilities/

[27] Snehesh Alex Philp, "How the IAF plans to get the edge back from Pakistan on air-to-air strike capability," *The Print*, March 9, 2020. https://theprint.in/defence/how-the-iaf-plans-to-get-the-edge-back-from-pakistan-on-air-to-air-strike-capability/377071/

[28] Anurag Sharma, "Time IAF Upgraded its Largest Combat Fleet," *Manohar Parrikar Institute for Defence Studies and Analyses*, September 30, 2020. https://idsa.in/idsacomments/iaf-upgraded-largest-combat-fleet-asharma-300920

[29] Snehesh Alex Philip, "HAL cuts its profit on Tejas Mark 1A deal by 50%, fighter jets to take to sky by 2022," *The Print*, March 19, 2020. https://theprint.in/theprint-essential/hal-cuts-its-profit-on-tejas-mark-1a-deal-by-50-fighter-jets-to-take-to-sky-by-2022/383730/

[30] "Will order for 83 Tejas soon, HAL to deliver 70 aircraft by 2026: IAF chief Bhadauria," *The Print*, May 31, 2020. https://theprint.in/defence/will-order-for-83-tejas-soon-hal-to-deliver-70-aircraft-by-2026-iaf-chief-bhadauria/432320/

[31] Trilok Chand, "Made in India: The IAF will soon get 324 Tejas aircraft in different configurations," *Force Magazine*. http://forceindia.net/force-defexpo-11-14-april-2018/made-in-india/

[32] Snehesh Alex Philip, "IAF set to place orders for 21 MiG-29 jets from Russia by Dec to shore up aircraft strength," *The Print*, October 6, 2020. https://theprint.in/defence/iaf-set-to-place-orders-for-21-mig-29-jets-from-russia-by-dec-to-shore-up-aircraft-strength/517907/

[33] Ajai Shukla, "After Rafale splurge, a sensible Jaguar upgrade," *Business Standard*, May 24, 2018. https://www.business-standard.com/article/economy-policy/after-rafale-splurge-a-sensible-jaguar-upgrade-118052400060_1.html

[34] Snehesh Alex Philip, "IAF needs 200 new fighters but Modi govt has cut funds in Budget 2020," *The Print*, February 1, 2020. https://theprint.in/defence/iaf-needs-200-new-fighters-but-modi-govt-has-cut-funds-in-budget-2020/358347/

[35] "Outgoing Pakistan Air Force Chief:JF-17-block III Design Finalized," *Quwa*, March 19, 2018. https://quwa.org/2018/03/19/outgoing-pakistan-air-force-chief-jf-17-block-iii-design-finalized/

[36] Franz-Stefan Gady, "Report: JF-17 'Thunder' Block III Fighter Jet Production Is Underway," *The Diplomat*, March 13, 2019. https://thediplomat.com/2019/03/report-jf-17-thunder-block-iii-fighter-jet-production-is-underway/

[37] "JF-17 Block-III: Pakistan's new fighter," *Quwa*, January 5, 2020. https://quwa.org/2020/01/05/jf-17-block-iii-pakistans-new-fighter-2/

[38] "JF-17 Thunder Block III: Outshines anything currently in Indian arsenal," *Global Village Space*, January 13, 2020. https://www.globalvillagespace.com/jf-17-thunder-block-iii-outshines-anything-currently-in-indian-arsenal/

[39] Jamal Hussain, "India's Acquisition of S-400 Air Defence System: Implications For the PAF," *Strafaisa*, February 13, 2020. https://strafasia.com/indias-acquisition-of-s-400-air-defence-system-implications-for-the-paf/

[40] Franz-Stefan Gady, "The Indian Air Force's Big Problem: Not Enough Pilots!" *The Diplomat*, April 30, 2015. https://thediplomat.com/2015/04/the-indian-air-forces-big-problem-not-enough-pilots/

[41] Bindanda Chengappa, "How the IAF compares with the PAF," *The Hindu Business Line*, March 1, 2019. https://www.thehindubusinessline.com/opinion/how-the-iaf-compares-with-the-paf/article26411688.ece#

[42] Ashley J. Tellis, "Troubles, They Come in Battalions: The Manifold Travails of the Indian Air Force," *Carnegie Endowment for International Peace*, 2016, 47.

[43] Pierre Tran and Vivek Raghuvanshi, "India Inks Deal with France for 36 Rafale Fighter Jets," *Defense News*, September 23, 2016. https://www.defensenews.com/global/asia-pacific/2016/09/23/india-inks-deal-with-france-for-36-rafale-fighter-jets/

[44] "IAF ramping up deployment in key bases along LAC amid border row with China," *Business Standard*, July 4,2020. https://www.business-standard.com/article/current-affairs/iaf-ramping-up-deployment-in-key-bases-along-lac-amid-border-row-with-china-120070401157_1.html

[45] Rustam Roy, "How Indian Air Force intends to counter China's forward airbase close to LAC," *WION*. https://www.wionews.com/photos/how-indian-air-force-intends-to-counter-chinas-forward-airbase-close-to-lac-326902

[46] Roy, "How India Air Force intentds".

[47] Rahul Bedi, "Rafale Maintenance Costs Will Add Hugely to IAF's Already Strained Finances," *The Wire*, July 31, 2020. https://thewire.in/security/rafale-dassault-france-iaf-aircraft-fighter-jet-cost-ambala

[48] "Why is the Pakistan Air Force procuring 26 JF-17Bs?" *Quwa*, January 19, 2020. https://quwa.org/2020/01/19/why-is-the-pakistan-air-force-procuring-26-jf-17bs-2/

[49] "Pakistan should prioritize investment in the JF-17," *Quwa*, April 5, 2020. https://quwa.org/2020/04/05/pakistan-should-prioritize-investment-in-the-jf-17-2/

[50] Usman Ansar, "What does Pakistan need to close its air defense gaps?" *Defense News*, April 10, 2019. https://www.defensenews.com/global/asia-pacific/2019/04/10/what-does-pakistan-need-to-close-its-air-defense-gaps/

[51] Sibel Duz, "The ascension of Turkey as a drone power: history, strategy and geopolitical implications," *SETA*, July 2020. https://setav.org/en/assets/uploads/2020/07/A65En.pdf

[52] Franz-Stefan Gady, "China, Pakistan to Co-Produce 48 Strike-Capable Wing Loong II Drones," *The Diplomat*, October 9, 2018. https://thediplomat.com/2018/10/china-pakistan-to-co-produce-48-strike-capable-wing-loong-ii-drones/

[53] Jamal Hussain, "The Rafale Factor and Options for the PAF," *Pakistan Politico*, February 19, 2020. http://pakistanpolitico.com/the-rafale-factor-and-options-for-the-paf/