EVOLUTION OF IAF HELICOPTERS - II CONSOLIDATION POST-1971 WAR

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By the late 1960s, an increase in Counter-Insurgency (COIN) operations and establishment of Indian Army/Assam Rifles outposts in relatively hostile areas of Mizoram and Nagaland, with an associated presence in Tripura, necessitated an increase in the commitment for the air maintenance effort by the Indian Air Force (IAF). This was largely undertaken by the C-47 Dakotas. There were also reports by ground troops about a substantial amount of stores being irrecoverable due to their being air-dropped in inaccessible ravines. The errors in drop accuracy were mainly on account of the small size of the Drop Zones (DZs). It was clear by the late 1960s that helicopters were an alternative worth exploring. The platform had already demonstrated these capabilities during the re-taking of Aizawl in the Mizoram operations.

Further, the significant success of helicopter operations in the outcome of the Bangladesh War of independence was partly due to the lessons learnt during the COIN operations in the northeast, along with the extensive planning carried out prior to the actual commencement of hostilities. This included devolving the decision-making to the Tactical Air Commands (TACs) set up especially for the purpose and, in a few cases, even to the field level. However, the roles in which helicopters could be employed kept on diversifying. Increased requirements logically

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INDUCTION OF MI-8S IN VIP AND OFFSHORE ROLES

When the Mi-8s, which were almost twice as capable as the Mi-4s, were offered by the Soviets, there was no hesitation to acquire these twin engine helicopters powered by the latest turbine engines. These capable helicopters, along with the economics of acquiring them from the Soviet Union, fitted perfectly with the IAF's requirements of the times.

After duly evaluating them in the North-East Frontier Agency (NEFA) in mid-1969, initial orders for 36 Mi-8s were placed to equip two Helicopter Units (HUs) viz. no 118 HU and 119 HU. This was followed by replacing the Mi-4s of 109 HU. Gradually, these helicopters took over the air maintenance tasks from the Dakotas in both the eastern and western sectors. As was the case with all helicopters, these were also tasked to undertake a role for VIP duties from time to time. However, it was only in 1984 that the Mi-8s also formally became a part of the Air Headquarters (HQ) Communication Squadron, which was formed on November 1, 1947, at Air Force Station, Palam, to convey VVIPs/VIPs of India and visiting foreign heads of states and governments. Post 1971 operations, it was an Mi-8 helicopter which transported Pakistani President ZA Bhutto and his party from Chandigarh to Simla for the historic Simla Accord in June 1972.[1]

The progressive induction of Mi-8s continued, with these gradually replacing the Mi-4s which were finally de-commissioned by 1981 after having been in service for over 20 years. The Mi-8s thereafter were also increasingly tasked with additional ground breaking responsibilities. These included supporting offshore oil exploration activities by the Oil & Natural Gas Commission of India (ONGC) and the Indian endeavours in Antarctica.

1. Pushpinder Singh, *History of the Indian Air Force: Volume III* (New Delhi: The Society of Aerospace Studies, 2007), p. 59.

In 1972, the initial efforts of ONGC for oil exploration were supported by Chetak helicopters of No.121 Helicopter Flight (HF). These single engine helicopters equipped with floats, made the first passenger trip to the Sagar-Samrat offshore drilling rig in 'Bombay High' in September 1973. Their relatively smaller size made it possible for them to land on smaller decks also. However, their size also limited their payload capacity and, thus, a need was felt to have a larger helicopter for this role.

To meet the increased tasks, the Mi-8s were inducted into 121 HF in October 1974 to support the ever increasing efforts of ONGC in its offshore oil exploration in the Arabian Sea. This role continues till today with an upgradation of the Mi-8s to the Mi-17s.

Earlier, in May 1972, the helicopters from 107 HU had already proven their worth and had been called upon to conduct searches over the sea for 22 ONGC personnel on board a small vessel. Having successfully located the vessel, vital medicines, water and food were dropped for the vessel. This effort, in addition to having an inherently high safety margin due to the twin engines, governed the decision for their induction in the offshore role. Hence, to meet the increased tasks, the Mi-8s were inducted into 121 HF in October 1974 to support the ever increasing efforts of ONGC in its offshore oil exploration in the Arabian Sea.[2] This role continues till today with an upgradation of the Mi-8s to the Mi-17s.

THE ANTARCTICA CONNECTION

With an intention to undertake scientific research and exploration in Antarctica, the first expedition of 77 days commenced on December 6, 1981, and was further followed up by yearly expeditions. The first two expeditions were largely exploratory. For the third expedition, the Government of India (GoI) tasked the three Services to help establish a permanent station. During this expedition, which established Dakshin-Gangotri as the first permanent station, the three Services played a major role. A total of 13 IAF personnel, including a doctor, formed a part of this mission. Thereafter,

2. Ibid., p. 59.

during the fourth expedition, the second permanent station, "Maitree Hill", was established and preliminary reconnaissance for a South Pole expedition was also carried out.[3]

Two Mi-8s formed a part of the third expedition which left Vasco Da Gama (Goa) on December 3, 1983, aboard the *Finnpolaris* which was a Finnish ice-class cargo vessel. On December 28,1983, the Mi-8s commenced flying by ferrying the advance party of army engineers to the chosen site. On the very first day, while undertaking underslung operations from the deck of the ship, one of the Mi-8s crashed into the icy waters. There was no loss of life and all personnel on board were rescued. However, the loss meant that all the equipment on board the helicopter was now to be transported inside the fuselage as the crew had also realised the perils of undertaking underslung operations under windy conditions. Such an operation from a ship was probably being attempted for the first time.[4] However to the credit of the operating crew, the second helicopter remained serviceable and by January 28, 1984, it had flown over 220 sorties, transporting over 200 tonnes of load.

Many lessons were learnt while operating the helicopters from the deck of a ship. The varied operations included logistic support operations, casualty evacuation, aerial reconnaissance and iceberg landings in often near white-out conditions in hilly, rough and icy terrain. The challenge of keeping the machine airworthy at all times was readily taken up by the accompanying technical personnel. The lessons included aero-medical aspects of protection of eyes from the glare from the snow, and measures to be undertaken for preventing hypothermia and frostbite.[5] These pioneers also laid a foundation and drafted standard operating procedures for the conduct of helicopter operations for subsequent expeditions. Thus, the helicopters made an immense contribution to the success of these expeditions and, more importantly, gained the experience of working for prolonged durations

3. Flt Lt Vijayan EK, "Memoirs", Member IVth Indian Scientific Expedition to Antarctica, Centre for Armed Forces Historical Research (CAFHR), USI Archives.
4. National Centre for Antarctic & Ocean Research, "Scientific Report of Third Indian Expedition to Antarctica: Introduction & Album", http://hdl.handle.net/123456789/670. Accessed on July 5, 2016.
5. Sqn Ldr KI Trivedi, "Assignment to Icy Continent", Member IIIrd Indian Scientific Expedition to Antarctica, CAFHR Archive.

under sub-zero temperatures. Little did they know that the experience so gained would be utilised back home also, as warning bells were ringing in the region of sub-zero temperatures within India, but at a much higher altitude, where the highest battlefield in the world, at the Siachen glacier, was about to be activated.

THE SIACHEN GLACIER: OP MEGHDOOT, INDUCTION OF MI-17 AND MI-26

The battle for controlling the Siachen glacier started immediately after the 1971 War. Mountaineering expeditions from various parts of the world had been to the Siachen area much prior to 1970. However, from the early 1970s, Pakistan started charging a licence fee for these expeditions, and by 1978, in an attempt to legitimise its claim, it also started sending military officers as a part of the expeditions for liaison duties.[6] Subsequently, it started depicting those areas to be a part of Pakistan in its maps.

A chance reporting of the matter by a Japanese expedition member set the alarm bells ringing in the Indian establishment. By this time, within the Indian polity, there was some recognition about the importance of the area and, thus, India also devised a counter strategy and started sending exploratory army expeditions to the area. These commenced in 1978 in the form of annual expeditions and patrols to the region.[7]

The onus of providing air cover for these expeditions fell upon the helicopters of 114 HU. They were called in to provide the necessary air support to the first ever army exploratory expedition which was led by Col Narendra Kumar of the Army High Altitude Warfare School. The first sortie to Siachen was launched on September 20, 1978, by a Chetak helicopter, mainly in the logistic support and casevac (casualty evacuation) role. As this expedition progressed, the first casevac was undertaken on October 6, 1978, from the Siachen Advance Base Camp.[8] The Chetak helicopters were soon

6. Jasjit Singh, *Kargil 1999: Pakistan's Fourth War for Kashmir* (New Delhi: KW Publishers, 1999), p. 81.
7. CAFHR, "Siachin", Air HQ Letter No. 99717/83/38/Org dtd February 4, 1993, CAFHR Archive.
8. Manmohan Bahadur, "NDTV.com:I Have Rescued Jawans at Siachin You Never Forget it-February 5, 2016", http://www.ndtv.com/opinion/ive-rescued-jawans-at-siachen-you-never-forget-it-1273940. Accessed on March 10, 2016.

modified with "snow-skids" to land on snow covered helipads, however, it was clear that the Cheetah (SA 215 Lama) helicopter would be more suited to operate in the prevailing conditions. As early as May 8, 1969, the Cheetah helicopter (SA 315), being produced by Hindustan Aeronautics Limited (HAL), had landed at an altitude of 22,500 ft in Karakoram as a part of flight trials. Hence, the Cheetah was subsequently tasked extensively to undertake operations in the Ladakh sector, especially in the Siachen glacier. A task, which is continuing to this day as a part of Operation Meghdoot which was launched in 1984.

On March 28,1984 India launched Operation Meghdoot to preempt Pakistan's intention of securing the Siachen glacier. The glacier was secured by April 17, 1984, and Pakistan's repeated attempts to gain a foothold in the Saltoro watershed were thwarted by the Indian troops. However, due to the almost daily exchange of fire, it became an active battlefield. The army, till date, continues to undertake patrols at heights of upto 20,000 ft with temperatures as low as minus 40°. Motorable roads at these heights are virtually non-existent.

These conditions mandated the use of helicopters that could operate at those altitudes with sufficient load lifting capacities. It was already clear during the conduct of the operations that the Cheetah was most suited to undertake these operations but a need was felt to augment and replace the Mi-8s as they were operating at the boundaries of their manufacturer-specified performance limits. In certain cases, the graphs for the expected altitude of operation were not even specified by the manufacturer[9]—the graphs were being used by extrapolating the lines.

Hence, the Mi-17s were inducted on June 10, 1985 (No. 127 HU was raised)[10] and they commenced their operations as part of Operation Meghdoot by September 1985. Even though at those altitudes, the Mi-17 could lift only 25 percent of its payload lifting capacity at sea level, it was the best helicopter

9. Rajesh Isser, *The Purple Legacy: Indian Air Force Helicopters in Service of the Nation* (New Delhi: Pentagon Press, 2012), p. 138.
10. Singh, n.1, p.60.

available and, thus, was utilised for all high altitude operations.[11] Casevac, communication and logistic supply sorties to the forward posts involving landing of the helicopter continued to be undertaken by the Cheetah.

The build-up of troops also needed a huge infrastructure, the build-up of which was limited by the road access which was open during the summer months only. Recognising the strategic importance of the region and also being aware of the relative ease of access to the region by the Chinese and Pakistani troops, along with an imperative need to build up a sizeable presence, India evaluated, and placed orders for, the world's largest helicopter, the Mi-26 (Bhim) from the Soviet Union.

The first two of the four helicopters ordered arrived by ship on April 25, 1986, and had their maiden flights on May 31, 1986, and June 1, 1986, respectively. By July 29, 1986, high altitude trials were conducted in Thoise and Siachen, with a hover at Kumar post. On September 9, 1986, the first landing was executed at Daulet Beg Oldi (DBO) at 17,000 ft, the world's highest landing zone. Thereafter, started one of the most significant operational uses of the heavy lift helicopter, with heli-lift of a one-tonner, a jonga, prefabricated huts and other supplies to DBO, along with hospital containers to Thoise (Thoise being an acronym for a transit halt of induction to Siachen). The maximum lifting capacity at favourable temperatures was 5,000 kg at DBO. The Mi-26, thus, contributed significantly by heli-lifting heavy as well as odd sized stores to forward areas where the ground defences were built and reinforced .

The Mi-26 was also thereafter moved to the eastern part of the country to heli-lift army field guns, ammunition, trailers, wheeled vehicles and bulldozers. The heli-lifting of dozers to multiple locations resulted in the construction of the strategically important Hayuliang to Walong road by the Border Roads Task Force (BRTF) in record time.[12] The development of the road, besides improving connectivity and contributing to the development of the region, also improved the security infrastructure of the region.

11.. CAFHR, "Air Maintenance by Mi-17 Heptrs in Siachin Area", A report by 153 HU, April 18, 1994.

12. CAFHR, "126 HFAF: Brief History Oct 85- Aug 04", A report by No.126 HF, CAFHR Archive

It is understood that the army's proposal for its own aviation corps was mooted in 1963, after the 1962 War. Effective use of transport aircraft and helicopters during the operations in both the western and the eastern theatres to support the retreating ground forces governed the proposal.

Thus, the conduct and progress of Operation Meghdoot played a pivotal role in the expansion of the helicopter fleets of both the IAF and the army as a part of the Army Aviation Corps. The army already had a rich history of its Air Observation Post Flights (AOP Flts) taking part in various operations since their establishment prior to independence.

ARMY AVIATION CORPS (AAC) AND INDUCTION OF THE MI-25/35 HELICOPTER

The proposal by the army for significantly expanding its own limited air assets was mooted as far back as 1949. The Joint Staff Committee (JSC), while examining the proposal, had entrusted the task to the IAF. The JSC had also agreed that the IAF needed to consolidate and, consequently, had approved the tasking of the IAF to meet all the requirements of the army.[13]

It is understood that the army's proposal for its own aviation corps was mooted in 1963, after the 1962 War. Effective use of transport aircraft and helicopters during the operations in both the western and the eastern theatres to support the retreating ground forces governed the proposal. In 1969-71, a decision was also taken to equip the AOP flights with the Chetaks for the plains, and the Cheetahs for the mountains.[14]

By this time, there was adequate awareness about the roles that an armed helicopter can play in the kind of conflict situations being faced by the country. Also, the modification on the Chetak, to enable it to carry rocket pods, as was done during the 1971 Bangladesh liberation operations, was discontinued. Hence, when an opportunity arose, the first of the dedicated assault helicopters, the Mi-25s, were inducted into the IAF's inventory in November 1983, with the raising of No. 125 (Helicopter) Squadron.

13. History Division, GoI, "Experience of Air Force and Air Force Matters:JPC Paper No. 28(49) on Intercommunication Flight for the Army, November 18,1949", File no. 601/1513/H
14. Rajiv Ghose, *Army Aviation in Modern Warfare* (New Delhi: KW Publishers, 2011), p. 16

By the time the second attack helicopter squadron was formed in March 1990 (104 Sqn), the AAC had already been formed, on November 1, 1986. The salient points of the government's decision to create the AAC were[15]:

- All Air OP units to be transferred to the army, and to be wholly manned, maintained and controlled by it.
- The army to have its own utility helicopter units, which would be wholly manned, maintained and controlled by it.
- Attack helicopter units would continue to be IAF assets, but placed under the command and control of the army for the duration of the operations.
- The army would create its own Air Traffic Control (ATC) facilities at the army's aviation bases.
- The army would create its own organisational infrastructure for the management of its army aviation units.

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Presently, with its own fleet of helicopters, the army is operating a mix of Chetak, Cheetah and Advanced Light Helicopters (ALHs), besides undertaking exercises with the two attack helicopter squadrons of the IAF. The creation of the AAC was a long drawn out process and caused much heartburn between the two "sister" Services. The debate over the projected requirement of the attack helicopter and requirement of their own fleets of transport aircraft continues till today.

However, with the Government of India's decision to intervene militarily in the events occurring in Sri Lanka, for the first time, simultaneous operations by the helicopters being operated by the army and air force were conducted. The joint structure to exercise control over the IAF helicopters (including the attack helicopters) had been activated for the first time since 1971 and was immediately put to test.

15. Vijay Oberoi, *Indian Army Aviation 2025* (New Delhi: KW Publishers, 2007), p. 6

SRI LANKA OPERATIONS: OPERATION PAWAN

On July 30, 1987, induction of the Indian Peace-Keeping Force (IPKF) started in Sri Lanka after the signing of the Indo-Sri Lanka agreement, with an initial task of "supervising the surrender of arms of all militant groups". The Indian forces had to commit to active operations against the Liberation Tigers of Tamil Eelam (LTTE) when 12 LTTE cadres committed suicide in the custody of the Sri Lankan Army (SLA) on October 10, 1987. This intervention was mainly to enforce the surrender of arms. By May 1988, the strength of the IPKF had been progressively increased to 60,000 troops. Operations were conducted till it was assessed, politically as well as militarily, that elections could be held. Provincial council elections were thereafter held on November 19, 1988; the presidential election on December 19, 1988; and the parliamentary elections on February 10, 1989. This was followed by the de-induction of IPKF troops from Sri Lanka which was completed by March 25, 1990.

Specifically, the involvement of IAF helicopters commenced on July 24, 1987, i.e. even before the accord was signed in Colombo on July 29, 1987. They were tasked to land at Jaffna to pick up LTTE supremo Prabhakaran who proceeded to Delhi via Thanjavur for discussions. The first troops were airlifted on July 30, 1987, and six Mi-17s were put on standby at Thanjavur as a part of a Quick Reaction Force (QRF) under the direct control of Air Headquarters (HQ). These Mi-17s were later replaced by the Mi-8s which were the first to be inducted—five at Jaffna and one at Trincomalee. During August to September 1987, the LTTE's top echelons freely utilised these helicopters to move around and meet their cadres and other personnel. The LTTE was, thus, fully exposed to all the happenings of the IPKF, with the reverse not being so.

Initially, helicopters provided extensive air maintenance and logistics support to the army. With the commencement of hostilities, the Mi-8s were often escorted by the Mi-25s (inducted on October 23, 1987) to provide suppressive fire. Subsequent operations by the Mi-25s proved to be highly effective owing to their accurate engagement of targets. The use of the Mi-8s, Mi-17s, armed Chetaks and Mi-25s resulted in the LTTE adopting guerrilla

type warfare tactics. To counter these, a number of Special Heliborne Operation (SHBO) missions were planned and executed. By the end of March 1990, the Mi-80s had heli-lifted 68,579 troops and over 8,971 tonnes in over 19,545 operational missions. The Mi-17s heli-lifted over 26,331 troops and 4,150 tonnes of load in over 5,036 sorties. The air effort on the part of the Anti-Tank Guided Missile (ATGM) Chetak and Mi-25s amounted to 587 and 1,023 sorties respectively.[16] The operations against the militants in the COIN mode utilising the firepower of the Mi-25s and the tactical mobility of the Mi-8/MI-17s was highly effective and proved to be a real force multiplier. An important highlight of these operations was the effectiveness of the Mi-25s in jungle terrain. The initial hesitation to use the newly acquired gunships paved the way for their full-fledged deployment, with the escalation of the hostilities. Their successful employment in a carefully calibrated manner to avoid civilian casualties resulted in evolving procedures for undertaking escort and close support missions to own troops, wherein they acted as 'an airborne artillery', neutralising the LTTE war-waging assets. Numerous lessons were also learnt during the actual conduct of operations.

A classical example of one such coordinated mission was undertaken during Operation Checkmate (June 17, 1988 to September 15, 1988) on June 23, 1988. The mission plan involved searching of hideouts with the help of heliborne para-commandos, who would be winched down from helicopters into clearings in the jungle and be picked up again after a search of the area—this exercise was repeated for multiple sites. The Mi-8 would be escorted by an Mi-25 gunship.[17] During the first such mission itself, the Mi-8 and the commandos were fired upon while being winched down. The timely intervention by the Mi-25s resulted in limiting the casualties, and possible loss of the aircraft. Thereafter, this format of a tactical heli-insertion and extraction escorted by the gunship was standardised for all such missions. The extensive use of helicopters in both the armed, logistic support and casevac roles, in close coordination with, and in direct support of, the army,

16. Bharat Kumar, *Operation Pawan: Role of Air Power with IPKF* (New Delhi: Manohar Publishers, 2015), pp. 392-395.
17. Ibid., p. 233.

resulted in formalising procedures as well as promoting the cause of the army to extend the scope of its own helicopter fleet, now known as the Recce and Observation (R&O) flights.

This experience gained in operating the Mi-8s/Mi-17s and Mi-25s in such an integrated mode was also thereafter effectively utilised in the tasking of helicopters for various United Nations (UN) missions.

ROLE OF HELICOPTERS IN UN MISSIONS : PART I

In October 1993, helicopters were inducted into Somalia in support of Indian troops as a part of the UN peace-keeping mission. Two Chetaks in the ATGM configuration were inducted to undertake the tasks of road opening, convoy escort, aerial reconnaissance, communication and casevac. This mission by the IAF for the UN was undertaken after a gap of over 30 years and lasted till December 21,1994.

For the first time, helicopters formed a part of such a mission.[18] The pre-departure preparation by the Chetak ATGMs included live firing of missiles in the Pokhran range. The first sortie was launched within an hour of the Indian contingent's arrival from India. The helicopters were mostly used in the recce and casevac roles. During one such casevac operation, they were utilised to provided evacuation services to the "bandits" who had attacked the soldiers of the Mahar regiment of the Indian Army.[19]

Thus, the experience gained during this mission and the contribution made by the Indian contingent to the overall UN tasks, paved the way for the participation by Indian helicopters in subsequent missions also. Meanwhile, hostilities with Pakistan were once again about to commence, this time in the Kargil sector.

KARGIL OPERATIONS: OPERATION SAFED SAGAR

In May 1999, clandestinely carried out infiltration by regular Pakistan Army troops in the Kargil-Dras sector was detected. The Pakistani troops had occupied positions of advantage which enabled them to threaten the

18. Isser, n. 9, p. 8.
19. IAF, "IAF Contingent in Somalia", www.indianairforce.nic.in/show_page.php?pg_id=136. Accessed on August 8, 2016.

Kargil valley and the national highway 1A. The Indian Army, though initially caught by surprise, moved in swiftly to clear the occupied posts, and suffered heavy casualties. The Cabinet Committee on Security (CCS) approved limited IAF offensive action on own side of the Line of Control (LoC), probably to avoid the escalatory effect of air power. The IAF combat power had to be applied in the mountainous terrain at an altitude exceeding 15,000ft and, to its credit, it did so without any delay.

The IAF was also called upon to deploy the Mi-25s/35s but were unable to do so due to their operating limitations, and instead deployed the Mi-17s with an intention of pounding the enemy positions with rocket projectiles while remaining on own side of the LoC. The initial estimate of 600 infiltrators was a gross underestimation of the numbers involved as were their capabilities in terms of availability of Surface-to-Air Missiles (SAMs). By May 28,1999, three IAF aircraft, a MiG-27, a MiG-21 and an Mi-17 were lost—the MiG-27 due to an engine malfunction and other two to enemy action.

As a result of the loss of the Mi-17, and after a careful reassessment of the threat, the offensive role for the Mi-17s was discontinued, and thereafter, these were used for the tasks of casevac, troop induction, air maintenance and tactical air support. The Chetak and Cheetah helicopters were also tasked extensively and besides undertaking routine duties of Search and Rescue (SAR) and communication, undertook at least 50 Airborne Forward Air Control (ABFAC) missions between May 1999 and July 19, 1999.[20] Notably, it was during these operations that Flying Officer Gunjan Saxena became the first woman pilot in the IAF to fly a helicopter in a war zone without crossing the LoC.[21] It was an achievement of sorts as the women helicopter pilots who had been first inducted for training in 1993, had, till then, been utilised for non-combat aircrew duties only.

The operation which ended in July 1999, taught valuable lessons to the military planners in terms of the need for accurate intelligence based upon threat perception, concept of "jointness" in operations and application of air power in high altitude operations. The success of the helicopter as an

20. Isser, n. 9, p. 168.
21. "MOD Approves Induction of Women as Fighter Pilots", *India Strategic*, vol. 10, November 11, 2015.

The loss of a helicopter during the Kargil operation and the inability to use the Mi-25 attack helicopter, did stimulate the thought in the IAF establishment to have a rotor wing capability for undertaking attack helicopter operations at higher altitudes also.

offensive platform had fuelled the invention of counter-measures in terms of shoulder-fired munitions. Consequently, the necessity of constantly changing tactics and availability of onboard counter-measures was also realised. The inability of utilising the Mi-25s/35s at the operating altitudes required for undertaking the Kargil operations brought back the focus on the indigenous manufacturing capabilities of HAL. A need was felt to design a helicopter for the unique operational environment faced by the Indian armed forces, especially in the high altitude regions.

By the turn of the century, the Mi-17s had been undertaking operations under Operation Meghdoot for over 15 years; they were operating at their performance limits and there was now a need to augment them. The process for acquisition which had been initiated in the mid-1990s fructified in 2000, when the Mi-171Vs (Mi-17 One Vees) were inducted between 2000 to 2003. These were essentially upgraded versions of the Mi-17s, with a rear opening ramp instead of a clamshell door.

Thus, the loss of a helicopter during the Kargil operation and the inability to use the Mi-25 attack helicopter, did stimulate the thought in the IAF establishment to have a rotor wing capability for undertaking attack helicopter operations at higher altitudes also. However, the learning curve by the IAF helicopters continued to rise, with the acceptance of a greater role in UN peace-keeping missions which were in addition to the ongoing commitments for Operation Meghdoot and air maintenance tasks in the eastern sector.

ROLE OF HELICOPTERS IN UN MISSIONS : PART II

The first UN mission in 1993 was followed by the United Nations Mission in Sierra Leone (UNAMSIL) from December 1999 to February 2001. The IAF contributed a self-contained contingent of 212 personnel along with eight

helicopters (three each of Mi-35 and Mi-8 helicopters along with two Chetaks). The operational highlight of this mission was the mounting of "Operation Khukri" in coordination with three Chinooks and one C-130 of the Royal Air Force, to rescue two companies of 5/8 Gorkha Rifles which had been under siege by the rebels/militants for over two months. In a well planned, coordinated and executed action, over 222 troops were extricated by a forceful and decisive action.[22] The plan, having in-built flexibility, which was executed under trying circumstances and adverse weather conditions, contributed immensely to the experience as also evidenced by the figures of the ammunition used, which included firing of 7,906 12.7mm rounds and over 918 Rocket Projectiles (RPs). This highlighted the potential and the ability of IAF helicopters to undertake missions in coordination with friendly forces.

The mission was different from the others as it had to operate under the "peace-enforcement" mandate which was different from the earlier "peace-keeping" mandate. The helicopters were utilised in multiple roles and, by the end of the mission, had airlifted 14,35,814 kg of load, transporting 71,814 passengers, while clocking 10,420 hours of flying.

By the time the IAF helicopters were tasked to undertake other such operations in the Democratic Republic of Congo (DRC) as a part of the United Nations Mission in the Republic of Congo (MONUC), they were well prepared for the task at hand. MONUC was an eight-year commitment in support of the Indian Army and UN forces, commencing in 2003. The mandate of the mission was to lend offensive support to the humanitarian tasks of the peace-keeping force during which over 18,000 accident-free sorties were flown by the Mi-17s, and the Mi-25s clocked over 5,000 flight hours during various missions.

Contributions to UN missions further expanded with the UN mission in Sudan (UNMIS) in 2005. The operations in Sudan were undertaken from October 2005 to December 2010, according to well established Standard Operating Procedures (SOPs), and the coordination achieved with their

22. Isser, n. 9 , p. 247.

own and allied UN troops was of a very high degree. This mission was different from the others as it had to operate under the "peace-enforcement" mandate which was different from the earlier "peace-keeping" mandate. The helicopters were utilised in multiple roles and, by the end of the mission, had airlifted 14,35,814 kg of load, transporting 71,814 passengers, while clocking 10,420 hours of flying.[23] The professionalism and competence shown by the personnel involved stood them in good stead and was well appreciated and recognised by the UN. However, with the IAF being increasingly tasked for the movement of Central Armed Paramilitary Forces (CAPFs) during the anti–Naxal operations back in India and also on the suggestion by the IAF to recall around 15 helicopters deputed for UN peace-keeping operations due to resource constraints, the UN missions undertaken by the helicopters came to an end.[24]

These resource constraints were a result of the extensive demands having been placed upon a limited number of helicopters with the immediate cause being the tasking of helicopters for fighting the Naxals in addition to the tasking for Operation Meghdoot.

The state of IAF helicopters, predominantly of Russian origin, was also highlighted during an audit of the "Mi series" of IAF helicopters, undertaken by the Comptroller and Auditor General (CAG). This independent and comprehensive evaluation was carried out by the CAG, Government of India (GoI) in 2008-09, and submitted its report in Financial Year (FY) 2010-11.

CAG REPORT[25]

The audit conducted by CAG on the operation and maintenance aspects of the Mi series of helicopters of the IAF, which constitute around 60 percent of its total helicopter fleet, submitted its report in FY 2010-11. The auditor pointed out a deficit of 26 percent in total availability of helicopters

23. Ibid., p. 9.
24. Indiatoday.in, "Anti-Naxal Ops: IAF for Recall of Choppers on UN Missions", www.indiatoday.intoday.in/story/antinaxal-ops-iaf-for-recall-of-choppers-on-un-missions/1/102248.html. Accessed on April 11, 2016.
25. CAG Audit Reports, "Operation and Maintenance of MI Series Helicopters of the IAF", http://www.cag.gov.in/sites/default/files/audit_report_files/Union_Performance_Defence_Union_Government_Air_Force_and_Navy_7_2010.pdf. Accessed on April 11, 2016.

compared to the numbers required for achieving the current operational projections. For attack helicopters, the holdings were projected to be 46 percent below the actual requirement. It further added that the existing fleet is ageing and nearly 78 percent of the helicopters have completed their prescribed life, and Total Technical Life (TTL) extension has been carried out on them to elongate their life. Serviceability levels were also projected to be consistently short of 75 percent.

The CAG further directed the Defence Ministry to address the IAF's current shortfall in the helicopter fleet by ensuring that there were no further slippages in the acquisition programmes, and expedite the on-going procurement processes. This is significant, as the build-up of the helicopter fleet through the initial years had been keeping pace with the expected requirements, however, post acquisition of the Mi-17s in 1985, and despite the Kargil conflict, the expansion had slowed down and the IAF had countered it by increasing the Total Technical Life (TTL) of the Mi-17s from 15 years to 35 years and had also reduced the tasking. Limited availability of spares was also a reason for the reduced availability of helicopters. As per the report, significant numbers of helicopters were deployed for UN and VIP duties and this had an adverse impact on the availability of helicopters for their primary tasks. Thus, this observation effectively ended the participation for IAF helicopters in UN missions, in a way, depriving them of the rich operational experience in international missions, with interactions with other nations' armed forces. The limited availability of the helicopters may also be attributed to the increasingly complex Defence Procurement Procedure, a debate which continues till today.

Similar sentiments were echoed by the then Chief of the Air Staff (CAS) Air Chief Mshl FH Major , who, in an interview to a magazine in 2008, agreed that the acquisition process in the case of helicopters had suffered after the 1990s. However, he envisaged that the helicopter fleet would undergo a major transformation with the upgradations to the existing Mi-17s and Mi-35s. He also added that a global Request for Proposal (RFP) for 24 state-of-the-art

attack helicopters and 12 heavy lift helicopters, was being carried out.[26] The procurement process which had been initiated before 2008 for the attack helicopters, and for the heavy lift helicopters, remains incomplete till today. The increasing complexities involved in the procurement process, ostensibly to keep it transparent and fair, and much of it beyond the purview of the IAF, delayed the planned inductions, which had been remarked upon in the CAG report. Certain measures were, therefore, initiated in right earnest to address the issues highlighted during the audit.

The Mi-17 V5s (Vee Fives) were inducted on February 17, 2012,[27] for which the contract was signed in December 2008 (for a total of 80 in number)[28]. This number has now increased to a total of 159. The Mi-17 V5s, with an operational ceiling of 6,000 m and a standard range of 580 km, are equipped with the advanced KNEI-8 avionics suite which is manufactured by Radio-Electronic Technologies Concern (KRET)[29] of Russia and includes multi-function displays integrating them with the onboard Night Vision Forward Looking Infra Red (FLIR) system. The helicopter is also armed with the Shturm-V missiles, S-8 rockets, a 23 mm machine gun and up to eight sub-machine guns, with the cockpit and vital component suitably protected by armoured plates. Additional survivability is also ensured with provisioning of self-sealing fuel tanks, which are filled with polyurethane foam along with engine-exhaust Infrared (IR) suppressors, flares dispensers and jamming equipment.[30] Provision of the equipment indicates the IAF's persistence with a proven design and a continuation in the multi-role/ multi-mission type of deployments envisaged for its helicopters with medium lift capability and an enhanced capability of undertaking similar operations by night. Over the years, a critical aspect significantly impacting IAF upgradation plans had been the unforeseen delay in achieving the long cherished dream of having its own expertise for manufacturing helicopters.

26. "IAF to Acquire 24 Attack and 12 Heavy Lift Helicopters-Gulshan Luthra", *India Strategic,* vol. 2, Issue 2, February 2008.
27. Rotor India, "IAF Formally Inducts Russian Chopper Mi-17 V5", QE March 31, 2012.
28. Rotor India, "Kazan Helicopters Delivers Mi-17 V 5 to IAF", QE December 31, 2011.
29. "KRET to Supply Avionics for Mi-17 V5", http://kret.com/en/news/3205/. Accessed on April 15, 2016.
30. Airforce-Technology, "Mi-17 V5 Military Transport Helicopter", http://www.airforce-technology.com/projects/mi-17v-5-military-transport-helicopter/. Accessed on April 15, 2016.

INDIGENOUS HELICOPTER MANUFACTURING PROGRAMME

A committee constituted by the Government of India in 1967, known as the Aeronautics Committee had decided that HAL should build up its own design competence in producing rotary wing aircraft. The aim was to design, develop and produce advanced state-of–the-art helicopters for the armed forces. A Helicopter Design Bureau was established in 1970 which was renamed as the Rotary Wing Research & Design Centre (RWRDC) in 1998, to carry out focussed research. In June 2005, this design centre became a part of the Helicopter Division which itself was established in 1974. It is also an AS 9100C and 14001:2004 certified organisation. The experience gained during the licensed manufacture of the Chetak and Cheetah stood in good stead for the design and development of the Cheetal and Lancer helicopters. The Lancer was a light attack helicopter developed from the basic structure of the Cheetah, with bullet-proof front panels and a gun-cum- rocket pod fitted on either side. The Cheetal is the reengined version of the Cheetah which set the world record of the highest landing at 'Saser Kangri' in 2006.

The experience gained during the production of these helicopters formed the basis for the development of the Advanced Light Helicopter (ALH) which was christened 'Dhruv'. Built to the standards specified in the Federal Aviation Regulations (FAR 29), the basic design catered for its utilisation in multiple roles for both civilian and military purposes. Extensive use of composites which amount to nearly one-third of its total All Up Weight (AUW) along with the modern avionics and engine governing systems, demonstrated an indigenous design and system integration capability which is at par, if not better, with any other manufacturer in the world.

Once the basic system was developed, it was made available to the Services, even though this took a considerable amount of time; subsequent enhancements have materialised at a faster rate. Till date, three versions of the Dhruv helicopter have entered service with the IAF, with initial deliveries of four aircraft in 2003.[31] The initial configuration of the Mk I (Mark one) was

31. Army-Technology, "Dhruv Advanced Light Helicopter (ALH), India", www.army-technology.com/projects/dhruv/. Accessed on April 11, 2016.

The helicopter display team, which is one of the two such professional display teams in the world, has performed in over 35 air shows in India and abroad. These professional displays played an important role in exhibiting the entire range of capabilities of the helicopter and also paved the way for their export to Ecuador, Nepal and Mauritius.

a conventional cockpit, with mechanical gauges and Turbomeca TM-333-2B2 engines. The Mk II was similar to the Mk I but was equipped with a glass cockpit developed by a joint venture between HAL and Israel Aerospace Industries (IAI). The Mk III which was inducted in February 2012[32] is equipped with the "Shakti" engine having a power output of 1400 SHP (Shaft Horse Power). This engine which was co-developed by HAL and Turbomeca (Safran) of France is also likely to power the Light Utility Helicopter (LUH).[33] The development history and efforts indicate an active attempt on the part of HAL to fill the technology gaps by building up strategic partnerships with global concerns, as evidenced in case of its tie-up with one of the world's leading manufacturer of aero-engines (Safran), with which it has had a relationship of over 60 years.[34] The co-development of the Shakti engine and its licensed production would continue to play a crucial role in the development of technologies and induction of systems which would provide the crucial edge to the armed forces and which would also make pure economic sense and preserve national economic resources.

The recent thrust on the "Make in India" campaign augurs well for the indigenous production and manufacturing of helicopters. This had got a fillip much before the current campaign when the Dhruv helicopter became a natural choice for a formation display team of helicopters being raised by the IAF. The team, christened the 'Sarang' (derived from the Sanskrit word

32. "IAF Inducts ALH MK-III Helicopters", *India Strategic,* www.india strategic.in/topstories1371_IAF_inducts_ALH.htm. Accessed on April 11, 2016.
33. Safran, "Ardiden 1H/1U", www.turbomeca.com/helicopter-engines/1000-2000-shp/ardiden/ardiden-1h/1u. Accessed on April 11, 2016.
34. Safran, "Press Release:Turbomeca and HAL Forge Support Partnership for Indian Customers, June17,2015",http://www.safran-helicopter-engines.com/engine-partnerships/partnerships/shakti/shakti. Accessed on April 11, 2016

for peacock), was formed in 2003 and owes its genesis to the erstwhile 'Advanced Light Helicopter' Evaluation Flight (AEF) which had been formed at the Aircraft and Systems Testing Establishment (ASTE), Bangalore, on March 18, 2002. The helicopter display team, which is one of the two such professional display teams in the world, has performed in over 35 air shows in India and abroad.[35] These professional displays played an important role in exhibiting the entire range of capabilities of the helicopter and also paved the way for their export to Ecuador, Nepal and Mauritius.

Borrowing heavily from the ALH (Dhruv), the LCH differs in having a sleek and narrow fuselage, tail wheel type of tri-cycle crashworthy landing gear, crashworthy and self-sealing fuel tanks and armour protection.

The RWRDC which had designed the ALH (Dhruv), under production since FY 2001/2002[36], was thereafter tasked to weaponise it. The Weapon Systems Integrated (WSI) version of the Dhruv has been christened "Rudra". The army and air force helicopters have been modified with stub wings to carry up to eight anti-armour missiles, four air-to-air missiles or four rocket pods for 70mm and 68mm rockets. A contract had also been awarded by HAL to the Nexter systems in December 2006 to install a THL 20 20mm gun turret armed with the M621 low-recoil cannon on the Dhruv variants. The version for the Indian Army is to have the indigenously developed Nag anti-tank missile, with imaging infrared guidance.[37] These options were explored by HAL probably on the specific requests made by the army and IAF based on the types of roles envisaged by each of the two Services and the extensive experience already available while operating the Mi-25s/Mi-35s.

However, the helicopter still had a limited offensive capability at the unique altitudes at which the Indian Army and IAF were being tasked

35. Press Information Bureau(PIB) GoI, "IAF'S Sarang Helicopter Display Team To Set Hearts Flutter," February 17, 2015", http://pib.nic.in/newsite/PrintRelease.aspx?relid=115524. Accessed on April 11, 2016.
36. www.hal-india.com, "Dhruv", www.Hal-india.com/Common/Uploads/DMS/Civil%20Variant.pdf. Accessed on April 11, 2016.
37. n. 31.

to undertake operations. The lessons from the 1999 Kargil War and the continued "blow hot-blow cold" situation prevailing in the Siachen glacier necessitated the requirement of a helicopter which had substantial offensive capability to perform at those altitudes. The unique requirements also needed a unique approach and, thus, a Light Combat Helicopter (LCH) project was announced in 2006 by HAL with its Technology Demonstrator-1 (TD-1) version making its first flight on March 23, 2010, just seventeen months after the sanction of funds. Borrowing heavily from the ALH (Dhruv), the LCH differs in having a sleek and narrow fuselage, tail wheel type of tri-cycle crashworthy landing gear, crashworthy and self-sealing fuel tanks and armour protection. Aiming to have a day/night targeting capability with a helmet pointed sight and electro-optical pod consisting of a Charge Coupled Device (CCD) camera/Forward Looking Infra-Red (FLIR)/ Laser Range Finder (LRF)/Laser Designator (LD), its battle survivability would be ensured by the self-protection suite consisting of radar/laser missile warning systems and Counter-Measures Dispensing System (CMDS). HAL, with all its experience, was able to progressively integrate the systems and produced three more prototypes (TD-2, 3 & 4). These flew on June 28, 2011, November 12, 2014, and December 01, 2015, (TD-4) respectively. Having completed the performance trials which included trials for cold weather, hot weather and hot and high weather operations (most adverse conditions for helicopter operations) in 2015, the Light Combat Helicopter (LCH) achieved another milestone by satisfactorily firing rockets (70 mm) from its prototype, TD-3, in a weaponised configuration. The LCH is now undergoing certification trials and has also participated in the IAF's `Iron Fist 2016' exercise on March 18, 2016.[38]

The development of the LCH has demonstrated the unique advantages in having indigenous capability which can be effectively tailored to suit specific roles as envisaged by the armed forces: a mandatory expertise to have, especially when compared with procurement of "off the shelf systems",

38. HAL-India, "Media Release March 14,2016- Indigenous LCH Fires Rockets; Will Participate in `Iron Fist' Exercise-2016", http://www.hal-india.com/Indigenous%20LCH/ND__154. Accessed on April 16, 2016.

modifications on which are governed by contractual obligations and do not necessarily involve transfer of technology.

A similar much delayed project for procurement of the Light Utility Helicopter (LUH) by the three Services as a replacement for the ageing Chetak/Cheetah is likely to be governed by proposed indigenous manufacture of the Ka-226T, the deal for which was signed by HAL with the Russian firm Rostec in December 2015.[39] The co-axial technology available on the K-226T, along with the modular concept of the role equipment is likely to further enhance the technical expertise of the RWRDC, the future work of which would be governed by the orders received from end users (both civil and military). The futuristic plans in the pipeline by HAL also include the design and development of the Indian Multi-Role Helicopter (IMRH), which would be a medium lift helicopter, and also the development of the Rotary Wing Unmanned Aerial Vehicle (RUAV), which is being designed and developed jointly by HAL, Aeronautical Development Establishment (ADE) and Indian Institute of Technology (IIT) Kanpur.[40] The RUAV project displays an understanding of the direction in which the technologies are going to evolve in the near future.

PRESENT CAPABILITY AND FUTURE ROADMAP

Through the years, the IAF has been exploring additional roles for its rotary wing arm to fully exploit its overall combat potential. These efforts also received a fillip with the induction of the attack helicopters in 1985. Recognising the important role which may be played by helicopters in future operations, the IAF, on its part, had also initiated a Helicopter Combat Leader (HCL) course to be conducted in the Tactics and Combat Development and Training Establishment (TACDE) as early as June 1997[41], in order to train helicopter pilots on the lines of the Fighter Combat Leader (FCL) and

39. www.capsindia.org, "Manufacturing of Ka-226T Helicopter By HAL: A Make in India Initiative," *CAPS In-Focus*, March 1, 2016.
40. www.hal-india.com, "Rotary Wing", www.hal-india.com/Rotary%20Wing/M_147. Accessed on April 11, 2016.
41. Bharat-Rakshak, "Comment dated July 26,2016 by Teshter Master Sr**.,** McLean, Virginia, on article titled TACDE ", http://www.bharat-rakshak.com/IAF/units/squadrons/13-tacde.html#Aircraft%20Types. Accessed on August 1, 2016.

There is a distinct shift in the IAF's plan to move from the assault helicopter concept of Russian origin to a purely attack one of Western origin. The Mi-25/35 has the capability to insert or extricate troops from a heavily defended area whereas the AH64E with a two-crew complement is a dedicated attack helicopter.

Fighter Strike Leader (FSL) courses. This unique effort, probably the only one in the world, oriented the rotary wing arm of the IAF force and imparted the necessary continuity training to maintain their combat potential in addition to the other peace-time tasks such as Humanitarian Assistance and Disaster Relief (HADR) and logistics support operations.

Currently, the vintage Mi-8s and some Mi-17s are being phased out and new units have been raised with the latest Mi-17V5 helicopters. Through the orders placed in 2008 and 2012, around 151 Mi-17V5s have been purchased. In September 2015, the Defence Acquisitions Council (DAC) also cleared the purchase of an additional 48 Mi-17V5s for the IAF.[42] This would significantly address the concern mentioned in the CAG report that "a large proportion of the helicopter fleet will reach the end of their operational lives in the near future."

Simultaneously, the case for procurement and expansion of the helicopter fleet with the induction of 15 Chinook (CH-47F) and 22 Apache (AH 64E Block III) helicopters, with an option of placing follow-on orders for seven Chinook's and 11 Apaches, is near fructification. The AH-64E sale is likely to include 50 T77-GE-701D engines, 12 An/APG-78 fire control radars, 12 AN/APR-48A radar frequency interferometers, 812 AGM-114-L-3 hellfire longbow missiles, 542 AGM 114R-3 hellfire missiles, 245 stinger block I-92H missiles and 23 modernised target acquisition designation sight/Pilot Night Vision Sensors(PNVS), rockets, training and dummy missiles as well as 30 mm ammunition.[43] With this acquisition, there is a distinct shift in

42. Flight Global.com, "India Approves Third Batch of Mi-17 V5 Rotorcraft", www.flightglobal.com/news/articles/india-approves-third-batch-of-mi-17-v5-rotorcraft-416360/. Accessed on April 4, 2016.
43. Rotor India, "22 AH-64D Apache Longbow Block IIIs for IAF", QE December 31, 2011, vol. 11, issue 2.

the IAF's plan to move from the assault helicopter concept of Russian origin to a purely attack one of Western origin. The Mi-25/35 has the capability to insert or extricate troops from a heavily defended area whereas the AH64E with a two-crew complement is a dedicated attack helicopter with an all-weather, day/night capability. Procurement of limited numbers indicates that the Apache will be a replacement for the ageing Mi-25/35 and aims at maintaining the status-quo as far as the numbers are concerned. However, the expansion plans of the army and IAF do indicate the requirement of combat helicopters in larger numbers, as indicated in the force restructuring plans of the army. Considering the geographical attributes of the potential battle zones of the future, especially along the north, the wait for the LCH would be worthwhile, in economic terms as well as in evolving a platform specifically tailored to the requirements. Here the impact of increased standoff ranges of Ground-Based Surface-to-Air Defence Weapon Systems (GBADWS) and availability of portable Man-Portable-Air Defence Systems (MANPADS) in the future land battle scenarios would have to be carefully considered.

HAL will continue to play a pivotal role as far as the future of Indian helicopters is concerned and needs to build upon the expertise it has gained through 11 joint venture companies, which are as diverse as the Rolls-Royce overseas holdings of the United Kingdom (UK) and Snecma of France, besides many Indian concerns.

On the other hand, the CH-47F "Chinook" is being purchased as a replacement for the ageing Mi-26. However, a major difference remains between the two regarding the load lifting capabilities in terms of both size and weight of the cargo, with the Mi-26 clearly being the more capable one. The Mi-26 lifts a staggering 20 tonnes and the Chinook 9.6 tonnes with corresponding reductions with increase in operating altitude and conditions. However, the CH-47F has been evaluated to be more technically sound in terms of its life-cycle costs as well in meeting the criteria which must have been stated in the Air Staff Qualitative Requirements (ASQRs) specified for the same. With the induction of the Chinook and the Ka-226T, the IAF would

be operating helicopters with all the three possible rotor combinations viz. the conventional tail rotor main rotor type, the tandem rotor type as in the Chinook, and the co-axial contra-rotating type as in case of the Ka-226T. Operating the three diverse types, differing purely in terms of rotor systems, comes with its own set of maintenance and logistic support concerns in terms of availability of spares and establishment of Maintenance, Repair and Overhaul (MRO) facilities. Training of the air and operating crews would also have to be tailored to cater to these unique challenges.

A careful consideration of all the aspects and exercising due economic jurisprudence in building own indigenous capability would be the governing factors to be considered for all future procurements, for which a clearly defined roadmap led by the armed forces and the DAC is a must. HAL will continue to play a pivotal role as far as the future of Indian helicopters is concerned and needs to build upon the expertise it has gained through 11 joint venture companies[44], which are as diverse as the Rolls-Royce overseas holdings of the United Kingdom (UK) and Snecma of France, besides many Indian concerns. Hence, the technology gaps are being filled by HAL through the joint venture and joint development route.

THE EVOLUTION CONTINUES

The saga of helicopters in the armed forces which began with the induction of the Sikorsky S.55 in the IAF inventory in March 1954, continues. Helicopters have proved themselves to be a worthy platform in virtually every facet of modern warfare as well as in their utilisation in peace-time roles, and have become an integral part of the IAF force structure.

The requirements of these versatile platforms projected by the Indian Coast Guard (ICG) and the law enforcement agencies are also a testimony to the usefulness of the platform in a myriad roles. However, with the cost of operations being inherently high, the "helinomics" or the economics of operating them would continue to play an important role in their procurement and evolution. This also is probably the single most important factor in the

44. HAL-India, "Joint Venture Companies", http://www.hal-india.com/Joint%20Venture%20Companies/M__29. Accessed on August 6, 2016.

gap between the projected and envisaged expansion of civil as well as military helicopters in India. Added to these are the development costs involved in the future development of unmanned rotary wing systems which will also play an important role in the future battlefield scenario.

Their proven track record and expected involvement in tasks as varied as counter-air campaigns, Battlefield Air Interdiction (BAI) and Battlefield Air Support Missions (BAS), urban warfare, counter-surface operations, combat enabling air operations, combat enabling ground operations and sub-conventional warfare, besides nation building/HADR, aerial diplomacy and perception management show the indisputable necessity of helicopters being an integral part of the experienced IAF force structure.[45] Their full potential and effective contribution towards the overall air power can only be truly realised by developing a clear understanding of their characteristics and limitations. Despite their perceived vulnerabilities in battle situations, helicopters would remain an important part of the current and future armed forces force structures and battlefield applications.

45. IAP 2000-12, *Basic Doctrine of the IAF* (New Delhi: Indian Air Force, 2012), pp. 79-123.