ENERGISING AEROSPACE INDUSTRY: A NATIONAL SECURITY IMPERATIVE

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> *[I]t was surprising that whereas every country wanted to produce her own war material, in India, even very senior officials and Ministers wanted to remain dependent on foreign countries and governments for military hardware and would not take any initiative for local production. These people did not understand that a country must not remain forever dependent on another country for her military requirements as, in the event of a war breaking out, that country could stop supplies, putting the receiving country in dire difficulties when her need would be the most acute.*[1]
>
> — Jawahar Lal Nehru

A recent statement of Raksha Mantri, Shri A.K. Anthony, putting emphasis on a greater need for indigenisation of the defence industry, has renewed focus on this long-standing issue of indigenisation being pursued since independence, though with not so encouraging results. There can be no denial of the fact that technology is, indeed, a critical component of national security. Essentials like doctrine, strategy training, and morale, undoubtedly, enhance the effectiveness of national security (and that of the Air Force); but the primary pillar of strength of any air force is its technological vitality. An aspiring nation with limited resources and huge

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1. B. N. Mullik, *My Years with Nehru: 1948-1964* (New Delhi: Allied Publishers, 1972), p. 130.

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economic and social commitments, has no option but to innovate and strengthen its own Research and Development (R&D) since no nation would share its cutting edge technology; and, secondly, commercially available overseas technology has its own problems, termed as the *"triple-trap":* the technologies developed abroad may not be suitable to us; the suitable technologies may be denied; and the technologies available may be unaffordable.[2]

Alongside, trends in national defence as well as the civil aviation sector project humongous growth in the coming decades. In the next five years, India is expected to invest US $ 100 billion in defence and out of this expenditure, about 15-20 per cent is expected to be spent on military aircraft. As per Air Mashl R.K. Sharma, Deputy Chief of the Air Staff, the Indian Air Force (IAF) alone is likely to spend about ₹ 2 lakh crore on procurements during the 12th and 13th Plans.[3] In addition, Boeing expects a demand of between 900 to 1,000 commercial aircraft in the next 20 years, worth US $ 100 billion approximately.[4] Hence, the size of the cake would be really large, and the opportunities unprecedented.

These inputs invoke several questions. What should be the national approach to comprehensively meet the military aerospace requirements? What is the dynamics of indigenisation and how far have we succeeded in this pursuit? What milestones have been crossed and why are we still appearing to be far away from any semblance of a credible indigenous defence design, development and production system? Can the IAF play a constructive role and energise the process of indigenisation? This paper is an attempt to explore answers to such questions; the scope of this paper is largely limited to the military aviation, which is critical for the IAF that is

2. Dr V. Siddhartha, "The Triple Trap, Dual-Use and Single Reform" in Satish Kumar, ed., *India's National Security: Annual Review 2011* (Delhi: Routledge, 2012), pp. 444-445.
3. Air Mshl R.K. Sharma DCAS addressed the 7th Aerospace Industry Conference jointly organised by the IAF, Centre for Air Power Studies and CII at India Habitat Centre on September 20-21, 2012.
4. Confederation of Indian Industries website www.cii.in/Sectors.aspx?enc=prvePUj2bdMtgTmvPwvisYH+5EnGjyGXO9hLECvTuNtzD8aRMyMz, accessed on November 20, 2012.

facing severe weapon system constraints in terms of fighter, transport as well as trainer aircraft. Against an approved force level of 39 and a half combat squadrons, presently, the IAF is meeting the national security and defence requirements with just about 28 combat squadrons. The rationale behind the authorised combat strength is another debate which is kept out of the purview of this paper as the focus is entirely on the process and dynamics of indigenisation.

As the colonial powers trod the path of industrialisation, they deliberately deindustrialised India and used it as a major source of raw material for their industry, as well as a market for their industrial products.

HISTORICAL PERSPECTIVE

Before coming to the Indian aerospace industry *per se*, it will be appropriate to touch upon some historical facts about industrialisation in India. In the 18th century, India had an impressive and large manufacturing base. In 1750, India was producing roughly 24 percent of the world's manufacturing output and China was the only nation ahead of India, with a production of about 31 percent of the world's manufacturing output. That is, more than half of the world's goods were produced by India and China; while Britain's share was barely 2 percent. However, as the colonial powers trod the path of industrialisation, they deliberately deindustrialised India and used it as a major source of raw material for their industry, as well as a market for their industrial products. Thus, by the time India became independent, the equation had totally reversed — Britain's global share scaled up to 24 per cent while India's share dropped down to less than 2 percent.[5]

India entered the aviation era in such an unfavourable background. Nonetheless, Hindustan Aircraft Private Limited, the first aircraft industry in India, was set up in 1940 as a private joint venture between an Indian entrepreneur, Walchand Hirachand, and William Douglas Pawley, an American entrepreneur who had established China's first aircraft factory. The Maharaja of Mysore strongly supported the cause in terms of 50 percent

5. M.J. Akbar, "Indian Armed Forces and Strategic Environment," *USI Journal*, April-June 2012 (Delhi: USI of India, 2012) p. 182.

investment in the shares of the new company and land in Bangalore (now Bengaluru). Soon, the licence produced Harlow PC-5 trainer was flying and designing of fighter aircraft was on its way. However, to meet the post Pearl Harbour expanding requirements of the Allied forces in the Asia-Pacific region, the company was soon taken over by the British government in New Delhi and was leased to the United States Army Air Force (USAAF) for overhaul and repair. As a result, aircraft design and development, which is the bedrock of the aircraft industry, suffered a harsh setback in its infancy.[6]

POST INDEPENDENCE

The 1948 Blackett Report largely laid the foundation of defence of independent India. Dr P.M.S. Blackett, a Nobel Prize-winning British physicist, examined how science could contribute to Indian defence and emphasised on development of an industrial and technological base, to give India a self-supporting defence identity at the earliest. His recommendations like India must limit its ambitions and pursue a policy of non-alignment to escape an unnecessary arms race, and military spending shall not exceed 2 percent of the Gross Domestic Product (GDP), continue to be the cornerstones of Indian national policy.[7] However, his military perceptions about weapon systems were debatable. Chris Smith has brought out that most of his advice was against the grain of military professionals. (Is the nation still appearing to be following this tradition of not giving due cognisance to the demands, requirements and opinions of the military professionals?)

Nevertheless, being a scientist, the following advice of Blackett in respect of defence science and organisation was indeed valuable and insightful. [8]

- No executive responsibilities to be given to the Scientific Adviser to the Defence Minister, though he would have the right to be consulted on the research programmes and on appointment of the scientific staff.
- Indian defence science to follow the organisational pattern of the British

6. Jasjit Singh, *Indian Aircraft Industry* (New Delhi: KW Publishers, 2011), pp.30-31.
7. Sunil Dasgupta and Stephen P. Cohen, "Is India Ending its Strategic Restraint Doctrine?", *The Washington Quarterly Journal*, Spring 2011, pp. 163-177. Blackett also argued against nuclear and chemical weapons, but geo-strategic compulsions made India opt for the strategic nuclear weapon.
8. Singh, n. 6, pp. 84-87.

Admiralty (and not of the British Army or the Air Force). As per this framework, R&D establishments work under the Services' control and usually have a Service officer as Director. The Director of Scientific Research assumes mainly an advisory role.

The former recommendation does not seem to have convinced the policy-makers as yet. Till date, the chief of the Defence Research and Development Organisation (DRDO) exercises executive as well as advisory powers. Despite being the Director General DRDO, he is the Scientific Adviser to the Raksha Mantri as well as the Secretary, Department of Defence R&D. Regarding the latter recommendation with respect to following the pattern of the British Admiralty, out of the three Services, only the Indian Navy inherited and continued to follow this concept. The Indian Navy established the Directorate of Warship Designs and associated institutions like Weapons and Electronic System Engineering Establishment (WESEE) and Controller of Warship Constructions, as an integral component of the Naval Headquarters. As a result, the Navy has reaped significant benefits, and today, it is a prime stakeholder in warship design, development and production. On the other hand, despite a long journey of over eight decades, the IAF has largely remained detached from the process of design, development and production. In the present set-up, the role of the IAF appears to be limited to defining the Air Staff Requirement (ASR) during the inception stage, and thereafter it comes into the picture in the final phase when the new weapon system is offered to the IAF for trials. The IAF plays hardly any significant role in the system development process. I will come back to this aspect a little later.

At the national level, India aspired for *self-reliance* in defence equipment through a three-pronged strategy: **direct purchase; licensed production; and indigenous design and production.** Fundamentally, there are three broad avenues for any technology procurement: purchase (buy); indigenous development (build); and espionage (steal). Various combinations of these three primary avenues lead to another three broad options – reverse engineering (combining buy/steal and build); co-production (combining

buy and build), and co-development (combining buy and build, with an emphasis on build). There are costs, benefits, and trade-offs inherent in each approach. The quest for 'strategic autonomy' through the policy of 'non-alignment' definitely impacted India's pursuit for progress in science and technology, including defence technology. Unlike Pakistan, which got humongous support from the US as an ally, Indian attempts to get access to leading technology have been repeatedly scuttled.

LICENSED PRODUCTION VIS-A-VIS INDIGENOUS DESIGN AND DEVELOPMENT

India embarked on the journey of establishing its military aircraft industry with reconstruction and overhaul of war-time residual aircraft like the B-24 Liberators, Tiger Moths and Harvards. Alongside, Hindustan Aeronautics Limited (HAL) commenced licensed production of the flying trainer Percival P.40 Prentice T3 aircraft and also established the Aircraft Design and Development Department at Kanpur. The Hindustan Trainer No.2 (HT-2) Basic Trainer was the first aircraft to be designed, developed and manufactured in India in the early 1950s and this successful aircraft continued to be with the IAF training schools till 1981 when another indigenously designed and developed trainer, the HPT-32, started replacing it.[9] The HPT-32 was recently grounded, in 2009, due to serious accidents in basic flying training. The first jet aircraft designed, developed and manufactured by HAL, the HJT-16 Kiran, the intermediate jet trainer, has also been serving the IAF for a long time.

The HF-24 Marut (a multi-role combat aircraft) was the first combat aircraft indigenously designed by HAL. It was developed in collaboration with a team of German designers led by Dr Kurt Tank but the fundamental principle of designing an aircraft around a proven engine was violated and, subsequently, the government failed to materialise a suitable agreement for an appropriate engine. Though the Marut had its own share of problems, it was 30-40 per cent superior to the Ajeet in various aspects and its accident rate was also approximately one-eighth of that of the Gnat/Ajeet.[10]

9. Pushpindar Singh, *Diamonds in the Sky: Sixty Years of HAL 1940-2000* (New Delhi: HAL, 2001) p. 38.
10. Singh, n. 6, p. 159.

Table 1: Procurement Mode of IAF Aircraft Inventory[11]

	Direct Purchase	Licensed Production	Design and Development
Trainer	Iskara Pilatus PC-7Mk II	DH-82 Tiger Moth(150)[12] Ajeet Hawk AJT	HT-2 HPT-32 Kiran HJT-16
Helicopter	Mi-4, Mi-8, Mi-17, Mi-25, Mi-26 Bell Model 147 G Sikorsky S 55 C	Cheetah (SA 315 BLA MA) Chetak (Alouette-III)	Dhruv (ALH) Saras
Transport	DHC-3 Otter, DHC-4 Caribou, TU-124, Super Constellation, Packet C-119, Vickers Viscount, Super Aero-45, AN-12, An-32, IL-14,IL-76, IL-78, AWACS, C-130 J Super Hercules, Boeing 737, EMB135 Legacy, C-17 Globemaster,	Avro HS-748 Do-228	Krishak HAOP-27
Fighter	Mystere, Hunter, Canberra, SU-7, Ouragon, Mirage2000, MiG-23, MiG-25, MiG-29, SU-30	MiG-21, , Jaguar, MiG-27, SU-30 MKI, Ajeet, Gnat, Vampire	Marut HF-24 LCA

Through licensed production, HAL has produced a variety of aircraft in significant numbers. The IAF had entered the jet age with the de Havilland Vampire — the first jet fighter produced under licence in India. All the aircraft produced under licence in India—862 MiG-21s between 1967 and 1987;[13]over 400 Cheetahs and Chetaks; and 90 Ajeets—speak volumes

11. Ajay Singh, "Quest for Self-Reliance" in Jasjit Singh, ed., *India's Defence Spending: Assessing Future Needs*, Second Edition (New Delhi: KW Publishers, 2001), p. 134 and Vijay Seth, *The Flying Machines: Indian Air Force 1933-1999* (New Delhi: Sethi Communications, 2000) pp. 10-11.
12. Chris Smith, India's Ad Hoc Arsenal: Direction or Drift in Defence Policy (New York: Oxford University Press and SIPRI, 1994 reprinted in 2008) p. 159.
13. Singh, n. 6, pp. 183-184.

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about the professional ability of HAL. Since 1983-84, HAL has also been manufacturing the Dornier transport aircraft, and for the past five years, this aircraft has not been imported.[14] HAL is also manufacturing under licence the Su-30 MKI, MiG-27 M and Hawk advanced jet trainer. But the quantum of production has been inadequate and the IAF had to resort to purchase of a significant number of various types of aircraft from Russia, North America and West Europe.

The next logical step forward should have been indigenisation through initiation of design and development of sub-systems and components and then graduating to complete weapon development in an incremental manner. But, unfortunately, the strengths of licensed production have not been harnessed to develop incremental expertise in design and development – a critical pillar for achieving self-reliance. The Aeronautics Committee headed by C. Subramaniam rightly opined way back in 1968 that licensed production was inhibiting indigenous development and it would completely extinguish development.

Let us have a closer look at the DRDO, the flag bearer of defence research and development in India. In indigenisation of weapons production, DRDO has not moved beyond the 30 per cent mark it had reached in 1995.[15] And it is yet to produce a single aerospace system for the IAF that could alter the strategic balance in the subcontinent.[16] Nevertheless, there have been spurts of success, though separated with long gaps. The Marut (1964), Ajeet (1978), Light Combat Aircraft (LCA) (2001) and Advanced Light Helicopter (ALH) are a few significant breakthroughs in design and development which can be talked about. A huge gap of nearly thirty years between design and

14. Defence Minister Shri A.K. Antony in a written reply to Shri P.R. Natarajan in the Lok Sabha on December 4, 2012. accessed at http://pib.nic.in/newsite/erelease.aspx?relid=13232, the official website of the Press Bureau of India on January 7, 2013.
15. Yatish Yadav and Nardeep Singh Dahiya, "The Secret World of DRDO," *The Indian Express*, September 2, 2012
16. Dasgupta and Cohen, n. 7, pp. 163-177.

development of successive fighter aircraft (Marut and LCA) or even between basic trainer aircraft (HT-2 and HPT-32) are inexplicable. The gap is even larger for the intermediate stage trainer since, after the Kiran aircraft, the design process has not fructified yet.[17] Dr Shyam Chetty, Director National Aerospace Laboratories (NAL) under the Council of Scientific and Industrial Research (CSIR) brought out during one of his public addresses that these long breaks have led to yawning gaps in the skill sets, especially at the middle level, and core competencies in R&D are hardly available.[18]

To meet this challenge, for the LCA programme, the nation preferred creation of a new organisation rather than strengthening the existing set-up of HAL. Thus, the Aeronautical Development Agency (ADA) was established under DRDO as an ad-hoc institution by pooling resources mainly from various HAL Divisions. The LCA was originally meant to be a much simple aircraft — a replacement for the MiG-21. But its specifications were scaled up far beyond the design capabilities of ADA. The project was launched three decades ago in 1983 and the first test flight was flown in 2001. In January 2011, the Indian Air Force formally granted initial operational clearance to the country's first indigenously manufactured light combat aircraft. In the meantime, NAL was established under the CSIR which was under the Ministry of Science and Technology, for designing aircraft like the Hansa trainer and Saras light transport aircraft.

OPPORTUNITIES MISSED

There are several instances of missing an opportunity of promoting and strengthening design and development. For example, in the 1960s, William Edward Petter, design leader of Midge – an air superiority fighter being developed by Folland for a North Atlantic Treaty Organisation (NATO) requirement — had agreed to offer his services to the Government of India for the development of the Gnat and had also proposed to establish a design bureau in India for the development of more advanced versions of the Gnat. But the proposal was not accepted probably because the HF-24 design and

17. Singh, n. 11, p. 133.
18. Shyam Chetty addressed the seminar entitled "Competitiveness in Indian Aerospace and Defence Sector" at India Habitat Centre, New Delhi, on December 8, 2012.

development was already approved and a poor nation could not afford the luxury of two concurrent programmes to design and develop jet fighters.[19] However, it is interesting to note that India contracted for the Gnat since it was four times cheaper than the Ouragon (Toofani) and was recommended to Nehru by Mountbatten (though it was not approved for selection as a NATO fighter). In the 1965 War, the Gnat proved itself and gave a sterling performance, earning fame as a "*Sabre slayer*".[20]

India exhibits a propensity for initiating new programmes and letting existing ones decay,[21] and the aircraft industry is no different. Multiple agencies have tried various combinations from time to time, but the nation failed to adopt a good strategy for further promoting the successful experiments. There are various instances of half-hearted efforts, a variety of experimentation, premature termination of design and development projects and changing track mid-course without achieving success or learning from the failures. As mentioned above, in addition to HAL, ADA and NAL have been created under different departments and ministries. Even the Directorate General of Civil Aviation (DGCA), a regulatory authority for civil aviation, unsuccessfully tried to design a trainer aircraft along with the Indian Institutes of Technology (IITs).

There are several examples of abandoning of progressive projects. The Hindustan Turbo Trainer HTT-34, a modified aircraft with a turboprop engine, designed and tested by HAL and the IAF in the 1980s was also not inducted.[22] In 1983, HAC-33, another project for indigenously designed aircraft was abandoned in favour of licensed production of the Dornier 228. The Gas Turbine Research Establishment (GTRE) had developed an afterburner (reheat) for the Bristol Orpheus 703 engine and successfully demonstrated its design performance of 20 percent increase in thrust on the testbed. But instead of redesigning the fuselage for fitting the same, a short-cut was attempted by fitting the afterburner after the end of the

19. Singh, n. 9, p. 47.
20. Mullik, n. 1, pp. 125-131.
21. Deepak Pental, "Our Scientific Experiment", *The Indian Express* (New Delhi), January 18, 2013, editorial page.
22. Singh, n. 6, p. 116.

fuselage. Obviously, the experiment failed as the added drag nullified the extra thrust generated by the indigenously developed reheat system; and the HF-24 programme was prematurely closed rather than capitalising on the progress made and furthering the development. In the early 1980s, the IAF prematurely retired the HF-24 fleet of 141 serviceable aircraft.[23] The proposal for HAL manufacturing 108 HTT basic trainers was also rejected by the Ministry of Defence (MoD) in late 2012 since HAL trainers were costing significantly more than the PC-7 Mark II being purchased from Pilatus.[24] Largely, it appears that India is weak on turning its research into profitable application. The problem lies in the deep-rooted bureaucracy, importance to hierarchy over passion for knowledge, ritualism over scientific temperament, and acceptance of mediocrity. Suitable structural changes to address these cultural deficits are essential.[25] These issues must be debated and discussed and viable solutions must be explored on priority. Just creating more institutions and abandoning the existing ones without addressing pertinent issues would not fructify into success. Failure in realisation of the dream of *self-reliance* in military weapons has resulted in substantial dependence on foreign support.

INDO-SOVIET MILITARY RELATIONSHIP

Military equipment transfer has been a strong pillar of the Indo-Soviet relationship since the 1960s. Although Soviet arms sales to India started in the 1950s, supply of the MiG-21 was the first significant high-end combat equipment, which fructified due to heightening tension between India and China as well as between Beijing and Moscow.[26] To counter the US supply of arms to Pakistan and China's increased military level engagement with Islamabad, the Indo-Soviet military relationship continued to deepen during the Cold War. By the time the Soviet Union broke up, it was fulfilling nearly 80 per cent of India's defence needs. But the changing realities called

23. Ibid., pp. 170-173.
24. Ajai Shukla "IAF to Order 37 More Pilatus Trainers Worth Rs 1,250 Cr Pilatus Could Eventually Supply 183 Basic Trainers," *Business Standard* (New Delhi), February 4, 2013,
25. Pental, n. 21.
26. The Soviet Union had refused to sell the MiG-21 to China.

for reorientation and adjustment in the Indo-Soviet relationship. The two decade-old Indo-Soviet Treaty of Peace Friendship and Cooperation of 1971 was amended — the word *'peace'* was dropped from the title as was the famous Article IX, the kernel of the old arrangement. [27]

The collapse of the erstwhile USSR resulted in its inability to sustain its elaborate aerospace and defence industry. The well established aerospace industry as well as the huge pool of trained engineers and scientists, with vast knowledge and experience, were suddenly facing an existential crisis and were exploring overseas economic opportunities for their survival. This was a strategic opportunity for India to boost its aerospace industry and several efforts were made.[28]

The Long-Term Integrated Military Technical Cooperation Agreement of 1994 renewed the defence cooperation and paved the way for joint development of technologies and systems. The agreement provisioned for even exporting jointly developed products. Under this agreement, a broad spectrum was covered, which included significantly strategic projects like development and production of the cruise missile, the Brahmos, purchase and production of the SU-30, development of avionics for the Indian LCA, advanced air defence missiles, upgradation of old MiG aircraft, joint development of military and civilian transport aircraft and multiple-launch rocket systems, etc.[29] The contract includes licensed manufacture of over 200 Sukhoi 30 MKI air dominance fighters, development and licensed manufacture of a similar number of Fifth Generation Fighter Aircraft (FGFA) estimated at $25 billion, development of the medium tactical military transport aircraft to replace the fleet of 100 AN-32 aircraft and procurement of 80 new MI17 1V helicopters (which is underway and the first squadron has been inducted at Air Force Station Phalodi in Rajasthan), to be followed by an order of 59 additional machines.[30]

27. C. Raja Mohan, *Crossing the Rubicon: The Shaping of India's New Foreign Policy* (New Delhi: Viking, 2003), ch. 5, pp.125-126.
28. Though it is understandable that it was not easy to make strategic moves whilst both the nations were undergoing a crisis and there were several barriers. And business with a disintegrating Russia was not as simple as a bilateral agreement with the erstwhile USSR.
29. Raja Mohan, n. 27, pp. 128-129.
30. Air Mshl B.K.Pandey, "US Aerospace Industry and India," *Indian Defence Review*, vol. 26.1 January-March 2011.

Despite the huge opportunity that presented itself, the nation failed to take effective advantage of the situation towards its quest for self-reliance. Notwithstanding a long and healthy relationship with the Soviet Union and the transition from a buyer-seller relationship to joint development of technologies and systems, the nation has failed to harness this strategic opportunity for developing the research, design and development capacity of the national aerospace industry. It seems the leadership entirely missed a vital point that in the long run, appropriate financial and intellectual investments in research and development of the aerospace industry would not only energise the industry but the nation would also reap phenomenal economic benefits as well. And both are essential for the overall national development and security of an aspiring global power.

India is still struggling to be counted as an accomplished science and technology nation, and the aircraft industry is no different.

THE WAY AHEAD

At the time of independence, amongst all the nations that got freedom from colonial powers in the 20th century, India exhibited most progressive leadership in critical fields, including science and technology. However, despite a visionary start and a passionate approach towards science and technology, India is still struggling to be counted as an accomplished science and technology nation, and the aircraft industry is no different.

Strengthening Defence Public Sector Undertakings (DPSUs), DRDO, HAL, Ordnance Factory Boards (OFBs), promoting Foreign Direct Investment (FDI) and private sector involvement, establishing joint ventures, boosting the Public–Private Partnership (PPP) model, establishing Aerospace Innovation Parks, integrated Special Aerospace Economic Zones (SAEZs) and Aviation Technology Parks (ATPs), and harnessing offsets are crucial for energising the indigenous aerospace industry. But most important is to establish a **National Aeronautics Commission (**like the Atomic Energy Commission and Space Commission) and formulate a comprehensive and

futuristic National Aerospace Industry Policy. The commission will also help in synergising knowledge, experience and infrastructure available with various agencies including the IAF, ISRO, HAL, NAL, DRDO, ADA, ADE, GTRE, IISc, IITs.

At the same time, the expanding aerospace industry would require strengthening of the ecosystem across the industry. The certification agencies — the **Centre for Military Airworthiness and Certification (CEMILAC)** for defence aircraft and **DGCA** for the civil aircraft — would deal with the increased workload, necessitating beefing up and overall strengthening. For stringent quality control, Quality Assurance (QA) organisations — Directorate General of Aeronautical Quality Assurance (DGAQA) and DGCA, responsible for the defence and non-defence sector respectively – are to be scaled up and made accountable.

Role of IAF in Energising Aerospace Industry: The long journey of the IAF is studded with attempts to make a dent in the field of R&D and industry. In fact, the IAF has made a few landmark accomplishments. In the 1960s, the IAF took an unprecedented lead and manufactured the **Avro HS-748** — the first transport aircraft in India — at Kanpur under an IAF organisation, the Aircraft Manufacturing Depot (AMD). The efficiency of the project can be adjudged from the fact that in November 1961, the licensed manufactured medium transport aircraft was test flown barely two months after the first British produced aircraft was flown. However, the winning combination was disturbed: AMD was taken away from the IAF in 1964 and later merged with HAL. Was the IAF leadership not keen to take on the responsibility of producing equipment or were there other reasons for this decision? Whatever may have been the reason, but this great opportunity to assume a greater role in design, development and production was missed. Nevertheless, in 1969, the IAF created a Directorate for Projects at Air Headquarters (HQ) and there are several feathers in its cap for the successful execution of development and integration projects. In the early 1980s, the IAF integrated the navigation attack and weapon aiming system for the Jaguar called the DARIN, and made Indian Jaguars far superior to those of the Royal Air Force (RAF) and French Air Force. Additionally, the Radar

and Communication Projects Office (RCPO), INAS Integration Organisation (ITO), Low Level Radar Networking Group (LRNG) also had a high component of design and development and these were executed well.[31] Despite the phenomenal success of such projects, the IAF leadership has not been able to adequately prioritise in-house design and development capabilities though many retired IAF officers, including retired Air Marshals have advocate the same in their writings and dispositions at seminars.

The inability of the research body to involve the armed forces in developmental projects from the start has also been identified as a major area of concern.

At the same time, some analysts believe that the IAF's quest for the world's best weapon systems has been self-damaging. There are opinions that had the IAF not scaled up the LCA ASRs—initially, the LCA was planned to be a replacement of the MiG-21s with slight upgradation – probably ADA would have been able to develop and deliver the aircraft much earlier; and the present scenario of the IAF still awaiting induction could have been avoided. The modest indigenous defence industry has largely failed to produce high end technology systems as per the IAF requirement, even after phenomenal time and cost overruns. Hence, the IAF is finding itself in a severe weapon system deficit which may jeopardise national security. This has also been disastrous for the national aircraft industry as well, since in the quest of producing cutting edge technology products, the DPSUs have failed to produce anything worthwhile or viable. The P. Rama Rao Committee of 2008, which was formed to revamp DRDO, concluded that DRDO's tendency to overestimate its capabilities is the major cause for delays and failures of indigenous defence products. The inability of the research body to involve the armed forces in developmental projects from the start has also been identified as a major area of concern.[32] As a result, self-reliance is still a distant dream and the nation is forced to directly purchase

31. Air Mshl P.V. Athawale, *Indian Air Force: The Maintenance Paradigm* (New Delhi: KW Publishers, 2013), pp.64-65.
32. Manu Pubby, " What Went Wrong with LCA, Arjun Tank, Akash Missile," *The Indian Express*, March 3, 2009.

equipment from abroad, resulting in a long (almost unending) wait, high cost, a huge drain on the country's foreign exchange reserves, increased national dependency on foreign suppliers; and getting trapped into the aforementioned *triple trap.* Thus, the quest for the best is not working out for anyone – neither for the IAF nor for DRDO nor the industry as a whole. Rather '*the best is becoming the enemy of the good*'. Air Chief Mshl S.P. Tyagi has been cited telling his staff, "*Guys, get me the 2nd best in the world, but in time and of the right quality. I am tired of waiting for the best to come up*!"[33]

How do we address this huge gap between high user expectations and inadequate indigenous capability not able to match up? Should the IAF remain a technology intender; or should it make wholehearted efforts to boost the national R&D capability and promote design, development and production of cutting edge technology? Air Mshl P.V. Athawale, former Air Officer-Commanding-in-Chief (AOC-in-C) Maintenance Command, has addressed the issue of high user expectations and inadequate indigenous capability in a more practical manner. While recognising the critical relationship among R&D, industry as well as the IAF, he has explicitly explained their respective perceptions. Each organisation largely defends its own turf and apportions blame on systemic fault lines.

The Air Marshal has suggested a good and viable model which would suit all the stakeholders and synergise the system. While the IAF may continue to look globally for inducting the best in the world, it has no choice but to assume a greater role in scaling up the indigenous production process and about 30 percent of the inventory may be mandated for indigenous replacements. And for this 30 percent, the IAF needs to visualise and contract with the DPSUs and even the private sector for deliveries in a well defined time period, within clearly defined conditions. However, while defining the ASRs, the IAF must adopt a more realistic approach. Indigenous capability, relative cost and domestic constraints are to be kept in mind. The **IAF has to fundamentally change its role from a 'technology indenter' to a 'technology co-developer'.** Nevertheless, such projects need

33. Athawale, n. 31, p. 63.

to be actively monitored and steered by the IAF. To avoid time and cost overruns, which has largely remained a common denominator in the past, accountability has to be well defined at the contract finalisation stage.

Aggregation among research, manufacturing and the military sector is imperative. Many IAF veterans are also in its favour, and in their writings and in various discourses, they have strongly recommended a driving seat for the IAF with a permanent complement of research labs having elements of the airframe, aero-engines, avionics, Electronic Warfare (EW) capabilities, and electronics. It is also suggested that after the LCA programme, the Aeronautical Development Agency (ADA) could be shifted under the control of the Air Force, and on the lines of the Radar and Communication Projects Office (RCPO), a dedicated supporting structure may be created for design, development and projects. Establishment of a three-star PSO (Principal Staff Officer) as Director General (Design, Concepts and Projects) would go a long way in driving all the visionary design and development activities and related projects. The proposed Director General (DG) is to be given the command and execution function of research establishments, including the Software Development Institute (SDI), Aircraft & Systems Testing Establishment, (ASTE), Electronic Warfare Development Department and other laboratories and infrastructure dedicated to research activities. Institutionalisation of a specialised cadre of officers as well as airmen completely dedicated to design, development and R&D activities is essential since this work is entirely different from routine maintenance work.

At the same time, regular monitoring of the progress, with a provision for timely intervention and course correction are essential. The common practice of ascertaining the organisational accountability by looking at the end product towards the end of the project is an inherently faulty mechanism. This process is too unrealistic as it leaves very little scope for course correction amounting to nothing but a *fait accompli.* To avoid and minimise wastage of national resources, it is necessary to have a mechanism that regularly monitors the progress and does not allow a long rope beyond certain pre-defined limits.

A model with a well defined accountability and delivery schedule with embedded provisions for timely intervention and course correction would catalyse indigenous R&D and industry. And as the indigenous capability matures, the percentage of the indigenous share would keep growing and the nation would eventually be able to achieve self-reliance.

CONCLUDING THOUGHTS

The West took 300 years to reach this advanced stage of technology and industrial growth. But India would not have this luxury and needs to hasten the process before it becomes too late and the fleeting opportunities evaporate. It is time for the nation to reach out and create a vibrant Indian aerospace industry and leverage its economic and security benefits. To begin with, the leadership must define a vision, chalk out a strategy and show a will to execute its practical plans to achieve self-reliance in the aerospace industry. Measures like vertical integration in government agencies dealing with design, development and production of aircraft, with a decentralised decision-making process and horizontal links amongst all the stakeholders, are essential. Delinking the executive and advisory role of DRDO is another critical requirement. India has no choice but to promote innovation, PPP, joint ventures and harness the demographic dividend through attracting FDI and harnessing offsets.

The IAF needs to initiate concrete steps to energise the national aerospace industry through all possible means and like the Indian Navy, it has to become a co-developer rather than a mere indenter awaiting aircraft, avionics and weapon systems. Establishment of Director General (Design, Concepts and Projects) has to be an IAF strategic priority towards channelising its efforts in this direction.