



Radiance in Indian Skies The Tejas Saga



Air Marshal P Rajkumar
BR Srikanth

Defence Research & Development Organisation
Ministry of Defence, India

"You have to dream before your dreams can come true,"
goes a famous quote of Dr APJ Abdul Kalam. Avant-garde scientists, engineers
and test pilots accomplished extraordinary feats of engineering and human
achievement against mind-blowing odds to realize their dreams:

The Light Combat Aircraft.

Radiance in Indian Skies-The Tejas Saga is a riveting portrait of one of the
spectacular aviation triumphs and fruition of dreams in recent times. It is filled
with telling personal anecdotes and high adventure with narratives, from these
scientists and engineers as well as pilots of the Indian Air Force and the Indian
Navy, along with their up-close portraits to inspire Gen Next to dream big and to
script many a success story as examples of a strong and self-reliant India.

Radiance in Indian Skies- The Tejas Saga

Air Marshal Philip Rajkumar PVSM AVSM VM (Retd)
BR Srikanth



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A Tribute to Team LCA

This book is dedicated to those thousands of men and women who worked tirelessly for three decades to make the Light Combat Aircraft a success. They are the indomitable and indefatigable Team LCA.

Acknowledgements

We would like to place on record our gratitude to everyone—serving and retired scientists, engineers, academicians, test pilots, maintenance crew and DESIDOC—who helped us chronicle all facets of the Light Combat Aircraft programme. An impeccable flow of this thoroughly engrossing narrative—*Radiance in Indian Skies-The Tejas Saga*—mirrors the truthful and enriching views shared by all of them on every feature of this Made-in-India aircraft. We thank them for their inspiring guidance, friendly advice and constructive criticism while recounting the journey of the aircraft from the drawing board to the skies.

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Foreword

Air Chief Marshal RKS Bhadauria, PVSM AVSM VM ADC, Chief of the Air Staff

The book, “Radiance in Indian Skies - The Tejas Saga”, by Air Marshal Philip Rajkumar and BR Srikanth chronicles the development of the Indian Light Combat Aircraft (LCA) programme. Air Marshal Rajkumar was the first Project Director (Flight Test) of the LCA project at the Aeronautical Development Agency (ADA).

Under his astute leadership and professional guidance the LCA Technology Demonstrator-1 (TD-1), flew its first flight on 04 Jan 2001. The meticulous and thorough planning of the project under his close supervision ensured success during its nascent developmental stage. I was privileged to be associated with Air Marshal Rajkumar and also fly the Tejas in some of its crucial phases of flight testing.



**Air Chief Marshal RKS Bhadauria,
PVSM AVSM VM ADC, Chief of the Air Staff**

The LCA programme, has created a state of art eco-system of aeronautical laboratories which have given India the unique capability to design and develop a fighter aircraft. The revival of this capability, after a gap of nearly four decades is in itself an extraordinary achievement. The LCA project, even though delayed by many years is an astounding success as it is one of the best ‘Light Weight Fighter Aircraft’ of present era.

The new technologies used to make the LCA such as the digital Fly-By-Wire, Mission Computer-Controlled Avionics and Composite Material were developed indigenously. In the process, India has been able to leap frog a vast technology gap, from a first-generation Marut (HF-24) fighter to a fourth-generation combat jet. The success of making an advanced fighter aircraft has given our aerospace development

community the confidence to commence work on the next generation of aerial platforms.

Air Marshal Philip Rajkumar has given a gripping narration of the unswerving resolve of scientists, engineers and IAF test pilots and test engineers to design, develop and manufacture a sophisticated aircraft to defend Indian skies. The author’s personal association with the LCA adds deep value to the story he weaves of the progress of the programme. The book is a source of inspiration to young aerospace engineers, scientists and test pilots.

Introduction

Dr G Satheesh Reddy, Chairman, DRDO

Today Tejas has become an integral part of Indian Air Force. However, development of a state of the art indigenous fighter aircraft has been a very challenging task which has had its ups and downs. The programme is a shining example of 'Made in India' and puts the country firmly on the path towards *Aatmanirbharta* (self-reliance) for combat aircraft. History is one of the best teachers and chronicling the history of this technologically complex programme provides important lessons not only for future aircraft programmes but also every other technologically complex endeavor.

The monograph, "Radiance in Indian Skies-The Tejas Saga", describes the extraordinary journey of the Light Combat Aircraft (LCA) from concept to entry of the fighter jet into squadron service. It is a story of the many

hundreds of men and women who toiled ceaselessly, without being discouraged by endless criticism of prophets of doom. In the process, India has leap-frogged the technology gap from those which powered a first-generation fighter to a fourth-generation combat jet. It has carved a niche for itself as the first programme in the history of Indian aviation to have clocked almost 5,000 flight test sorties with a stellar safety record. It cost a fraction of similar development



Dr G Satheesh Reddy
Chairman DRDO & Secretary DDR&D

programmes in countries with better expertise and infrastructure. In 2016 and 2018, the 'Tejas' was applauded by the international aerospace community at air shows in Bahrain and Langkawi, Malaysia setting at rest doubts about DRDO's capability to develop a world-class aircraft. The combat aircraft's spectacular performance over the skies of Bahrain and Langkawi has engendered enquiries for exports from friendly countries.

The programme has overcome several hurdles including the technology embargo imposed by the US administration post Pokhran-II, in 1998. It was an ambitious venture with three well-defined aims: (a) bridge the technology gap which had opened up after the end of the Marut development in the 1960s (b) develop the indigenous aeronautical industry and (c) provide the Indian Air Force with a ready-to-go-to-war fighter in a fixed timeframe of 15 years. This was a daunting task. To the credit of ADA and all agencies which worked in the programme, the fighter was successfully developed, productionised by HAL and handed over to the first Tejas squadron of IAF in July 2016.

Air Marshal Rajkumar is eminently qualified to chronicle the history of

LCA development. He has had a ring-side view of the development during the most critical phases. The National Flight Test Centre (NFTC), a unique National Team for flight testing of the LCA was formed in 1994. Air Marshal Rajkumar served as head of NFTC from its inception till August 2001. During this period, he oversaw the two critical In Flight Simulation exercises of LCA in 1995 and 1996. It was also during this period that the programme overcame the setback of US sanctions and subsequently made history with the first

flight of LCA TD-1 on 04 January 2001. Subsequently Air Marshal Rajkumar also served as Director, ADA from 2001 to 2003. He provided leadership not only (to) the flight test activities but also contributed significantly to design evaluation and project management during his almost decade long association with the LCA programme.

Through this monograph, Air Marshal Rajkumar and BR Srikanth have managed to fulfill three critical objectives:

- to create a written historical record of the developmental

story gleaned from records and interviews with major players in the development

- to provide the Indian public and indeed the world at large an insight into this heart-warming saga of Indian technological endeavor
- to inspire young aerospace engineers and scientists to develop cutting-edge technologies for the defence sector in the near future.

The monograph covers the gamut of activities associated with the programme while at the same time giving adequate recognition to people who played a critical role in

the process of design and development of the ‘Tejas’.

DESIDOC of DRDO has commissioned this monograph to highlight this awe-inspiring saga of India’s aeronautical prowess, and unswerving resolve of scientists and engineers to design and roll out a sophisticated aircraft to defend Indian skies. I compliment Air Marshal Rajkumar and BR Srikanth for a lucidly written monograph which will serve as an invaluable reference for all future aerospace designers, planners and aerospace enthusiasts.

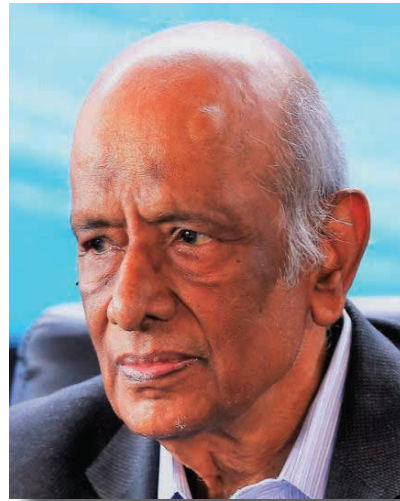
India Builds a Fighter, Tejas

Dr VS Arunachalam, Former SA to RM

India has a formidable Air Force, with over 1000 aircraft and a range of capabilities from aerial early warning to air to air refuelling. Indian Air Force institutions train their pilots and engineers well, and some are globally recognised for their outstanding performance. The manufacturing facilities at Hindustan Aeronautics Ltd are equally impressive with many large factories that manufacture aircraft of various types under license and components for imported ones. This has served the country well and India is able to manufacture the latest MIGs and SUKHOIs. The imported aircraft are good and the Indian experience in dealing with Russian technological culture has also come in handy.

But no Longer

There has been a digital technological revolution, and aeronautics is one of disciplines



Dr VS Arunachalam
Former SA to RM, Secretary DDR&D and DG, DRDO

that has benefitted from it. Large mainframe computing systems have made complex calculations manageable and complemented wind tunnel data with computational fluid dynamics solutions. The speed and versatility of modern digital computers have reduced the costly and cumbersome processes of manual design using drawing boards and blueprints. The advent of computer aided design and numerically controlled machines have transformed design and manufacture by speeding up the process and

improving quality. Even unstable configurations that would normally have been avoided in design can now be handled by these computers. They enable aircraft to react to fast changing air combat situations. The computer has thus become all pervasive.

Early jet engines were inefficient because hot end engine components could not be operated at high temperatures. There are a few major difficulties in reaching high temperatures: Metals and alloys become soft, corrosive and melt below 1500 °C. Their

creep resistance also reduces. Nonmetallic materials though oxidation resistant and strong at high temperatures become brittle. Engineers, therefore, have resorted to a few novel design techniques such as using single crystals and composite fibers.

The above paragraph, while describing the new technologies which are coming into use in a significant way, also underline the gross failure of Indian industries to acquire or develop them for industrial exploitation.

We realized that Hindustan Aeronautics Ltd did not have the necessary expertise in these areas which had to be either developed in country or acquired from abroad. It is in this context that India signed collaborative agreements with France and the United States. The collaboration with France was for participating in the Project Definition Phase (PDP) of LCA (Tejas). The US

collaboration was extensive and useful in buying jet engines for the Indian aircraft and co development of the fly by wire system. India did not have the necessary know how to make the fly-by-wire system. India planned to acquire this knowledge from the US. Indian engineers got the necessary training to design the fly-by-wire system by working in US laboratories. The collaboration was successful though subject to the vicissitudes of US policy. They refused to help in developing the control laws for a fly-by-wire aircraft. India developed this critical software on its own. India was willing to extend the collaboration with the French beyond project definition to full scale development but they insisted on India choosing and absorbing only those technologies which they recommended, especially the hybrid fly-by-wire system. Even after considerable persuasion the French did not relent and the collaboration did not go beyond the project definition phase. Surprisingly,

the collaboration with the United States, for the General Electric F 404 jet engine went smoothly. This was important as the indigenous attempt to design, develop and manufacture a jet engine could not have met project time lines.

For many years the Indian air force was pining for a fighter aircraft with new technologies that would further strengthen its fleet. Hindustan Aeronautics Ltd, the prime aviation industry in India did not develop any of the new technologies in house nor did it collaborate with national laboratories. The IAF was therefore hesitant to entrust the development project to Hindustan Aeronautics. Fortunately, Indian laboratories and academic institutions, had been working in advanced technology programmes for many years. Institutions like CSIR, DRDO and IISc were enthusiastic to collaborate.

The political leadership of that time felt India was being subjected to foreign pressures

in times of difficulties. There were problems in sourcing systems and components without conditions and collaboration with foreign laboratories was declining. There were instances where components even from the Soviet Union were difficult to procure. They were reluctant to share their experience with advanced systems.

The Indian government was also concerned about India falling behind in advanced technologies and wanted to encourage development of such technologies in the country. It was in this context, a separate organization looked far more relevant and we at the Ministry of Defence pursued this route by setting up an independent institution called the Aeronautical Development Agency (ADA). The Government agreed with this recommendation though many organizations did not initially favour this decision. Dr Kota Harinarayana, a young engineer from DRDO was appointed as programme Director and he persuaded DRDO and HAL to depute

scientists and engineers to join this programme. We thus established a design team of 300 engineers in about three months. There were two options to pursue this programme. One was to contract the whole project to an agency in India with total foreign collaboration or design and manufacture in India with ADA taking prime responsibility. Even though the first option appeared safer and less risky, we choose the second one as we had the potential to build technological capabilities that could stand the country in good stead in the coming years. Initially the Air Force appeared interested in pursuing the second option, though hesitant at times to totally trust Indian competence. After some discussion they agreed to the manufacture of two technology demonstrator aircraft before going ahead with full scale engineering development. To reach this level, we had to face many challenges and it was finally agreed that HAL and ADA would roll out two demonstrator aircraft for the

IAF to test and prove core technologies. The naysayers were surprised to see how effective the collaboration between the Indian Air Force, HAL and ADA was. Along with the design ADA also helped create an ecosystem in the country with participation

of 300 industries, 40 research and development laboratories and 25 academic institutions. This ecosystem is capable of developing future aircraft with advanced state-of-the-art technologies. In the year 2003, Prime Minister Atal Bihari Vajpayee named the LCA

“Tejas”. Final operational clearance has since been achieved and HAL has commenced serial production and manufactured more than 20 aircraft. 100 more are in the pipe line. Discussions are ongoing to produce variants of the Tejas as well.

Many years ago, Indian scientists and engineers had dreamt of making a modern aircraft. After years of frustration and disappointment they have built a versatile single engine fighter. The dream has thus been realized.

Up Close with the LCA Project

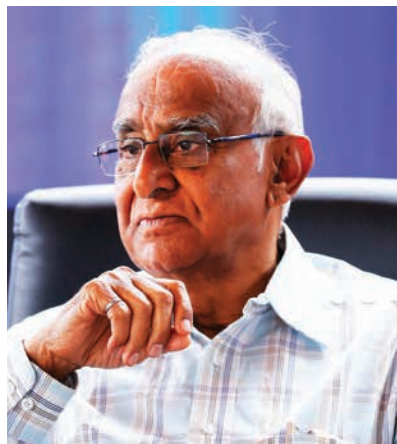
Dr VK Aatre, Former SA to RM

“Last Chance for Aatre”

This was the punch line of an uncomplimentary news report published in a leading national newspaper a day after I addressed the media on completion of the first quarter of my tenure as the Scientific Adviser to Raksha Mantri. The report was disparaging about the manner in which DRDO executed its programmes and projects, including the Light Combat Aircraft (LCA). The correspondent punned on LCA (Last Chance for Aatre) in the punch line of the report because I wore two other hats: Director General of DRDO, and Director General of the Aeronautical Development Agency (ADA).

Unambiguously, as the new occupant of the corner office in Sena Bhavan, New Delhi, I had the greatest challenge on hand vis-à-vis the LCA programme. I, therefore, got engrossed in understanding the complex technologies involved, as well as administrative requirements

of the project with the help of Dr Kota Harinarayana, programme Director, ADA, and many other top scientists and engineers who were part of the national team tasked with the design and development of this fourth-generation combat aircraft. I chaired meetings on the third Saturday of every month in Bengaluru, not just to review the progress but also to lay down targets and address managerial and administrative bottlenecks. During these meetings, members of the national team suggested alternative approaches to overcome technological hurdles triggered by



Dr VK Aatre
Former SA to RM, Secretary DDR&D and DG, DRDO

sanctions imposed by the US administration. The outcome: complex systems such as the Quadruplex IFCS (Integrated Flight Control System), advanced avionics or primary actuators were designed and made indigenously.

In about a year of my appointment as Scientific Adviser to Raksha Mantri in December 1999, I was convinced that we were close to the maiden flight of the Technology Demonstrator (TD-1) because many engine ground runs, taxi trials and rotation of the aircraft were successfully completed. We decided the Technology

Demonstrator (TD-1) should take to the skies in early January 2001, but kept this decision under wraps, while inviting a select few dignitaries to witness the historic flight.

January 4, 2001, will remain etched as the most memorable day of my career in DRDO. I define it as the most memorable day for many reasons. First, we demonstrated to the world the competence of Indian aeronautical community to design and fly a modern combat aircraft. Second, it was the beginning of accomplishment of many milestones: a fly past at Aero India 2001 on February 10, 2001, just over a month after the first sortie, approval of full scale engineering development of LCA by the Cabinet by the end of 2001, maiden flight of the second Technology Demonstrator (TD-2) on June 6, 2002, commencement of manufacture of eight aircraft as part of the Limited Series Production (LSP) programme

by Hindustan Aeronautics Ltd (HAL), Bengaluru, a formal approval by Government of India to design and develop the naval version for operations from the deck of an aircraft carrier in early 2003, christening of LCA as 'Tejas' (Radiance) by Prime Minister Atal Bihari Vajpayee on May 4, 2003, breaking of the sound barrier on August 1, 2003, first flight of PV-I or Prototype Vehicle-I on November 25, 2003, and safe completion of the Technology Demonstrator phase on March 31, 2004, after 202 sorties (a sortie is one mission from take off to landing).

At every stage, we were supported and cheered by Mr Vajpayee and Defence Minister Mr George Fernandes. I remember the accolades proffered by Mr Vajpayee on the day he christened the LCA as 'Tejas.' "I am confident that this world-class fighting machine will make a glorious contribution to the nation's defence. I am happy to name it Tejas. May it bring glory to our aerospace industry," he told the gathering at HAL. Mr George Fernandes, who

along with Principal Scientific Adviser to Government of India, Dr A P J Abdul Kalam, and Chief of the Air Staff, Air Chief Marshal Anil Yashwant Tipnis, witnessed the first flight of LCA, allowed us to make independent decisions and secured the Cabinet's assent for all proposals concerning the LCA programme. I recall his reaction when I broached the issue of a fly past by the Technology Demonstrator (TD-1) at Aero India in February 2001: "You are the head of the department, and it is your decision."

Though all systems and subsystems performed to expectations during 202 flights of the Technology Demonstrator phase, the primary radar (Pulse Doppler Multi-Mode Radar) and the 'Kaveri' engine were a cause of much concern to me. While several subsystems of the Multi-Mode Radar, jointly developed by Electronics & Radar Development Establishment (LRDE), and HAL, Hyderabad, worked satisfactorily during tests carried out in the laboratory, performance of

the integrated systems was below expectations. The time factor involved with flight trials of LCA forced DRDO and the IAF to decide in favour of Israel's ELTA radar. And with the development of the 'Kaveri' engine not keeping pace with progress of the LCA programme, a decision was taken to import the General Electric F-404 engines to power the limited series production aircraft and beyond. We were, however, successful in design and development of many structures and technologies such as the ones required for compound delta configuration, quadruplex fly by wire flight control system, innovative avionic systems, and co-bonded and co-cured composite technology for the airframe.

'Tejas' has crossed many more milestones over the last decade, including air-to-air refuelling, and joined the fleet of the IAF on July 1, 2016, with the formation of No. 45 Squadron (Flying Daggers). It stole the thunder at the Bahrain Air Show in January 2016 and the Langkawi

International Maritime and Aviation (LIMA) airshow in Malaysia in 2019, and even secured the Final Operational Clearance (FOC) in March 2020. In January 2020, the naval variant successfully carried out the first arrested landing and ski-jump take off from the aircraft carrier INS Vikramaditya.

The flight test programme of the LCA has been a success story in itself. It is rare in the history of fighter aircraft development for an aircraft to go from first flight to entry into operational service without major incidents or accidents. A single accident at any stage would have jeopardised the entire programme. Unfortunately carping criticism in the media continues with all sorts of ill-informed stories doing the rounds.

For me, however, it is a moment of quiet pride when I look back at how I grabbed a challenge posed by the correspondent who mocked me with the punch line "Last Chance for Aatre", and helped accomplish many milestones of the LCA programme.

A Dream Come True

Air Marshal Philip Rajkumar PVSM AVSM VM (Retd)

Former Test Pilot and Director ADA

Newton would think he had made a mistake

To see those young men and the chances they take

(Those Magnificent Men in their Flying Machines)

I was indeed young, just 78, when I realized my long cherished dream to fly the ‘Tejas’ on February 28, 2020. It was a balmy Saturday morning with a bright blue sky dotted with wispy clouds over Bengaluru—a good day to be in the air.

A familiar smell of aviation turbine fuel mixed with a bit of oil and grease greeted me as I stepped into the ejection seat in the rear cockpit of the trainer variant parked on the tarmac at HAL. Straps, personal equipment connector, oxygen tube, g suit hose and R/T leads were connected in quick time and Gp Capt Deepak of NFTC got into the front cockpit. A reassuring “Do you hear me sir?” came over the radio. Soon, the engine wound to

life and we started to taxi out. The cockpit had changed so much since I retired from the programme in 2003. There was not even a single conventional round dialed instrument in the cockpit! I had to ask Deepak to run through the symbology on the HUD and other displays. Deepak gave me the controls to taxi, and the ground handling was crisp. The nose wheel steer and rudder pedal movement were harmonized well and the brakes were effective.

As we lined up on the east facing runway, indelible memories of the morning of January 4, 2001, when Wing Commander Rajiv Kothiyal had lined up in similar fashion for the historic first flight, re-emerged. Now, several

thousand flights later, I was doing the same!

The afterburner was engaged and after rapid acceleration, Deepak lifted her off at 146 kts. Once airborne, he handed over the controls to me, and I got to handle the controls for the first time. Truly, it was agile, responsive and gave a delightful feel, just

as the designers had planned. Soon, some gentle turns became steeper and tighter as I got used to the aircraft. Deepak turned on the radar and showed me the various modes and weapon aiming symbology. Flying at an altitude of 15,000, we carried out a simulated bombing



Air Marshal Philip Rajkumar (Retd)
after his sortie in February 2020

run on a small dam in Tamil Nadu, and the display showed the bomb release when the continuously computed impact point reached the target. The man machine interface and intelligibility of displays reflected the years of effort put in by the development teams at ADA, NPTC, HAL and DRDO labs. It was a dream ride as I got a feel of the fly-by-wire flight control system several thousand feet above terra firma. I had tested this control software on both the ground and in-flight simulators a quarter of a century ago.

The radar modes were an eye opener about the way modern radars have evolved since the early years of the MiG 21 in India more than half a century earlier. The Tejas was meant to replace the MiG 21 in the IAF but was far superior in every metric of performance and capability. Having flown 3261 sorties on all marks of the MiG 21, I have no hesitation in making this assessment.

The radio and navigation aids available removed one of the biggest bugbears of any pilot- uncertainty of position. The GE F404 IN20 engine sipped fuel in the dry regime and I ventured to do some wing overs and rolls. My personal gyros held and I was really having a great time in a fighter cockpit after close to two decades on the ground. I wish one never had to stop flying!

All good things have to come to an end and Deepak took over controls for the landing. An instrument approach was flown and a smooth touch down at 14 units of angle of attack was made. Brakes and tail chute allowed us to turn off the runway well short of the end. I taxied back till entry into the dispersal. Deepak parked, put off the high pressure fuel cock and the engine wound down.

My dream ride was over but what a fantastic memory I have for keeps!

Co-author, BR Srikanth

Former Executive Editor, Deccan Chronicle, Bengaluru

Co-author, BR Srikanth, former Executive Editor, Deccan Chronicle, Bengaluru, and an award winning journalist, has been prolific with his pen on the LCA programme.

This aerospace enthusiast has made sure he did not miss any significant event in the aircraft's journey—from the drawing board to squadron service.

On January 4, 2001, he clambered up a tile-roofed house next to runway 09 at HAL airport, Bengaluru, to witness the maiden flight of Technology Demonstrator-1 (TD-1), following an eleventh

hour alert from a 'Deep Throat' in DRDO.

For the next major milestone on June 6, 2002, the first flight of Technology Demonstrator-II, he coaxed none less than Air Marshal MSD Wollen (Retd), former Chairman & Managing Director, HAL, to join him atop a wall near the runway to view the takeoff.

And on the day of formation of the first squadron, July 1, 2016, he got up close to the first aircraft which joined the IAF's fleet.

A dream ride onboard the 'Tejas' is all that he's waiting for.



Co-author, BR Srikanth

on the day of formation of the first LCA squadron, July 2016

Chapter 1

Genesis of the LCA Programme



The old bringing in the new: MiG 21 and Tejas

In a manner of speaking, the astounding journey of the Light Combat Aircraft (LCA) programme commenced in 1969.

A Committee on Aeronautics, chaired by the former Defence Minister, C Subramaniam, recommended India should prepare a roadmap for the development of aeronautics in the country with the focus on an indigenous fighter aircraft, a helicopter and a cargo aircraft.

The committee felt self-reliance in aeronautics was an extremely desirable national goal, keeping in mind civilian industrial requirements as well. For this dual purpose, the committee recommended strengthening the aeronautical research and development base in the country, and the establishment of an Aeronautics Research and Development Board (AR&DB) to advance the cause of self-reliance in aeronautical technology. The AR&DB was created in the mid-1970s under the umbrella of the DRDO, but Government investments to promote aeronautical R&D remained low.

The Indo-Pakistan war in December 1971, the nuclear test in 1974 resulting in a technology embargo by the western world, the imposition of the Emergency by the late Prime Minister Mrs Indira Gandhi, the arrival of the Janata Party government in New Delhi, and return of Mrs Gandhi's government in March 1980, were the tumultuous events during the decade which put the fighter programme on the backburner. Some preliminary studies on the concept were, however, initiated at HAL's Design Bureau.

Prof Roddam Narasimha of the Department of Aerospace Engineering, Indian Institute of Science (IISc), Bengaluru, had worked with the HAL Design Bureau in the late 1970s. The idea was to build the HF-25, also known as the Tactical Air Support Aircraft, powered by an after-burning Russian engine, replacing the two dry Bristol Orpheus engines which could not make the HF-24 go supersonic. In his article published in Indian Aviation in 2001, the late Air Mshl MSD Wollen (Retd), former Chairman,

HAL, recalled "based on IAF's 'air staff target' papers, HAL finally completed design studies for the Tactical Air Support Aircraft in 1975, and it appeared HAL would, after a lapse of twenty years, get down to developing a fighter. However, the selected 'proven engine' from abroad, could not be procured, and the project fell through. HAL's design and development capability started to decline."

With the purchase of Jaguar fighters by the IAF, and HF-25 proving a non-starter, Prof Narasimha resigned from HAL. He, however, conceived the idea of a supersonic Light Combat Aircraft (LCA). "I was with the Department of Aerospace Engineering, IISc, at that time, and I couldn't meet even the normal expenses associated with my involvement in the project. I was at that time head of the group, making studies on LCA performance and configurations. I mentioned this to Dr Raja Ramanna, then Scientific Adviser to the Defence Minister. He sent Mr Vivek R Sinha, at that time the Secretary to ARDB, to

discuss the problem with me. After Mr Sinha found out what my problems were, he agreed the simplest way the difficulties could be sorted out was to sponsor a project titled 'LCA Studies' with me as the Chief Investigator. A sum of Rs. One lakh was very promptly released for the purpose," reminisced Prof Narasimha. Later on, the project was considered both attractive and affordable by Dr S R Valluri, Director, National Aeronautical Laboratory, later known as the National Aerospace Laboratories (NAL), and Mr Raj Mahindra, Managing Director, Design bureau, HAL, Bengaluru. A team of engineers from the two organisations, working with him, started to make a preliminary design of the LCA. It was presented to the IAF in November 1978 at Bengaluru, and the response was positive.

The Indian Air Force (IAF), which was thinking of replacing the Ajeet and MiG 21 fleets, before long, agreed to support the programme as and when it was launched and issued Air Staff Target (AST) 201.

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About the Book

Development of the Tejas fighter aircraft was independent India's most ambitious aeronautical project. A group of visionary academics, engineers and scientists was convinced the country had the talent to undertake this journey on a road filled with many unknowns. The Government of India which always wanted the nation to achieve self reliance in high technology fields like aeronautics and space backed the idea. The Aeronautical Development Agency (ADA) was established in 1984 to manage the project. Hindustan Aeronautics Limited (HAL) was the principal partner in the project because it was the only organization in the country which had a design bureau and the infrastructure to manufacture prototypes and serially produce the aircraft. ADA, which was placed under the Defence Research and Development Organisation (DRDO), was strongly supported by many DRDO laboratories in particular the Aeronautical Development Establishment (ADE) and the National Aerospace Laboratory (NAL) under the Council for Industrial and Scientific Research. It was undoubtedly a mammoth multi disciplinary effort requiring good project management skills. The grant of Final Operational Clearance (FOC) for the aircraft, development of the trainer version, arrested landing of the Naval version on the carrier and the equipping of two front line fighter squadrons with the Tejas is testimony to the dedication and technical virtuosity of Team LCA, an omnibus term for the many hundreds of men and women who contributed to the success of the project. This book is about the inspiring journey of the Tejas from concept to entry into squadron service. A must read book for all Indians.

About the Authors

Air Marshal Philip Rajkumar (Retd) spent nine years in the programme from 1994 to 2003. He was given the onerous task of setting up the infrastructure and preparing for flight testing the two Technology Demonstrator aircraft. The National Flight Test Center(NFTC) was set up by him in 1994 which has since performed 5000 prototype test flights safely. Given his long association with the programme he was eminently qualified to chronicle the journey of the Tejas from concept to entry into service.

BR Srikanth has been writing on technology matters for over two decades. His keen interest in aerospace technologies enabled him to co author the monograph 'The Incredible Journey of the Indian AWACS' along with Dr K Ramchand and S Krishnaswamy. Progress of the Tejas project was closely monitored by him and he has provided many insights on personalities who have played a leading role in the programme.

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