ISSN 2230-9225

SP's Aviation

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Cost is not a constraint. For short flights, a very light jet like the Cessna Citation Mustang is preferred by small businesses.

Cover Story

SET TO TAKE OFF

Demand for jets is no more from the super rich. Indian entrepreneurs are now aspring to extend their empires ever more widely, and business jets are their tools of choice.

Cover Photo:
Business Aviation in India is on a high as number of business aircraft registered here is growing
Image By: *Hawker Beechcraft*

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ANNUAL SUBSCRIPTION
Inland: Rs 900 • Foreign: US$ 240

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It is comforting to know that the government has apparently decided that no cost is too much when it comes to safeguarding our national security. This augurs well for the country's strike force.

MAKE NO MISTAKE ABOUT IT: the Indian Air Force (IAF) is certainly bullish on modernising its combat aircraft fleet. It has gone full throttle to get the best possible medium multi-role combat aircraft (MMRCA) available in the global market. It would augur well for the future of the country's strike force if thinking in the political establishment runs parallel to the IAF's aspirations.

The offer by the US of the F-35 joint strike fighter (JSF) to India could provide new windows of opportunity for the Indian aerospace industry for a quantum technology leap. Air Marshal (Retd) V.K. Bhatia takes a closer look at the pros and cons of this remarkable aircraft—perhaps, as he says, "the only one in the world being developed from the beginning in vastly different variants to suit the multifarious needs of its various users". He points out that the offer of a fifth generation fighter of the F-35 class with a price tag of $65 million "is too mouth-watering to be ignored in totality." The offer is unprecedented, taking even the experts by surprise. Despite the conflicting pressures on decision-makers, the underlying imperative is that the IAF must receive the very best.

But that said, while buying off-the-shelf fighter aircraft may be a good idea, we cannot overlook a key aspect of modernisation: research and development (R&D). As Air Chief Marshal N.A.K. Browne admitted to *SP's Aviation*, in the absence of a sound R&D base, the IAF risks being left behind by other air forces of the world. We feature the Air Chief's views on the need for defence PSUs and other defence industry players to help the Defence Research and Development Organisation (DRDO) address the issue.

Be it for individuals or airlines, birthdays are always special. As civil aviation in India celebrates its centenary year, R. Chandrakanth writes on some of the beacons that guide the airline industry. Estimates suggest that domestic air travel in India will soar higher, thanks to low-cost carriers and the burgeoning upwardly mobile population. The 180 planes that IndiGo has ordered from Airbus and the 92 ordered by GoAir at the recent Paris Air Show prove this.

A.K. Sachdev, in his article, ponders a disturbing question: what ails regional aviation activity? The Directorate General of Civil Aviation (DGCA) is obviously flying blind, "due to a shortage of qualified personnel." This impacts monitoring flight and ground operations of air carriers and makes it difficult for airports to work optimally. A fall-out of this sad state of affairs is the stunted regional aviation activity in the Northeast, says A.K. Sachdev.

The aviation sector is often unfairly painted as one of the bad boys of global warming; never mind if flying produces just a fraction of the greenhouse gases that heat up the atmosphere. Air Marshal Bhatia makes out a credible case for 'green aviation.' Humans like to explore and having conquered the final frontier of space, the quest is now on to reach out to other planets in this solar system. Joseph Noronha salutes the human spirit of adventure in his article.

Well, on a more down to earth note, as I said in the beginning, it is comforting to know that the government has apparently decided that no cost is too much when it comes to safeguarding our national security. This augurs well for the country's strike force.

Jayant Baranwal
Publisher & Editor-in-Chief

PAK-FA AT MAKS AIR SHOW

Visitors to the recently conducted MAKS Air Show (August 16-21) near Moscow were treated to the first public performance of the Sukhoi's fifth generation frontline fighter, better known as T-50 PAK-FA. Russia has been conducting flight trials of the new generation supersonic combat aircraft since January this year. The aircraft has been designed to compete with the US F-22 Raptor and F-35 Lightning-II stealth fighters. When production begins, which could be as early as 2015, it will become Russia's first stealth aircraft and according to the designers will be considerably cheaper than its closest rival—the F-22 Raptor. A 50/50 partner in the PAK-FA project, India is likely to get its version of the fighter by 2017.

VIEWS

THE FIRST PUBLIC APPEARANCE of the T-50 PAK-FA at the August MAKS Air Show, both on the ground and in the air were indeed awe-inspiring and a real morale booster to the Russian military aviation industry. Although exact details are not known, the Russian PAK-FA dubbed 'Raptorski' by some Western analysts because of the striking similarity of its airframe with the US F-22 Raptor, its technical specifications and performance attributes are also likely to be very much similar to that of its US rival. This would be the first Russian fighter to have 'stealth' features—very low radar signature making detection by radar difficult if not impossible. Capable of achieving top speed of Mach 2+, the aircraft will have super-cruise capability and extremely high manoeuvrability, credit to vectored thrust. It will be equipped with the Russian active electronically scanned array (AESA) radar which is likely to be an advanced version of the NO35 IRBIS-E radar fitted on the Su-35. Currently, the PAK-FA is being powered by the NPO Saturn 117 engines but the later versions will use a completely new engine (17.5 tonnes thrust) developed by the same company or FGUP MMPP Salyut. Even though declared a 50:50 partner, India joined the joint venture (JV) after dithering for almost six years when it signed on the dotted line on October 27, 2007, committing about $5 billion (₹23,500 crore) for the development programme. This came as a shot in the arm for the Russian side which was facing innumerable hurdles and time delays, mainly connected with the financial crunch, to progress the programme further. However, with the first flight taking off in January last year, the programme seems to have been fully revived and the recent MAKS debut of the PAK-FA as promised by the designers confirms that the programme is well on track for operational induction into the Russian Air Force around 2015.

PHOTOGRAPH: SUKHOI

Meanwhile, the IAF has shown preference for a predominantly two-seat version of the aircraft in conformity with its operational doctrine and philosophy. The Indian JV partner, the Hindustan Aeronautics Limited (HAL) has reportedly negotiated to get a 25 per cent share of the design and development work in what it calls the fifth generation fighter aircraft (FGFA) programme. But while its work share might include some critical software such as the mission computer, navigation systems, cockpit displays and the CMDS equipment with the help of other related indigenous industries, it is highly doubtful whether it would be able to convert the airframe from single to twin-seat configuration with purely indigenous design changes. It is felt that that this work will have to be undertaken by the Russian designers; who in all probability would design a trainer version of the aircraft for their own use and upgrade it with full combat capabilities to suit the Indian requirements.

In the final analysis, while the Russian PAK-FA is likely to be an all-Russian aircraft, the Indian version might land up with 10 to 15 per cent of indigenous content, mainly connected with some software applications. As far as sharing of individual expertise on the airframe front is concerned, Russia's excellence in titanium structures could be complemented by India's in the field of composites and other light-weight high-strength materials. But HAL is unlikely to be elevated to anything more than the status of an inconsequential partner somewhat on similar lines as has been the case with the Indo-Russian BrahMos missile JV programme.

There is, however, a silver lining in the programme with HAL taking on the responsibility of co-producing the aircraft. Hopefully, this would give HAL the opportunity to imbibe new levels of technology, especially in the field of stealth and advanced engine designs that could prove to be useful in its future endeavours. It is also hoped that India might, in the long run, be able to reap financial rewards through jointly exporting the aircraft to other countries in the future. SP

—Air Marshal (Retd) V.K. Bhatia

Coming to an END

The Libyan freedom war has brought to the fore the relevance of air power wherein a ragtag rebel ground force with little knowledge of conducting military operations could still overpower a much superior adversary with the help of a properly planned and well-executed air campaign—in this case by the NATO forces

AS OF SEPTEMBER 1, 2011, Tripoli has been overwhelmed by the rebel forces and taken control of by the opposition National Transition Council (NTC), with the Libyan despotic ruler for 42 years consigned to a distant desert-hole. While the final battle may still have to be fought, it is almost certain that the days of the Gaddafi regime are over. The Libyan freedom war has also brought to the fore the relevance of air power wherein a rag-tag rebel ground force with little knowledge of conducting military operations could still overpower a much superior adversary with the help of a properly planned and well-executed air campaign—in this case by the North Atlantic Treaty Organisation (NATO) forces.

It all started when concerned with the appalling possibility of genocide and mass murder by Colonel Gaddafi's forces advancing onto the rebel-held city of Benghazi in Eastern Libya, and spurred by a large number of nations belonging to the Arab League, the United Nations Security Council (UNSC) finally took measures to prevent the impending massacre. UNSC Resolution 1973 adopted on March 17, 2011, was to enforce a 'no-fly zone' over the Libyan airspace to prevent Gaddafi's aircraft from attacking civilian targets opposed to the regime and stop air-logistic support for his ground forces.

Armed with the UNSC Resolution 1973, the coalition forces led by the United States lost little time to intervene militarily in Libya. Within 48 hours of the adoption of the 'resolution,' military action was well on its way to impose a 'no-fly zone' over the Libyan airspace. First on the scene were the hundred plus Tomahawk cruise missiles unleashed on the very first day by the coalition naval warships and submarines already patrolling in the Mediterranean waters off the Libyan coastline. These largely targeted the Libyan air defence radars and weapons such as its large arsenal of Soviet-built surface-to-air missile (SAM) sites. Destruction of an adversary's air defences becomes the first priority in the process of imposing a 'no-fly zone' over its airspace as it ensures freedom of friendly aircraft to carry out their missions without being engaged by its ground-based weapon systems.

A large number of nations contributed their air resources for the effort under different code names for air operations such as Operation Mobile for Canada, Operation Harmattan for France and Operation Elammy for the UK. The US in combination with Italy, Denmark and Norway named it Operation Odyssey Dawn (see box for a list of the countries which constituted the allied force with their commitments for imposition of the UNSC 'no-fly' resolution).

The list clearly illustrates the combined resolve of the participating countries and a formidable force of more than 200 combat jets and other ISR/AWACS platforms fielded against Libya to neutralise its air power. While the Libyan Air Force was known to have approximately 400 aircraft before the allied intervention started, its combat fleets mostly consisted of obsolescent Soviet-supplied aircraft such as the Su-22, Su-24 attack aircraft and, MiG-21, MiG-23, MiG-25 fighter aircraft, etc. Even under the best of circumstances, Libyan Air Force could hardly have been a match to the mostly modern inventories of the Allied Air Forces. In the then prevailing scenario, with a sizeable chunk of its fleets and airbases in the eastern parts of the country having fallen in the hands of the rebel forces, it had little chance of standing up to the allied onslaught. In the event, it took less than three days for the allies to establish an effective 'no-fly zone', over the entire Libyan air space and selectively ground that portion of the Libyan Air Force that remained under Gaddafi's control.

But it soon became amply clear that just the imposition of the 'no-fly zone' would not achieve the aim of defeating pro-Gaddafi forces and ousting of Gaddafi. On how the five-month air campaign was conducted to achieve the desired result, its pros and cons, international opinions and differences, and what lies ahead, turn to Forum. SP

—Air Marshal (Retd) V.K. Bhatia

COALITION AIR ASSETS FOR INITIAL NO-FLY ZONE OVER LIBYAN AIR SPACE

Belgium: 6 X F-16
Canada: 7 X CF-18, 2 X C-17, 2 X C-130, 2 X CC-150
Denmark: 6 X F-16
France: Up to 20 Rafale and Mirage 2000-5, C-160 SIGIN
Greece: Super Puma Helicopters, Embraer 145 AEW&C
Italy: 4 X Tornado, 4 X F-16 etc.
NATO: E-3 AWACS
Netherlands: 6 X F-16
Norway: 6 X F-16
Qatar: 6 X Mirage 2000-5EDA, I X C-17
Spain: 4 X F-18
UAE: 6 X F-16, 6 X Mirage 2000
UK: 4 X Tornado, 10 X Typhoons
USA: A large force comprising B-2 Stealth Bombers, AV-8B Harrier, EA-18 Growler, F-15, F-16, U-2 Spy planes, AC-130 and E-8C aircraft

COALITION FORCES: A ROYAL AIR FORCE TYPHOON PILOT ENTERS HIS COCKPIT AS THE SUN SETS OVER GIOIA DEL COLLE, SOUTHERN ITALY

PHOTOGRAPH: RAF

JASMINE REVOLUTION

It is certain that sooner or later, dead or alive, Gaddafi will be captured; bringing to an end the longest rule by a despot in the recent history of the world

THE DEMOCRATIC FRAGRANCE OF 'Jasmine Revolution' may have wafted through its neighbours Tunisia and Egypt, but in Libya, it turned into a horrible reek with the Gaddafi regime coming down with a sledgehammer to quell the protesting masses.

Though Libya, one of the largest oil producers of Africa, gained independence from colonial rule as Kingdom of Libya in 1951, it is being ruled from 1969 till date by Colonel Muammar al Gaddafi - who rose to power in a military coup. Gaddafi became one of the longest serving rulers in history. After abolishing the monarchy of King Idris, he created a new regime based on Arab nationalism and a welfare state, combining various roots of his political philosophy in his personal manifesto called "The Green Book". In 1977, he proclaimed that Libya was changing its form of government from a republic to a 'Jamahiriya', meaning government by the masses. But in reality, the one-man rule has continued till the present day. And as it usually happens, his autocratic iron-fisted rule resulted in suppression of the masses, large-scale corruption and his family amassing billions of dollars worth of ill-gotten public wealth. Even though Gaddafi entertained his foreign guests in a so-called tent—to showcase his Bedouin credentials—he, along with his family and members of his inner coterie lived in garish surroundings, trying to outwit each other as pompous autocrats; and in the process, totally alienating themselves from the country's citizenry.

The protests and confrontations which began in earnest on February 15 in Benghazi quickly spread like wildfire in other towns inviting the wrath of the security forces. By February 20, more than 200 people had been killed in Benghazi alone. The Libyan Government shut down the Internet and mobile phone network to hide the brutal violence. Gaddafi had declared war against his own people forcing some

of his own Ministers and high officials to either step down or distance themselves from him declaring his regime to be illegitimate. However, when Gaddafi roared to quash his opposition like rats and cockroaches by unleashing not only his ground forces, but also his air force war planes; the international community woke up to the possible reality of an impending genocide both on the ground and from the air.

In 2005, the United Nations approved a new doctrine called the "responsibility to protect" (R2P), declaring that world powers have the right and obligation to intervene when a dictator devours his people. The UN Security Council's (UNSC) Resolution 1973, authorising military intervention was essentially to provide a 'no-fly zone' over the Libyan air space, to prevent casualties to civilian population in Libya from the air. At the time of the passing of the UNSC Resolution, BRIC (Brazil, Russia, India, China and Germany) countries abstained, generally stressing reasons such as lack of full information, unintended consequences of military action and the need to address the problem through a political process rather than through military intervention. There were apprehensions that UNSC Resolution 1973 could tantamount to infringement of a country's sovereignty in solving its internal problems. Russian Prime Minister Putin went to the extent of calling the coalition air strikes to ensure no-fly zone (NFZ) over Libya, interference akin to medieval crusades; officially, the remark was withdrawn later on. But the other world powers spearheaded by France and UK and supported by Obama's Administration were unanimous for the need of military intervention to avert looming mass-scale annihilation of civilian population by Gaddafi's forces. The enforcement of the NFZ, therefore, couldn't have come sooner. Military intervention in Libya began on March 19. Within four days, on March 23, British Air Vice Marshal Greg Bagwell was quoted by BBC saying that the Libyan Air Force "no longer exists as a fighting force". With Gaddafi's air defence system and air force effectively out of the equation and a maritime embargo in place, the ground situation was not only retrieved but it also enabled rebel forces to regroup for a westward offensive push.

However, the coalition forces realised soon that imposition of the NFZ and maritime embargo alone were not adequate to achieve the ultimate aim of removing Gaddafi from power in Libya. But overstretched as they were on the ground in Iraq and Afghanistan and also due to severe political differences among the North Atlantic Treaty Organisation (NATO) nations on the correct interpretation and compliance of the UNSC Resolution 1973, it was decided not to use 'boots' on the ground. Instead, a middle path was adopted to intensify the air campaign to include Gaddafi's military targets, which would ultimately weaken the pro-Gaddafi forces and ensure their defeat even in the hands of the rag-tag opposition forces. By March 31, 2011, to cater to the sensitivities of individual nations, the NATO took over the responsibilities of ensuring the air and maritime embargos with the command of targeting ground units remaining with the coalition forces. Spearheaded by France and the UK, whose leaders were firmly opposed to the continuation of Gaddafi regime, a massive air campaign was unleashed in Libya with round-the-clock precision air strikes being carried out by frontline fighters of the participating nations. By August 31, a total of more than 20,000 sorties had been flown which included as many as 8,000 strike missions. By implying that anything of military value had the potential of causing harm to the civilian population, all military targets were considered legitimate for engagement. Nothing was spared whether these were Libyan armour, military or supply vehicles, surface-to-air missiles (SAM) sites or radars, command and control centres; even Bab al-Azizia compound—Gaddafi's stronghold in Tripoli. According to US Admiral Samuel Locklear, who heads the NATO's Joint Operations Command, NATO air raids had destroyed 5,000 military targets in Libya.

NATO air strikes continue to neutralise the last remaining pockets of pro-Gaddafi forces

Did the coalition forces' gamble to rely solely on air power to support the wobbly boots of rebels on the ground pay off? It certainly did, as Tripoli fell to the opposition forces on August 23 with most of Gaddafi's family having fled to Algeria and he along with his son and erstwhile heir apparent Saif al-Islam holed up like rats in the sands of Sahara desert. The wheel of time appeared to have turned a full circle from how he had addressed his opponents just a few months ago —rats and cockroaches—with the supremacy of air power established once again, without any doubt.

While the air strikes continue at Sirte and Bani Walid—two possible locations to flush out/eliminate Gaddafi, where he could be hiding—on the political front; the war seems to be over. As of August 24 meeting in Paris most of the countries including the BRIC nations recognised the National Transitional Council (NTC) as the true representative of the Libyan people. Speaking at a meeting in Qatar of Defence Ministers from the countries that have supported the anti-Gaddafi movement, NTC head Mustafa Abdel Jalil said, "I call for continued protection from NATO and its allies from the Tyrant. Gaddafi is still a threat, not just for Libyans but for the entire world as he is capable of doing something awful in the last moments." A NATO commander pledged to pursue the alliance's mission, at least until its internal mandate expires on September 27. Admiral Locklear in a news conference in Doha reiterated, "We believe the Gaddafi regime is near collapse and we are committed to seeing the operation through to its conclusion."

True to his words, NATO air strikes continue to neutralise the last remaining pockets of pro-Gaddafi forces while they are being urged to surrender to avoid further bloodshed. It is certain that sooner or later, dead or alive, Gaddafi will be captured; bringing to an end the longest rule by a despot in the recent history of the world. Meanwhile, with the war on the brink of being won from the air, a 1,000-strong NATO ground force is already assembling on the Mediterranean's northern shores for induction into Libya to help the country find its feet again through humanitarian tasks and running the ports, etc. SP

— Air Marshal (Retd) V.K. Bhatia

Fastest Flying Vehicle

DARPA's Falcon Hypersonic Technology Vehicle-2 aims at reaching anywhere in the world in less than an hour

THE FALCON HYPERSONIC TECHNOLOGY Vehicle-2 (Falcon HTV-2) aircraft is a wedge-shaped plane equipped with thrusters and aero-surfaces designed to provide control during hypersonic flight. It is built to withstand extreme heating since the flying at Mach 20 can subject it to temperatures of up to 1,900 degrees Celsius. Defense Advanced Research Projects Agency (DARPA) calls it the fastest flying vehicle ever constructed.

During the recent test flight, the flying prototype plunged into the ocean after shifting into a mode that allows it to fly Mach 20, or about 21,000 kmph. However, the test flight lasted longer than the project's first flight in April 2010. That first flight had lasted nine minutes and ended when an earlier hypersonic vehicle detected an anomaly and also crashed into the ocean.

To reach hypersonic speeds, the HTV-2 launched into sub-orbital space atop a Minotaur rocket. The vehicle then popped free of the booster and re-entered earth's atmosphere.

During the second test flight, DARPA scientists had expected the HTV-2 aircraft to use small rocket thrusters to control its re-entry and then pitch itself up to increase altitude and control. After that, the vehicle was expected to enter a long glide phase in order to perform a set of pre-programmed manoeuvring tests while flying at about 21,000 kmph.

Once those tests were complete, the vehicle was expected to crash itself into the ocean to end the mission. But during the actual flight, ground stations lost contact with the HTV-2 earlier than planned.

The rocket-launched vehicle is part of an advanced weapons programme, called conventional prompt global strike, which is working to develop systems of reaching an enemy target anywhere in the world within an hour.

"More than nine minutes of data was collected before an anomaly caused loss of signal," DARPA officials explained in a statement. "Initial indications are that the aircraft impacted the Pacific Ocean along the planned flight path." SP

PHOTOGRAPH: DARPA

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HAWKER

SET *to* TAKE OFF

PHOTOGRAPHS: DASSAULT AVIATION, CESSNA, BOMBARDIER & GULFSTREAM

According to the US consultancy Firestone Management Group, there were 136 business jets registered in India as on March 15 this year, 95 of which were less than ten years old. In the past 36 months alone, no fewer than 43 aircraft have been delivered to Indian customers, representing an impressive growth rate of 46 per cent.

By **Joseph Noronha, Goa**

WHEN BUSINESS JET MANUFACTURERS are down in the dumps they throw open their windows and look 'East' because that's where all the sunny news is coming from. The traditional markets of North America and Europe offer little cheer. Western businesses are grappling with the ever-present threat of double-dip recession and have neither the inclination nor the time to place fresh orders for jets. Although business aviation is now a key part of the global aerospace industry, Richard Aboulafia, Vice President Analysis with Teal Group Corporation, the US-based aerospace consultancy, says, "Business aircraft have been hit harder by the economic downturn than any other aerospace market." And what is striking is that even amongst business aircraft the pain is not evenly shared. The top half of the market—jets priced at $26 million

(₹117 crore) and above—managed to grow over the last three years, albeit at an unimpressive 1.5 per cent. But the bottom half of the market—jets costing $4-25 million—dropped by a devastating 57.1 per cent. Naturally, therefore, Embraer, Cessna and other business jet manufacturers have prudently cut low-end production rates. At least the market has stopped falling and is expected to look up again next year. And in China and India, both huge and growing economies, the potential for new business jet sales seems as strong as ever.

SPREADING WINGS

Indian entrepreneurs flush with rising revenues are now aspiring to extend their empires ever more widely. And business jets are their tools of choice. Till a few years ago, the demand for jets was mainly from the super-rich. In 2003, there were just about 350 private aircraft in the country. But now, with the total number hitting 650, business jets are seen less as status symbols and more as "must have" to ease pressure and save precious time for senior management. Even some middle level firms in Tier-2 and Tier-3 cities are seriously studying their business aviation options.

India's private aircraft fleet is still dominated by helicopters—about 375 of them. However, according to the US consultancy Firestone Management Group, there were 136 business jets registered in India as on March 15 this year, 95 of which were less than ten years old. In the past 36 months alone, no fewer than 43 aircraft have been delivered to Indian customers, representing an impressive growth rate of 46 per cent. Hawker Beechcraft tops the table with 35 private jets—26 per cent of the total. Cessna is second with 31 jets, Bombardier's tally is 24; there are 17 Dassault Falcon jets and Gulfstream Aerospace accounts for 15. Bringing up the rear, Embraer currently has nine, Boeing three and Airbus two business jets in India. According to Karan Singh, Vice President, Business Aviation Association of India (BAAI), "India is poised to be among the top five private aviation markets in the world. Even assuming a modest 12.5 per cent growth, which is less than the average achieved in the last five years, India will triple its fleet of private jets by 2020." By then there will be an estimated 1,800 private aircraft in the country.

Why are businesses so keen to acquire jets? The story of what happened to spur business aviation in North America and Europe is now being repeated in India. Strangely enough, one of the main reasons is that commercial flights are by and large limited to metropolitan areas and large cities. Infrastructure is not always available for big jets in the hinterland and connectivity between many smaller cities is not good. If business people wish to save time on travel (and they always do) their only option is to use private planes. The Airports Authority of India (AAI) is making determined efforts to upgrade the existing airports and establish new ones but its progress has been steady, rather than spectacular. For many years to come, the majority of airports in the country will only be accessible by smaller aircraft flown by regional carriers and private operators. That is why India is predicted to be among the top markets for business jets within a decade or two ahead.

The factors driving the growth of business aviation are not restricted to the country. Many Indian companies are spreading their wings to Africa and Eastern Europe and have to contend with unsatisfactory air connectivity to and within those regions as well. What could be more convenient than a corporate jet? And Indian companies can afford to buy, especially since jets are proven productivity-enhancing tools. There's also a growing demand for private jets from state governments which feel the need to stay connected even to their remotest regions.

Is cost a constraint? Far from it. For short flights, a very light jet like the Cessna Citation Mustang costing $3.1 million (₹14 crore), or Embraer's Phenom 100 going for $3.9 million (₹18 crore) are favoured by private owners and small businesses. They do well for short flights within the country or even to Singapore or the Middle East. However, a larger business jet is ideal for bigger companies and charter operators contemplating long-haul flights to Europe or North America. While the Bombardier's midsize Learjet 60XR costs $14.1 million (₹64 crore), the super-midsize Hawker Beechcraft 4000 bears a price tag of $22.9 million (₹103 crore). In the ultra-

VARIETY ON OFFER: DASSAULT'S LATEST FALCON 2000S; CESSNA'S VLJ MUSTANG - VERY DYNAMIC JET

COST NOT A CONSTRAINT: BOMBARDIER MIDSIZE LEARJET AND GULFSTREAM G550

long-range category, there's the Dassault Falcon 7X costing $48.6 million (₹219 crore). In fact, there's a variety of jets on offer, from the cheapest to the most expensive—about 60 models—going right up to the Airbus A320 Prestige that any major industrialist can own for a cool $85 million (₹383 crore). Perhaps 40 per cent of the private aircraft being bought in the country are new and the rest are pre-owned. India's army of billionaires and millionaires is also growing. According to Forbes' 2011 list, the country has 55 billionaires in dollar terms, the fourth highest number in the world. Although China has twice as many billionaires (115), India has almost twice the number of private jets. A recent study by global consultant Deloitte Centre for Financial Services predicts that the number of millionaire households in India will grow from 2,86,000 to 6,94,000 between 2011 and 2020—a growth of 143 per cent. That means many more potential customers for private jets.

FLYING ACROSS THE SPEED-BREAKERS

Could infrastructure and regulatory issues spoil the party? Less than 150 airports across the country can take business aviation aircraft and their facilities are hardly up to scratch. Despite owning their jets, travellers have to cope with all the hassles and delays that beset India's commercial airline terminals. Ground handling options are limited and expensive, while parking cannot be obtained for love or money. Some charter operators even prefer to undertake ground handling by themselves. Full-service fixed base operators (FBOs), valued in business aviation circles for providing a host of important services, are non-existent. Only limited-use FBOs are available, more in the nature of VIP lounges.

However, the soaring fleet of private jets is beginning to compete with commercial flights for the attention of airport operators and a few airports are keen to develop suitable general aviation (GA) infrastructure. Delhi's Indira Gandhi International Airport opened an FBO last year. It also plans to build an enhanced general aviation apron and upgrade its aircraft maintenance facilities. Recently, Mumbai's Chhatrapati Shivaji International Airport became the first in the country to start dedicated international operations from its existing general aviation terminal. This enables international travellers to skip the long immigration and security queues seen at the scheduled terminal. Cochin International Airport also plans to set up a dedicated terminal for private jets.

Indian business aviation still operates in a difficult regulatory environment. According to Kapil Kaul of the Centre for Asia Pacific Aviation (CAPA), the regulatory framework in India is meant for scheduled aviation and due attention is not being paid to the general aviation sector. Private aviation compliances are treated on par with those of scheduled airlines, so obtaining an operator's permit or buying a corporate jet is a long-drawn process that can take three to six months depending on the quantum of paperwork and permissions involved. It takes time even to get a simple no objection certificate (NOC) from the civil aviation authorities. Finance is accessible only if approval has been obtained from the Reserve Bank of India, a complicated process in itself. All this prevents many purchases from going through. If the jet does finally fly in, it has to contend with hefty customs duty, service tax, and tax on fuel. However, experts acknowledge that Central and state governments are gradually becoming more business aviation friendly. The BAAI has pledged to work closely with the authorities to find viable solutions to the contentious issues.

And all major manufacturers are optimistic about growth prospects. Cessna, which has a citation service centre at Hosur near Bangalore, plans to create another. Hawker Beechcraft is setting up a service centre in Mumbai, to add to its existing one in Delhi. Gulfstream says it is selling aircraft across its product spectrum and feels that long-range jets in particular will be in demand as businesses here spread globally. Embraer believes that India is one of the few countries in the world where its full-range of products finds takers.

"The growth opportunity for private jet manufacturers to deliver their products into India is tremendous," says Firestone's Managing Director Justin Firestone. "As the world's largest democracy, the second most populous country and one of the fastest growing major economies, the quantitative data indicates India is clearly embracing the need for safe and efficient business jet travel." India is projected to be the sixth largest economy by 2020 and the second by 2050. That is why BAAI's Karan Singh claims, "If we get the ingredients right, today represents just the tip of the iceberg." SP

LOOKING AHEAD

Private aviation prepares for long-term growth in India. Dassault Falcon expresses confidence as conditions for the industry develop.

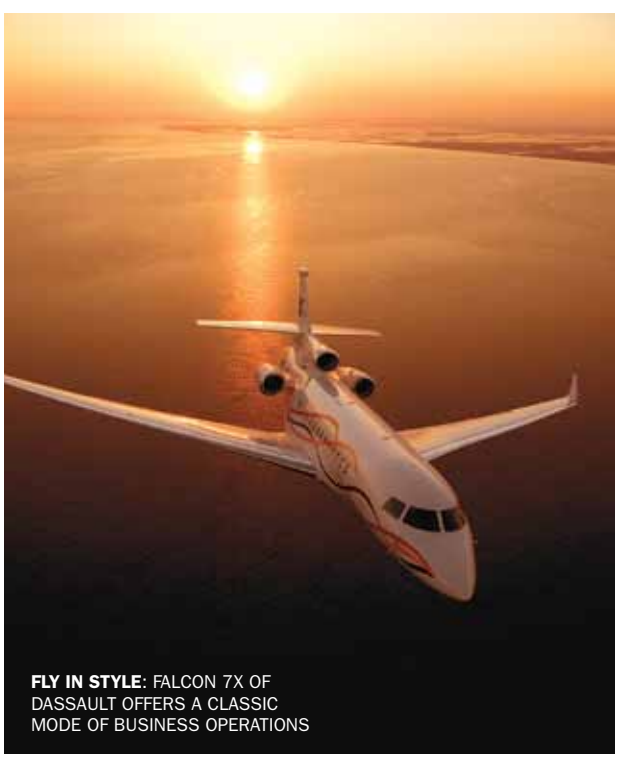
JOHN ROSANVALLON
President and CEO of Dassault Falcon

THE DEVELOPMENT AND HEALTH of business aviation correlates strongly with the economic development of a country, but it also plays a role in driving higher business activity and competitive performance. In India, private aviation is poised to expand significantly as the economy continues to prosper.

Our vision for the Indian business aviation market over the long term—15 to 20 years—is very positive based on a number of fundamentals being put in place. India's economy is growing at a very high rate planting seeds for a fast rise in high net worth individuals and sustained profits for corporations. As companies invest and expand, it is natural to find them using the most efficient and competitive way to travel—business jets. We have already seen significant business aviation activity in India and increased investment in the vital infrastructure necessary to support safe and reliable operation of business. Dassault, for instance, already has two offices in the country, with technical representatives and marketing activities, authorised service centres and a spares depot.

It is important that the fledgling private aviation industry in India organise itself and so we warmly welcome the formation of the Business Aircraft Operators Association (BAOA). The BAOA will be a strong advocate for further growth of the sector and will highlight the needs of its operators. It will help set high standards of safety, efficiency and professionalism, through the close cooperation of all its members.

Another important factor is the support of the government through the modernisation of airports, and the easing of regulations to encourage business aviation and private aircraft ownership and operations.



FLY IN STYLE: FALCON 7X OF DASSAULT OFFERS A CLASSIC MODE OF BUSINESS OPERATIONS

We can already see the positive impact of these activities in India. In the 1990s, there were only a handful of large cabin aircraft registered in the country. In 2010, India saw its largest rise in new aircraft registrations. Dassault Falcon currently has more than a 60 per cent share of the market for premium large cabin/long haul business aircraft and we expect the fleet to double in the next few years. Falcon aircraft are especially valued in India for their performance and their efficiency. They offer economical operation and environmentally responsible performance.

A vibrant business aviation sector is vital for the development of India's broader economy, to create access to more remote areas of the country in comfort and security. Dassault is playing its role with a long-term commitment to building our presence in the country, through new services and strong customer support. In a country which could offer the potential for 100 Falcon aircraft sales over the next 15 years, there is clear justification in our confidence and in committing the company to further expansion in India. SP

PHOTOGRAPHS: DASSAULT FALCON

IMMENSE LONG-TERM POTENTIAL

The Indian aviation industry is strong and vibrant, and we are excited about the future

JASON AKOVENKO
Regional Vice President,
Asia/Pacific, Gulfstream Aerospace Corporation

A LEADER IN BUSINESS AVIATION, Gulfstream designs, develops, manufactures, markets, services and supports the world's most technologically advanced business-jet aircraft. The company has been selling business jets worldwide since 1958 and has been active in the India market since the mid-1980s.

The Gulfstream fleet in Asia-Pacific has grown dramatically over the past decade. It is especially true in India, where the number of Gulfstream aircraft has grown from five in 2001 to 21 in 2011. The Gulfstream fleet includes the entry-level wide-cabin, high-speed Gulfstream G150; the super mid-size G280; the large-cabin, mid-range G350; the large-cabin, long-range G450; the large-cabin, ultra-long-range G500 and G550; and the ultra-large-cabin, ultra-long-range much-anticipated Gulfstream G650.

Gulfstream's G550 is one of the most popular aircraft in India. Powered by enhanced Rolls-Royce BR710 turbofan engines, the G550 has a range of 6,750 nm (12,501 km) at Mach 0.80 and a high-speed cruise capability of Mach 0.87. With its long legs, the G550 easily links Washington, D.C., with Dubai, London with Singapore and Tokyo with Paris. The Gulfstream G550 has the best overall cabin in its class with the longest floor space, largest baggage area that is fully accessible in flight, and the best overall environment. The G550 is renowned for its technologically advanced design and was awarded the National Aeronautic Association's Robert J. Collier Trophy, the most prestigious aviation award in the United States.

BEST OF THE BEST:
G550 IS ONE OF THE MOST POPULAR JETS IN INDIA. IT OFFERS BEST OVERALL CABIN IN ITS CLASS AND IS RENOWNED FOR ITS TECHNOLOGICALLY ADVANCED DESIGN

Gulfstream sees immense long-term potential for India's growing roster of business entrepreneurs with operations within India and beyond. Many rely on Gulfstream to help them move rapidly across continents to maximise speed, productivity and flexibility in today's competitive global market.

Over a quarter century, Gulfstream has earned a reputation as the preferred provider of private jets to many of the country's business leaders. The Indian aviation industry is strong and vibrant, and we are excited about the future. Gulfstream continues to expand its commitment in the country by significantly increasing marketing and product support activities to serve our customers.

In addition to manufacturing the world's most advanced business aircraft, Gulfstream has the world's number one support organisation and a total workforce of more than 3,300 employees standing behind it. Gulfstream aircraft are supported by Airworks India, with parts provided from major supply bases in Madrid, Dubai, Hong Kong and Singapore. In addition, the company recently named Arrow Aircraft Sales and Charters Private Limited, a professional business-aviation service provider, as its in-country authorised independent sales representative. SP

For further information, please visit: www.gulfstream.com

PHOTOGRAPHS: GULFSTREAM

FIT FOR INDIA

Hawker and King Air have been operating in India for decades so the operators can draw from an experienced pilot and engineer pool along with generally good availability of spares

DANIEL KEADY
Vice President-Sales
South Asia-Pacific/India, Hawker Beechcraft

HAWKER BEECHCRAFT CORPORATION (HBC) has been selling aircraft in India for over 60 years. India is and will continue to be integral to our international strategy as a company.

The *Asian Wall Street Journal (AWSJ)* recently reported India now has 55 billionaires that control nearly $250 billion in wealth. According to the *AWSJ* article if you compare this to China, China has 115 billionaires that control $230 billion in wealth, so as a percentage of GDP India would be higher. All of this points towards strong growing economies and this environment generally fuels business aircraft sales.

India has had a long history with general aviation and with the recent rapid gains in personal wealth, desire for individuals to better manage their time and the continued broader acceptance of aircraft being a business tool, we only see upside for corporate aviation in India.

As for the HBC products both the Hawker and King Air range, are a great fit for the Indian market. The King Air with its economical operating costs and great short field performance and the Hawker with its full seats full fuel capability. Both products have been operating in India for decades so the operators can draw from an experienced pilot and engineer pool along with generally good availability of spares. SP

WINNER ALL THE AWAY: THE FIELD PERFORMANCE OF THE NEW HAWKER 4000 IS IMPRESSIVE AND BEST IN CLASS IN THE SUPER-MIDSIZE CATEGORY

PHOTOGRAPHS: HAWKER BEECHCRAFT

Unsafe & Insecure

INDIRA GANDHI INTERNATIONAL AIRPORT: UNLIKE AT T3 WHERE THERE IS TIGHT SECURITY, SMALLER AIRPORTS ARE NOT SAFE

While security arrangements at the metros are visibly and oppressively stringent, smaller airports have comparatively lax structures and setups for security. A determined offender could get potentially dangerous material into the airside, which could also be flown into a metro.

By **A.K. Sachdev**

ALLIANCE AIR, AN INDIAN Airlines subsidiary, was introduced in 1996 with the objective of serving the regional air travel market; it failed to meet that objective as its fleet (mainly Boeing 737s) was not only ill-equipped to operate in regional airports, but also not suited for short haul flights. In addition, its four ATR aircraft could not be pushed for service elsewhere, as they were positioned to serve the Northeast market. When the second Indian aviation boom began in 2003, the Indian concept of regional aviation, an adapted mutation of the hub-and-spoke model, was again mooted as a response to the wanton proliferation of airline routes connecting big cities at the cost of neglecting the rest. In 2007, the Director General of Civil Aviation (DGCA) introduced a regulatory mechanism for promoting "air connectivity between specific regions and to enable more efficient air travel within the region, as well as linking such regions and expanding air travel services for Tier-2 and Tier-3 cities within the country's aviation network". The airports at Delhi, Mumbai, Kolkata, Chennai, Bengaluru and

PHOTOGRAPHS: WWW.WORLDISROUND.COM & SANDIP4ANGEL

Hyderabad were formally declared as "metros". The various "regions" were identified as North, South, West, East/North-east coinciding with the Flight Information Regions (FIRs); the airports in a particular region were those enumerated by the Airports Authority of India (AAI) for the respective regions. The laudable objective of providing connectivity to smaller cities and towns has, however, not been achieved in the four years since the promulgation of the policy. The single major reason for this has been the lack of adequate airports with the support infrastructure necessary for the sustenance of efficient operations safely. This article appraises the safety aspects of regional aviation in India.

AVAILABILITY OF AIRPORT DATA

The first concern that comes to mind is the suitability or otherwise of many of the non-metro airports for regular and sustained operations. Of the over 500 airports in India, only 44 in the public category and 16 in the private one are licensed by the Directorate General of Civil Aviation (DGCA) for operations. The qualitative difference that may exist between licensed and unlicensed airports is open to debate. After all, airports were in use for operation by civil aircraft much before the licence regime was introduced by DGCA. However, the issue here is that there is no guarantee that unlicensed airports meet the minimum theoretical standards of safety prescribed by DGCA. By extension of the logic, DGCA cannot at any time authenticate the suitability or otherwise of some of the airports although all airports are available to any operator for use for scheduled operations or diversion in case of bad weather or for other reasons. While AAI has published details of airports operated by it all over India, it is almost impossible to obtain an authenticated all inclusive list (including privately operated) of airports in India. Updated information on contact details, leading particulars of runway(s) and manoeuvring areas, navigational aids and watch hours, etc is thus not available to aircraft operators.

While the metros are generally under scrutiny of DGCA officials transiting through as also through regular audits, the infrastructure related problems at smaller airports often elude attention and opprobrium. Their shortfall could include runway and manoeuvring area surface condition, serviceability and reliability of airfield and runway approach and landing aids, runway incursions due to inadequately sterile perimeter walls/fencing, insufficient crash and fire fighting services, scant medical support services, poor tarmac discipline especially on the part of vehicles plying on the airside and so on. Even when unserviceability and breakdowns are reported at small airports, the priority accorded to the necessary repairs would always be lower than that at the metros.

LIMITATIONS OF DGCA

The DGCA, working at a sub-optimal efficiency due to a shortage of suitably qualified and trained personnel, is incapable of ensuring that every airport in use measures up to the stringent requirements for supporting aircraft operations. It may be said in DGCA's defence that it does have the intent but lacks the capability in this respect. According to one report, of the total 997 posts in the DGCA, 437 are not filled as of now. The Ministry of Civil Aviation (MoCA) is trying to ensure that vacancies are filled up soon and has taken up the matter with the Union Public Service Commission (UPSC). However, the actual recruitment process is taking inordinately long. Some more time will be lost in the process of training new incumbents for the job descriptions they are hired for. Meanwhile, the oversight of the non-metro airports continues to be at a low level.

There is also the issue of security infrastructure at smaller stations. While security arrangements at the metros are visibly and oppressively stringent, smaller airports have comparatively lax structures and setups for security. Thus, while getting access to the airside of a metro is well nigh impossible for a mala fide individual, there is another stratagem available to beat the system. On a smaller airport, where security is not so rigorous, a determined offender could get potentially dangerous material (explosives, incendiaries, weapons) into the airside. Once through the security gate and on the airside, the material could be used to cause damage to aircraft on the ground or in the air. In an even more chilling scenario, the material could be flown into a metro and used against aircraft there. This modus operandi would be of special interest to the terrorist whose main aim is to inspire terror through maximum visibility. The attention that a terrorist organisation would get at a metro would be much more than at a small regional airport which would have provided the gateway for the terrorist act at a metro. The situation in this respect is unlikely to be redressed in the near future as the Central Industrial Security Force (CISF), the primary agency responsible for airport security, is woefully short of manpower and does not seem to be in a hurry to get its numbers up to the strength required to man all airports, metros and regional, with the required degree of assurance.

> As long as the DGCA continues to work at its present subsistence level personnel strength, any additional airports added on at the "regional"level would represent incremental potential for infarctions of flight safety

AIR SAFETY IN THE NORTHEAST REGION

A special mention needs to be made of the Northeast region in the context of flight safety. The terrain is largely mountainous; the climate unkind to flying activities for a substantial part of the year, and the terrain around the few airports in the region treacherous as evidenced by the recent accident involving a charter aircraft that overshot the runway it was landing on. Diversionary airports are few, unlike in the plains. Radio communication can be affected by interceding contours. The same

would have been the case with radars had there been radars in the region. However, the radar coverage is inadequate for the existing and gradually expanding aviation activity in the region. As a result, regional aviation activity in the Northeast remains stunted and whatever activity does exist or has existed for the past few years, has had a more than proportionate share of accidents and incidents to highlight the safety aspects of flying in the Northeast.

THE WAY AHEAD

Regional Airport Holdings International Limited (RAHI) has announced a unique business model comprising aviation infrastructure, air services and geo-specific industry clusters to make regional aviation viable for private investment. It has plans to invest ₹3,000 crore ($650 million) in over 15 aviation infrastructure and services projects. RAHI has a three-pronged strategy for regional aviation, specifically in Tier-1 and Tier-2 cities in India. RAHI will not only develop airports and associated infrastructure but also have ITS own regional airline that will serve Tier-2 and Tier-3 cities. The government has also sporadically declared the intention to get all 500-odd airports in the country operational. In a bid to encourage regional aviation, it has also eased some of the stringent conditions the original policy had imposed. According to the changed norm, a new regional airline will need to reach a fleet size of three aircraft within two years instead of the earlier stipulated one year. In addition, only by the end of five years it would be required to operate five aircraft against the earlier deadline of two years. These moves are expected to provide fresh air to the stifled regional aviation growth in India. However, providing these sops are perhaps not the only step needed. Also required are steps to bolster the infrastructure and support systems that would enable, encourage and nourish safe and efficient aviation at the regional level. There is also the issue of whether DGCA would be able to extend the area of its surveillance and audit activities to include the large number of smaller airports that get added on to the present list of operational and active airports. The context here is of monitoring flight and ground operations of the aircraft operators which is different from the issue of scrutinising the health of airports for operations discussed earlier. On both these counts, as long as the DGCA continues to work at its present subsistence level personnel strength, any additional airport added on at the "regional" level would represent incremental potential for infarctions of flight safety. SP

Regional aviation activity in the Northeast remains stunted and whatever activity does exist or has existed for the past few years, has had a more than proportionate share of accidents and incidents to highlight the safety aspects of flying in the Northeast

HUMONGOUS Ascent

All in all, the civil aviation sector is the 'sunrise sector' as the Secretary of Civil Aviation has stated, with a potential of $150 billion investments in the next decade. The opportunities are huge and so are the challenges.

By **R. Chandrakanth**

AS THE INDIAN CIVIL aviation sector celebrates its centenary year, the year 2011 has been marked by milestones as the Indian skies continue to open up at an astounding pace. The airlines have led the growth story, albeit a couple of them are strapped for various reasons. Grabbing global headlines was IndiGo when it ordered 180 airplanes and a fledgling GoAir followed suit by picking up 92, both from Airbus. In December 2010, SpiceJet had placed an order for 15 Bombardier Q400 (with options for 15).

The 'plane rush' has not been surprising at all as Asian carriers have just started biting into the prospects that lie within the region first and elsewhere later. At the Paris Air Show 2011, Air Asia, a low-cost airline from Malaysia, made history of sorts by ordering 200 Airbus aircraft. Incidentally, Air Asia within a span of five years since its operations has connected to seven Indian cities with plans for more.

There are at present 11 scheduled operators including two cargo airlines (Table 1) with a total fleet of 429. Paramount Airways has been totally grounded, mired in legal battles, while Air India continues to be in a mess. It has forecast a loss of ₹6,994 crore for 2011.Though it has been in a restructuring mode with the government infusing equity of ₹800 crore during 2009-10; ₹1,200 crore in 2010-11 and ad hoc equity of ₹710 crore this year, the national carrier has not been able to regain its glory of the "Maharaja" days. Recently, with pressure building up from employees and other quarters, the government appointed Rohit Nandan as Chairman and Managing Director in place of Arvind Jadhav.

Be that as it may, airlines are busy acquiring aircraft in consonance with the demand. Boeing India President, Dinesh Keskar said the company forecasts a $150 billion market for 1,320 new passenger airplanes in India over the next 20 years as the economy aims for double-digit growth, stimulating strong demand for new and replacement aircraft.

What is driving such growth? The most visible is the increase in airline passenger movement as spending power is going north. In the first five months of 2011, airlines carried 24.5 million passengers, registering 17.6 per cent growth over the previous year. In the matter of a decade, passenger movement has been spectacular from 175.39 lakh in 2000-01 (plane load factor of 68.6 per cent) to 569.45 lakh in 2009-10 (plf of 71.5 per cent). Though the growth of freight not been commensurate, it has expanded from 59.385 tonnes to 3,60,297 tonnes (Table 2). The trend continues and India should be moving up the ranking within top five aviation markets in the coming years.

TABLE 1: TOTAL FLEET OF INDIAN OPERATORS

Airlines	Fleet
Air India (including Air India Charters & Airline Allied Services Ltd)	161
Jet Airways (including JetLite)	108
Kingfisher	66
SpiceJet	30
IndiGo	42
GoAir	10
Blue Dart	7
Deccan Cargo	5
Total	**429**

PHOTOGRAPHS: SP GUIDE PUBNS

At a conservative growth rate of 10 per cent, the throughput in 2025 is expected to be around 540 million passengers. The middle class is burgeoning and to use Air Asia's catchline, now 'Everyone can fly'.

The humongous growth has been on several fronts. Airport infrastructure development is happening at a considerable pace. As per the Airports Authority of India (AAI), from 50 operational airports in 2001, there are now 85 operational airports including 17 international airports and 11 are under the AAI. The AAI has embarked upon a modernisation programme of 35 non-metro airports as new sectors are adding to airline growth. The government has plans of developing 18 Greenfield airports. The hinterland is getting connected and that augurs well for economic development.

Around the same time, the government has announced incentives for those starting regional airlines. SpiceJet is all set to launch the service with Hyderabad as its likely hub. Also Chennai-based Air Dravida will soon be connecting 13 cities, all in South India, over a period of time. Regional airlines are eligible for concessions including tax on fuel which would come as a major relief, as currently the airline industry is grappling with escalating fuel costs which accounts for nearly 40 per cent of the operational costs.

Aircraft manufacturers are looking at new engine designs and technologies, which will drive efficiency. Not just the two major aircraft manufacturers, Boeing and Airbus are leading the technology developments, working on airframes, engine, etc to primarily increase fuel efficiency. The latest versions of narrow body aircraft promise at least 15 per cent less fuel consumption and airlines are re-jigging their strategies.

CONNECTING INDIA

While domestic airlines are buoyant, so are international airlines operating in and out of India. The government, according to reports, has signed 'air services agreements' with 108 countries. In 2004-05, 59 foreign airlines were flying into India, now nearly 80 foreign airlines from over 50 countries operate to and from India. International flights deployed by foreign carriers were 711 services per week in the winter of 2004-05, which increased to 1,315 services per week in the summer of 2009, an increase of 85 per cent. Correspondingly, the number of passengers has shot up from about 14 million to 27 million to/from India, a growth of 90 per cent. No wonder, there is a rush to connect India.

Many airlines from the Middle East and South East Asia have expanded aggressively into India in the recent past. Qatar Airways has the distinction of connecting 12 cities in India, followed by Air Arabia (11 cities), Emirates and Singapore (10 each); Air Asia (seven cities), not to forget the consolidation of operations by the long established players such as Lufthansa, British Airways, Air France, etc. The major markets for international traffic to/from India are the Middle East, West Asia, South East Asia, UK/Europe and USA. A liberalised tourist charter guideline has also helped boost traffic to places such as Goa, Kerala and the Golden Circuit.

Indian carriers operate to 27 countries and this is likely to go up as the government is relaxing rules for international operations. The number of seats per week available to Indian carriers from the bilateral treaties has increased from 2.5 lakh in 2004 to over seven lakh in 2010, growing at CAGR of 14 per cent.

TABLE 2: ANNUAL TRAFFIC (DOMESTIC AND INTERNATIONAL) OF ALL INDIAN CARRIERS

Year	Passengers carried	Passenger load factor	Freight (Including mail) tonnage
2000-01	1,75,39,916	68.6	2,68,019
2001-02	1,65,52,360	62.2	2,58,085
2002-03	1,81,51,799	64.8	2,83,314
2003-04	2,01,69,524	65.5	2,95,188
2004-05	2,47,71,264	68.4	3,57,308
2005-06	3,17,52,173	68.3	3,68,660
2006-07	4,33,53,973	68.4	3,90,115
2007-08	5,34,92,771	67.7	4,45,466
2008-09	4,95,16,433	64.7	4,51,700
2009-10	5,69,48,624	71.5	5,47,067

Source: DGCA

FREIGHT EXPANSION

While passenger growth has been unprecedented, cargo has lagged behind, albeit a tardy upward movement. India's cargo volume is much less than that of leading airports in the world. As per Airports Council International, Mumbai is ranked 30 whereas Hong Kong is the top airport for cargo handling in 2010. Airports such as Incheon in Korea; Shanghai, Dubai and Singapore are among the top 10 with regard to both passenger as well as cargo movement.

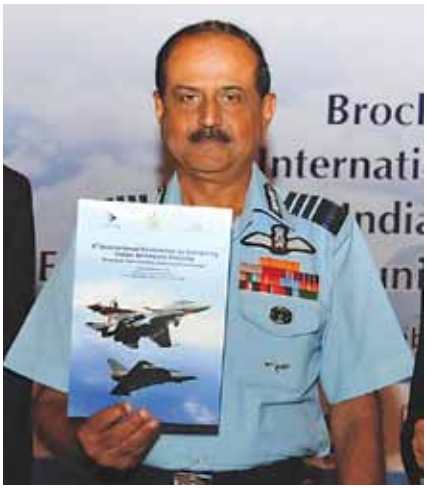
New players are entering the logistics business and much is expected of the MIHAN project in Nagpur, which hopes to boost not just domestic but also international trade with good connectivity. The potential to grow is huge here and several international cargo companies have started operations to capture the market. A recent entrant is TNT NV of Netherlands which has a freighter between India and Europe.

NASCENT MRO MARKET

As the carriers are expanding, there is a growing need for maintenance, repair and overhaul (MRO) industry within the country as going overseas for repair has become prohibitive. The Aeronautical Society of India has projected the MRO market to grow from less than $1 billion (₹4,500 crore) to about $2.6 billion (₹11,700 crore) by 2020. With such potential, there is growing interest by leading MRO players of the world. Boeing has a project coming up in Nagpur; Lufthansa Technik is operating out of Bangalore; Max Aerospace has tied up with Air France Industries; GMR has tied up with Malaysia Airlines for the MAS GMR Aerospace Engineering, etc.

All in all, the civil aviation sector is the 'sunrise sector' as the Secretary of Civil Aviation has stated, with a potential of $150 billion investments in the next decade. The opportunities are huge and so are the challenges. The civil aviation sector has to comprehensively address issues of airport infrastructure, regulatory mechanisms, foreign direct investment, funding, no-frills model, night landing facilities, heliports, etc, if India has to position itself as a global hub. SP

a NEW ERA *in* MAKING



Speaking at the curtain-raiser of the Sixth International Conference on Energising Indian Aerospace, Air Chief Marshal N.A.K. Browne cautioned the Indian aerospace industry against over dependence on foreign inputs

INDIAN AEROSPACE STANDS AT crossroads, ready to usher in a new era of research and development (R&D), said Chief of the Air Staff Air Chief Marshal N.A.K. Browne. He was speaking at the curtain-raiser function of the Sixth International Conference on Energising Indian Aerospace, held in New Delhi on September 2. A joint effort of the Indian Air Force (IAF), the Centre for Air Power Studies (CAPS) and the Confederation of Indian Industry (CII), the function was attended by senior officers of the IAF, Ministry of Defence (MoD), Defence Research and Development Organisation (DRDO), representatives of Indian and overseas industries, etc.

Describing the event as "a trailer on the shape of things to come in Indian aerospace," ACM Browne reiterated the key role of the industry in energising Indian aerospace. He, however, cautioned the industry against overdependence on foreign inputs. "For when the time comes, we'll have to ask our own industry to provide the necessary life cycle support to aircraft and equipment."

Later, in an interaction with the participants, he talked of the importance of R&D in securing the future of India's aerospace. Responding to *SP's* Editor-in-Chief, Jayant Baranwal, who wondered if R&D in India could be expanded beyond the DRDO, ACM Browne said, "While defence industry players in India like L&T and Mahindra have just entered the field, defence public sector undertakings (DPSUs) have a crucial role in helping DRDO augment its programmes. This will help resolve the life cycle support "disconnect" between DRDO and local players. And since funds for R&D are not easily available, it is up to the PSUs to ensure that at least 15 per cent of allocation goes for R&D. This is important if things are to move faster."

Brushing aside criticism that things move too slowly in India, he said the comparison of India's efforts to energise its aerospace sector by building a strong R&D base with that of China does not make sense. "Our system of doing R&D is very different from the Chinese way of doing things," he quipped. "Here in India, we do make haste, but slowly." If China's aerospace industry had developed quickly it is because "they don't attempt to do everything themselves." It is not uncommon for the Chinese to borrow technology, rather than spend several years on R&D. "After leapfrogging technology, they set up licence production very quickly as well," he said. "Their 'democratic' system allows this, unlike ours, which is not a party or state-driven effort." The Chinese are used to exploiting international industrial alliances to leapfrog technological gaps and boosting export revenues from the country's military industrial complex.

"Today's modernisation is tomorrow's readiness," he said, stressing the need for building infrastructure and capacity to absorb R&D. "The IAF is the most capital-intensive of the three services. So modernising it is not easy," he said. "But then this is the price we have to pay for national security. We cannot rely on the original equipment manufacturers (OEMs) alone, as a robust industry is imperative for extending logistic and life cycle support for our aircraft and equipment." He urged all players to consider a 'cradle-to-grave' period of at least 40 years. This can be done only with regular exercises like mid-life upgrades, for which OEMs and foreign partners are essential.

Noting that the government has shown "a certain amount of willingness to move forward" on suggestions along these lines, ACM Browne said, "We must capitalise on this with the help of the CII. For example, the government policy on double taxation stands in the way of progress. The CII must use its own pressure points to help clear such hurdles. We'll replace aircraft as necessary, buying from outside OEMs and building them here. Take, for example, a model of the Avro HS 748 proposed by the IAF. Its engine and airframe account for 60 per cent of the funds, leaving the rest to cover avionics, etc. This model involves licence production, particularly with foreign companies, and can set an excellent example not just for the IAF, but for the whole country. Given that R&D plus OEMs need an industrial base, it is good that the Ministry of Defence (MoD) is actively considering this proposal." SP

—By Prakash Chandra

PHOTOGRAPH: CII

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C-17: FIRST FLIGHT ON SYNTHETIC BLEND FUEL

MILITARY BLENDS WITH CIVIL

So sensitive has the civil aviation sector been to accusations as the environment polluter that it is increasingly launching research programmes and taking all possible steps to bring about reduction in the rate of fuel burn to ensure greener aviation

By **Air Marshal (Retd) V.K. Bhatia**

WORLDWIDE, THE AVIATION SECTOR has always been at the receiving end as the main culprit for causing environmental imbalances leading to 'global warming', even though it produces only a fraction of the greenhouse gas (GHG) with adverse effect on the earth's environment. At the turn of the century, the Inter-governmental Panel on Climate Change (IPCC) reported that, globally, directly fuelled transportation accounted for 14 per cent of carbon dioxide (CO_2) emissions into the atmosphere, but overall, aviation—all of it—accounted for just two per cent. The alarmists did revise this figure to around five per cent later on, but it is evident that culpability quotient of the aviation sector remained miniscule compared to the bigger defaulters such as surface transportation and the industry.

Whatever the case may be, it goes to the credit of the aviation sector which responded whole-heartedly to the challenges of global warming, by developing improved airframe/engine designs, to achieve time-bound targeted fuel efficiencies. There has been concerted effort both by the airframe as well as aero-engine manufacturers to redefine their strategies to bring about the necessary improvements. But the quest for 'greener' aviation does not end here. There are other related fields requiring concerted efforts, such as perfecting air traffic management to save fuel and also intensifying efforts to search for alternative fuels which give better thermal efficiencies and reduce 'emissions'.

CIVIL AVIATION: ON THE FAST TRACK

So sensitive has the civil aviation sector been to accusations as the environment polluter that it is increasingly launching research programmes and taking all possible steps to bring about reduction in the rate of fuel burn to ensure greener aviation. Airbus, for example, is promising up to 15 per cent fuel-burn improvement in its 'neo' (new engine option) featuring the Pratt & Whitney PW1000G PurePower high-bypass GTF (geared turbofan) engine as the lead development engine — due to enter service in 2015 (the Indian

PHOTOGRAPHS: SAFRAN GROUP, USAF & GE AVIATION

LCC IndiGo has ordered these in substantial numbers) — and CFM International's Leap-X as an alternative. Delving in research involving composite materials, next-generation 3D aerodynamics and improved combustion techniques, the CFM engineers are hopeful of the Leap-X turbofan engine (certification likely in 2016) will produce 60 per cent less nitrous oxide (NO_X) and 16 per cent less CO_2 than the present generation CFM56 engine.

In fact, there is no dearth of new initiatives being taken on both sides of the Atlantic to meet the 'green aviation' challenges that encompass all aviation-related areas and activities. For instance, the European Union (EU) has launched the 'Clean Sky' joint technology initiative which is focused on accelerating the development of breakthrough technologies to reduce aviation's environmental impact. The public-private partnership (PPP) initiative encompasses some 86 organisations in 16 countries along with 54 manufacturers, including all leading European aviation companies, plus 15 research centres and 17 universities. Clean Sky is currently working on integrated technology demonstrators such as smart fixed-wing aircraft, green regional aircraft, green rotorcraft, sustainable and green engines, systems for green operations and eco-designs. Single European Sky Air Traffic Management Research (SESAR) is another EU's Euro 30 billion air traffic management modernisation programme, the implementation of which would ensure more efficient air traffic control, shorter routings and fewer delays and is estimated to save 16 million tonnes of CO_2 in a year.

In the US, NASA launched National Plan for Aeronautics Research and Development, which aims to reduce fuel consumption, explore alternative fuels, and research technologies and operational procedures for reducing energy consumption, noise and emissions. Then there is the Federal Aviation Administration (FAA) 'NextGen' programme to totally transform the entire American air traffic control system. The FAA portfolio consists of seven solution sets, each focusing on a series of related operational changes. These include, trajectory based operations (TBO); high density (HD) airports; flexible terminals and airports (FLEX); collaborative air traffic management (CATM); reduction of weather impact (RWI); safety, security and environment (SSE); and terminal facilities. Comparable to SESAR in Europe, the latest FAA estimates reveal that by 2018, NextGen will be able to generate $22 billion (₹99,000 crore) in cumulative benefits in the civil aviation sector, save more than seven billion litres of fuel and cut CO_2 emissions by nearly 14 million tonnes. But are all the impressive steps being taken to address the environmental issues confined only to the civil sector in aviation?

MILITARY AVIATION: JOINING THE FRAY

Did military aviation in its quest for ever-increasing operational performance (to be one up on the adversary) ever even bothered about the seemingly trivial issues such as environmental concerns? Not really. But of late, critical issues such as emerging design philosophies and national strategic/geopolitical interests plus the sheer economic burdens of air operations have started to push practitioners of military aviation—directly or otherwise—towards greater acceptance of environmental concerns. For instance, till recently, combat aircraft did not come within the ambit of noise and emis-

SYNTHETIC FUELS

The term 'synthetic fuel' could have different meanings, but according to a generally accepted definition, synthetic fuel is any liquid fuel obtained from coal or natural gas. Synthetic fuel are produced by the chemical processes of conversion; either direct or indirect. The more popular indirect method involves the source substance to initially be converted into syngas (hydrogen + carbon monoxide), which then goes through additional conversion process to become liquid fuels such as diesel, aviation jet fuel, etc. A commonly used method is called the Fischer Tropsch (FT) method developed initially in Germany between the two Great Wars.

According to a 2007 study, even a medium-scale (30,000 BPD) coal-to-liquid (CTL) plant using FT method with bituminous coal as the source substance could become competitive with oil down to roughly $55 crude oil equivalent per barrel. The inclusion of carbon capture and sequestration (CCS) process to keep within limits the GHG emissions during the manufacturing process may add another $10 per barrel. With the international oil prices hovering between $90-100 per barrel and showing no signs of climb down, this could come as real good news, especially for countries with rich coal deposits such as the US, China, and even India.

Another plus point for the synthetic jet fuel is that it is less of a pollutant compared to regular petroleum-based jet fuels resulting in a win-win situation both on the economic as well as the environment fronts—justifying the seriousness with which the USAF is pursuing these programmes. Could the defence planners in India also think on similar lines? •

BRAND NEW:
NEW GENERATION ENGINE
LEAP-X FROM CFM

TURBOFAN ENGINE: LEAP-X WILL PRODUCE LESS CO_2 AND NO_x

sions restrictions. But the stealth factor alone, which is increasingly becoming a prominent feature of all fifth generation aerial combat platforms, necessitates the new designs to incorporate these restrictions as well. Second, with the era of cheap oil to be truly over, even military aero engine makers have little choice but to pursue more fuel-efficient designs. The enormity of the financial outgo on the military can be gauged from the US example, where even one dollar upward revision in the crude oil price translates to an additional $60 million (₹270 crore) burden on the US Air Force (USAF) (admittedly the biggest practitioner of air power). Little wonder then, the USAF has been constantly searching not only for fuel-efficient technologies but also for alternative fuels to meet its huge energy demands.

In 2007, the USAF Research Laboratory awarded contracts to GE Aviation and Rolls-Royce to start developing new 'green engine' technology. Although still in the early stages, the programme involves the adaptive versatile engine technology (ADVENT) which itself is one of the several related development projects being pursued under the USAF's versatile affordable advanced turbine engines (VAATE) programme. Phase-II of the ADVENT programme commenced in 2009 with 2013 set as the year for the commencement of engine testing.

In a bid to reduce its dependence on imported oil, the USAF (biggest single user of petroleum products in the US Government) is spearheading the country's alternative energy drive. For example, before the end of the current year, the USAF aims to make sure its entire fleet of bombers, fighters, transports and other aircraft can use a domestically produced 50:50 blend of synthetic and petroleum-based fuel. Tests have already been carried out on a large number of different types of aircraft to meet the above-stated aim; and by 2016, the USAF hopes to meet half its demand for fuel using the synthetic blend. The USAF is hopeful that its huge futuristic demand of synthetic fuels will stimulate the private sector to embrace the move towards synthetic fuels which in the long run, will prove to be mutually beneficial.

With concerted multi-directional efforts, different types of alternative fuels could be produced in large quantities to supplement the fast depleting sources of natural hydrocarbon fuels. The alternatives could include renewable sources for biofuels and coal to liquid/gas to liquid (CTL/GTL) methods to produce usable fuels for aero engines. Alternate-fuelled engines whether sourced from CTL/GTL or biomass feedstock's, represent near-paraffin hydrocarbon blends with Jet A-1 or JP-8 that perform as good as or even better than petroleum-based fuels and yet produce less aviation emissions. Bulk-produced with perfected techniques, these could ultimately prove to be not only cheaper but also much 'greener'—not only in the US but eventually on a global scale.

While the USAF is taking a leadership role in this endeavour, it would also ensure that these fuels can be used by the Army, Navy and marine aircraft as well, and if that happens, can the application in the civil aviation sector be left behind? On June 20, a C-17 Globemaster III cargo aircraft of the USAF, workhorse of the US-led wars in Iraq and Afghanistan and the military's biggest user of jet fuel, flew for the first time with coal-derived (CTL) synthetic blend as the only fuel on board. The C-17 was chosen for the transcontinental test flight also because of the fact that it's Pratt & Whitney F117-PW-100 engines are similar to Boeing 757 plane, commonly used by commercial airlines. Obviously, it could have a positive effect on the entire civil aviation sector in the coming years.

In the final analysis, while the civil aviation sector may have been the initiator for a fast-track response to environmental concerns, the military aviation has also joined the fray for its own reasons; both combining very well to provide much 'greener' skies—a perfect blend. SP

FAST TRACKING

It is almost certain that irrespective of which aircraft is finally selected in the MMRCA deal, India will have to fork out close to or even more than the recurring per flyaway unit price being quoted for the F-35. The IAF could exercise its choice when it reaches the stage of replacing its current fleets such as the MiG-27, MiG-29s or the Jaguars.

By **Air Marshal (Retd) V.K. Bhatia**

UNFAZED BY THE TEMPORARY grounding of the F-35 Lightning-II, the United States Air Force (USAF) officially inducted the joint strike fighter (JSF) into service on August 26 at Eglin Air Force Base in Florida. The official unveiling of the F-35A Lightning II joint strike fighter was labeled as a "historic occasion" by Air Force officials hosting the ceremony at the 33rd Fighter Wing which is gearing up to train pilots and ground crew on the USAF's brand new fifth generation fighter. Eulogising the F-35, General Edward Rice, Air Education and Training Command Commander and host of the milestone event called it the beginning of a new era for the USAF which will eventually have 95 per cent of its combat jet fighter inventory comprising the JSF.

The Lockheed Martin led F-35 JSF programme, which has been in the making for the last 15 years, could easily earn the sobriquet of 'mother of all fighter programmes' owing not only to its magnitude or its ambitiousness, but also to the vast array of complexities connected with various phases of design and development. The JSF programme is indeed unique as it was created to replace not one but a large variety of different aircraft on the inventories of the US armed forces with derivatives of just a single type. The F-35 JSF is well-poised to bring new capabilities to not only the USAF, US Navy and US Marine Corps, but also to some of the leading air forces in the world. Apart from the US, the F-35 programme has eight partners—UK, Italy, the Netherlands, Turkey, Australia, Norway, Denmark and Canada. Israel and Singapore also joined the programme as security cooperative participants. The F-35 is perhaps the only aircraft in the world designed and developed from the beginning in vastly different variants to suit the multifarious needs of its various

PHOTOGRAPH: LOCKHEED MARTIN

TABLE 1: F-35 VARIANTS GENERAL TRAITS & PERFORMANCE CHARACTERISTICS

General	F-35A (CTOL)	F-35B (STOVL)	F-35C (CV)
Wing Span	10.7 m	10.7 m	13.1 m
Length Overall	15.7 m	15.6 m	15.7 m
Height Overall	4.38 m	4.36 m	4.48 m
Wings Area	42.7 m^2	42.7 m^2	62.1 m^2
Weight & Loadings (Estimated)			
Weight Empty	13,300 kg	14,500 kg	15,800 kg
Max Weapon Load	8,160 kg	6,800 kg	8,160 kg
Max Internal Fuel Weight	8,278 kg	6,125 kg	8,960 kg
Max T-O Weight Class	31,800 kg	27,200 kg	31,800 kg
Power Plant: 1* Pratt & Whitney F135 afterburning turbofan			
Dry Thrust: 28,000 lbf (125 KN)			
Thrust With Afterburner: 43,000 lbf (191 KN)			
Lift Fan (STOVL): 1 * Rolls-Royce LiftSystem driven from fain power plant, 18000 lbf (80 KN)			
Note: Alternate Engine Under Development: GE/RR 136			
Performance (Estimated)			
Maximum Speed	**M1.6**	**M1.6**	**M1.6**
Range	2,200 km	1,667 km	2,200 km
Combat Radius	1,093 km	835 km	1,100 km
Service Ceiling	18,288 m	18,288 m	18,288 m
Rate of Climb: Classified (not publicly available)			
Thrust/Weight:			
With Full Fuel	0.84	0.86	0.77
With 50-Per Cent Fuel	1.04	1.02	0.95
G-limits	9 g	7 g	7.5 g

Armament

- **Guns:** 1* GAU-22/A 25mm (0.984 in) cannon—slated to be mounted internally with 180 rounds in the F-35A and fitted as an external pod with 220 rounds in the F-35 B and F-35 C.
- **Hard Points:** 6* external pylons on wings with a capacity of 15,000 lb (6,800 kg) and 2* internal bays with 2 pylons each (total weapons payload of 18,000 lb on A and C models).
- **Missiles**
  - **Internal:** Four air-to-air missiles, or two air-to-air missiles and two air-to-ground weapons.
  - **External:** Six air-to-air missiles, or four air-to-ground weapons and two air-to-air missiles with combinations for the following missiles:

Air-to-air missiles

- AIM-120 AMRAAM
- AIM-132 ASRAAM
- AIM-9X Sidewinder

Air-to-ground Weapons

- AGM-154 JSOW - AGM-158 JASSM

Source: Lockheed Martin/Open Sources

users. Three major variants comprise the F-35A for conventional take-off and landing (CTOL) operations, the F-35B for short take-off and vertical landing (STOVL) and the F-35C (CV) for the carrier-borne operations (see Table 1).

F-35 JOINT STRIKE FIGHTER VARIANTS

F-35A: The F-35A is the CTOL variant intended for the US Air Force and other air forces. It is the smallest, lightest F-35 version and is the only variant equipped with an internal cannon, the 25mm GAU-22/A. The F-35A is expected to match the F-16 in manoeuvrability, instantaneous and sustained high performance, and outperform it in stealth, payload, and range on internal fuel, avionics operational effectiveness, supportability and survivability. In the USAF, the A variant is primarily intended to replace the F-16 Fighting Falcons, and later the A-10 Thunderbolt II aircraft.

F-35B: The F-35B is the STOVL variant. The F-35B is similar in size to the F-35A, trading fuel volume for vertical flight systems. The F-35's main power plant is derived from Pratt & Whitney's F119 or GE/Rolls-Royce team's F136, with the STOVL variant of the latter incorporating a Rolls-Royce lift fan module. The F-35B uses a vectoring cruise nozzle in the tail, that is, the rear exhaust turns to deflect thrust down, and an innovative shaft-driven lift fan within the fuselage, located forward of the main engine, to maintain balance in vertical flight. This variant is intended to replace the later derivatives of the Harrier Jump Jet, which was the first operational short take-off vertical landing fighter aircraft. The Royal Air Force and the Royal Navy were to use this variant to replace the Harrier GR7/GR9s. The US Marine Corps will use the F-35B to replace its AV-8B Harrier II fighters.

F-35C: The F-35C carrier variant has been equipped with a larger, folding wing and larger control surfaces for improved low-speed control, and a stronger landing gear for the stresses of carrier landings. The larger wing area provides decreased landing speed, increased range and payload, with twice the range on internal fuel compared with the F/A-18C Hornet, achieving much the same goal as the heavier F/A-18E/F Super Hornet. The US Navy intends to replace its F/A-18A, Band C Hornets with F-35Cs. It will also serve as a stealthier complement to the Super Hornet.

The gigantic JSF programme, essentially has the US as the primary customer and financial backer. The other international partners joined the programme at different levels of participation and financial stakes, the combined total of which amounted to approximately $4.5 billion (₹20,250 crore) towards development costs. The total development costs were earlier envisaged to be about $40 billion (₹1,80,000 crore)—largely underwritten by the US. The total number of different variants to be acquired by the nine major partner nations was to be in excess of 3,000 aircraft with the US alone catering to an estimated 2,400 aircraft (for nation-wise breakdown, see Table 2).

It is a historical fact that no defence programme, big or small, has ever been accomplished without encountering problems vis-à-vis time and cost overruns; the massive JSF programme is no exception. Negotiating a labyrinth of intricate and interlaced technological and production challenges, the F-35 programme has battled its share of adversities, resulting in lapsed deadlines and burgeoning development costs. Early in the development phase, concerns had emerged

TABLE 2: JOINT STRIKE FIGHTER PROGRAMME INTERNATIONAL PARTNERS AND PLANNED QUANTITIES

Country	Numbers
USA (USAF)	1,763
(USN/USMC)	680
UK (RAF/RN)	138
Italy	131
Netherlands	85
Turkey	100
Australia	100
Norway	48
Denmark	30
Canada	65
Total	**3,140**

regarding the weight of the F-35B version. While review of structural design eliminated some of the excess, it was evident by early 2004 that further weight reduction initiatives would be necessary. These concerns were sufficiently serious to warrant postponement of the critical design review to 2006.

Consequently, it became necessary to delay the start of the SDD testing, in order to give Lockheed Martin additional time to solve the weight problem which amounted to a trim down of a phenomenal 1,500 kg of overweight. A special task force known as STOVL Weight Attack Team had to be put together to solve the problem, which propped by out-of-the-box thinking as well as some compromise of customer requirements, succeeded in removing about 1,225 kg of unwanted weight. It also proved necessary to modify the weapon bays, which on the F-35B, have reverted to the size originally specified, limiting internal carriage of weaponry to a pair of weapons in the 1,000 lb class plus two AIM-120 air-to-air missiles rather than the two 2,000 lb weapons that may be carried internally by both the F-35A and F-35C versions.

The problems with the F-35B were so acute that at one stage the critics of the programme wanted its total elimination from the overall JSF programme. In January this year, Robert Gates who was still the US Defense Secretary went on to state that if the F-35B variant could not be fixed in a specified timeframe, to get it back on track in terms of performance, cost and schedule, then it should be cancelled. However, Gates has since been replaced from his post and the F-35B version has moved ahead in its development programme. In a recent statement, Commandant of the USMC, General James Amos emphasised that despite its increasing costs and schedule delays, there was no plan B to substitute for the F-35B. But the F-35B acquisition plans have undergone some major changes. In October 2010, the United Kingdom decided to change its F-35B order to the F-35C (the carrier variant), which will be used for both land-based and carrier operations. It is not clear at this stage whether there will be any change in the numbers ordered. In another move, USMC and USN signed an agreement this year that the USMC will purchase 340 F-35B and 80 F-35C while the USN will purchase 260 F-35C aircraft. The F-35C squadrons of the USMC will be assigned to the US Navy carriers while the Marine Corps F-35Bs will be used on amphibious ships and from shore bases. The overall numbers for the USN/USMC at 680, remain unchanged from the original plan.

Notwithstanding the temporary grounding of the two jets at Eglin Air Force Base, the new inductions to start squadron level operational training in the USAF could be one of the indicators to suggest that the worst may be over in the JSF development programme. The good news is that all three variants are not only flying but also trying to catch up with the lost time through accelerated testing. As per the company records, the fleet remained 18 per cent ahead year to date (YTD) on flights with 449 (Plan 378) and 30 per cent ahead YTD on test points with 3,907 (Plan 2,996) (through June 30, 2011).

The other good news is that despite mounting apprehensions earlier regarding the viability/affordability factors, all the participating nations remain committed to the programme. In addition, Israel became the tenth committed nation to join the programme by signing the letter of offer and acceptance for the procurement of F-35 aircraft in October last year and would be the first nation to receive the jets through the foreign military sale (FMS) route.

According to Lockheed Martin, F-35 Lightning II programme is the latest chapter in the company's history of building the world's finest military aircraft. By bringing together stealth, agility and fifth generation technology, it claims to have built an aircraft which with its unrivalled situation awareness and decisive operational advantage is poised to dominate the world skies well into the middle of 21st century. It is also confident that incorporating lessons learned from development-aircraft production and the use of common manufacturing processes and parts, advanced digital design tools and assembly methods would greatly help achieve the programme's goals of affordability, quality and assembly speed. Highly upbeat about the programme, Dave Scott, Director F-35 International Business Development, Lockheed Martin, is confident that the F-35 (CTOL version) could eventually achieve an average unit recurring flyaway price of $65 million in 2010 dollars (₹293 crore)—that too with all its sensors, EW systems and weapons launching equipment that must be purchased separately for current generation fighters (see *SP's Aviation,* August 2011 issue).

Final word! Would the IAF be interested in the F-35's acquisition? It is rumoured (also covered in some sections of the press) that post the short-listing of the European fighters in India's ongoing medium multi-role combat aircraft (MMRCA) programme, there was the US offer of F-35 to India, however, with no disclosure of the price tag. It is almost certain that irrespective of which aircraft is finally selected in the MMRCA deal, India will have to fork out close to or even more than the recurring per flyaway unit price being quoted for the F-35. While India cannot 'and should not' back out of the MMRCA deal at this stage, the offer of a fifth generation fighter of the F-35 class at $65 million a piece is too mouth-watering to be ignored in totality. The IAF could exercise its choice when it reaches the stage of replacing its current fleets such as the MiG-27, MiG-29s or the Jaguars. Perhaps, by that time, with mass production of the JSF well under way, the amortised cost of the lucrative fighter may actually come down to match the unit recurring flyaway price, as quoted. SP

GAME CHANGER: EUROCOPTER'S X3

Hover or forward speed—helicopter designers have long been plagued by this dilemma. Practically every aerodynamic feature that helps hover hurts forward flight, and vice versa. So designers have toyed with various outlandish ideas to improve the top speed of helicopters.

THE RACE

PHOTOGRAPHS: EUROCOPTER, SIKORSKY & AGUSTAWESTLAND

By **Joseph Noronha, Goa**

THE SONOROUS WHIRR OF a helicopter's rotor unmistakeably heralds the approach of one of the most versatile machines in the sky. The whirly birds' ability to take off and land vertically frees them of the constraint of elaborate infrastructure support that other aircraft need. Consequently they have proved their worth in a variety of roles in every type of terrain. Over the years, their performance and reliability has improved tremendously, except in one crucial aspect—speed. Indeed, throttling up these tortoises of the air presents substantial cost and engineering challenges. While a cruising speed of 150 knots (277.8 kmph) has long been accepted as a practical limit, 200 knots (370.4 kmph) was considered an insurmountable barrier and rare the attempts to breach it. The last major effort to design nippier helicopters happened in the 1970s, but they quickly fizzled out. The absolute speed record for rotorcraft was set by a specially modified Westland Lynx ZB-500 in 1986. Piloted by John Egginton, the aircraft reached a speed of 216.45 knots (400.87 kmph). This record was recently surpassed by two similar sounding but radically different designs—Sikorsky's X2 and Eurocopter's X3. And both manufacturers describe their creations as "potential game changers."

Tilt-rotors, of course, go a long way towards solving the forward speed challenge. Take the Bell-Boeing V-22 Osprey, operated by the US Marine Corps and Air Force. It is a hybrid—half helicopter and half aeroplane. For take-off and landing, it functions as a helicopter with the twin rotors horizontal. Then, by tilting its wingtip rotors forward through 90 degrees and flying like a plane, the Osprey can cruise at around 250 knots (463 kmph) and fly farther, un-refuelled, than pure helicopters. But it is subject to hover limitations. It can't hover as most other helicopters and especially above 4,000 ft. In a theatre like Afghanistan, this can be a severe drawback. Then there's the AgustaWestland AW609 (formerly known as the Bell/Agusta BA609). It is a civil twin-engine tilt-rotor aircraft with a configuration similar to the V-22 Osprey.

Hover or forward speed—helicopter designers have long been plagued by this dilemma. Practically every aerodynamic feature that helps hover hurts forward flight, and vice versa. So designers have toyed with various outlandish ideas to improve the top speed of helicopters. Some even considered using jet engines to spur the machines at a faster clip, using small wings to provide additional lift. But they faced the same problem—the main rotors would develop asymmetric lift and become unstable on account of the much feared "retreating blade stall". How does retreating blade stall happen? A rotor provides vertical lift as well as forward thrust. In order to fly faster, more thrust is generated by increasing the tilt of the rotor disk. Although this can only be done to a limited extent, it does not present any problem so long as the helicopter is moving forward at low-to-medium speed. But if it continues accelerating to higher speeds, the rotor blade travelling backward, cannot generate sufficient lift because its speed is low compared to the oncoming faster airflow. It stalls. High drag and twisting moments on the stalled blade create vibrations strong enough to be felt on the controls. Further acceleration can result in uncommanded pitch and roll motion. To make matters worse, the tip of the advancing rotor blade may approach supersonic speeds, creating shock waves and more vibration.

The US helicopter major Sikorsky Aircraft claims to have licked the phenomenon of retreating blade stall by the advancing blade concept employed on its X2 technology demonstrator. The X2 has a pair of coaxial main rotors. So there are always advancing blades on either side of the helicopter. As the helicopter's forward speed increases, the rotational speed of the main rotors is deliberately reduced, but the dual advancing blades generate sufficient lift to keep the helicopter flying. The lower rotor speed also keeps the tips of the blades subsonic. A bonus of the coaxial rotor configuration is that torque effects are eliminated. So this machine does not need a power-hungry tail rotor. The X2 also has a pusher propeller that gives it the capabilities not found in conventional helicopters. For instance, from a level attitude, the pilot can engage the propeller and accelerate or decelerate without changing the angle of the main rotors.

After a series of gradually accelerating test flights, last September, the X2 crossed 250 knots (463 kmph) true air speed in level flight, setting an unofficial record for a helicopter and achieving the programme's ultimate speed milestone. That made it the fastest helicopter ever without external jet thrust. The X2 design also won Sikorsky one of aviation's most prestigious prizes—the Collier trophy. Sikorsky spent $50 million (₹225 crore) to develop this technology demonstrator which is likely to retire soon. But the story doesn't end there. The company also has plans for the military-focused S-97 Raider using X2 technology. The S-97, an armed reconnaissance type, will be about 30 per cent larger than the X2, with a two-pilot cockpit and space for armament and auxiliary fuel or troops. However, before this cutting-edge technology is applied to a production helicopter, rotor blade design will be critical, since at high speed there will still be a large increase in drag. The more

FAST & FURIOUS: SIKORSKY'S X2

complex transmission and drive systems will require redundancies to limit the possibility of failures. Active vibration suppression will be needed to minimise noise, prolong component life, and ensure crew comfort. Also, fly-by-wire will be essential to seamlessly transfer engine power from the main rotors to the forward propulsion system and back again, while constantly maintaining desirable handling qualities. The first flight of the S-97 Raider is expected in 2014 and the US military is likely to be the launch customer.

MILITARY-FOCUSED: SIKORSKY'S S97 RAIDER

TILT ROTORS: BA609 IS NOW AW609 AFTER ACQUISITION BY AGUSTAWESTLAND

The Eurocopter X3 (pronounced "X-cubed") is another high-speed concept that has taken a rather different tack. Eurocopter believes that main rotors are high-drag producers and counter-rotating designs are inefficient as well as mechanically complex. Its X3 design is a hybrid configuration that offers the full hover capabilities of a helicopter with the forward speed of a turboprop plane. The lateral wings produce some lift, so the main rotor—which needs to provide no forward thrust when the aircraft is level—can be slowed during cruise, reducing drag. The X3 (based on the EC155 Dauphin medium helicopter) is equipped with two turboshaft engines that power a five-blade main rotor system and two propellers which are installed on short-span fixed wings. The propellers provide propulsive force in forward flight and anti-torque control in hover, thus dispensing with a tail rotor. During high-speed cruise, the main rotor is flat, which significantly reduces drag and vibration. The X3 demonstrator has conventional flight controls and is claimed to be controlled almost exactly like a traditional helicopter. However, changing the power allocation between the rotor and the propellers could possibly be made more efficient with fly-by-wire controls.

Aimed at least initially at the civilian market, the X3 is one of the fastest rotorcraft in the world, having achieved a cruising speed of 232 knots (430 kmph) for several minutes in stable level flight during a test flight on May 18. The machine's test programme will continue throughout the year to explore its full flight envelope. Eurocopter's aim is to deliver an aircraft that increases cruising speed by 50 per cent, while limiting the price premium over a conventional helicopter to 25 per cent. It also intends to offer X3 technology as an option to standard configurations. Although the aircraft still has the potential to go faster, perhaps as fast as 250 knots, Eurocopter feels its 220-knot target speed is an economical sweet spot. It believes this design is inherently more efficient than a pure helicopter. So, despite the higher speed, fuel burn will be similar to that of a helicopter cruising at 140 knots. Second, spending less time in the air for a given trip will reduce the maintenance costs based on flight hours. Overall, there's a projected 20 per cent cut in operating cost. Eurocopter predicts a wide range of roles for the X3 hybrid-helicopter concept, including long-distance search and rescue (SAR) missions, coast guard duties, border patrol missions, passenger transport and offshore operations.

At least two major Russian companies are eager to enter the high-speed helicopter race. The Kamov Ka-92 is quite similar to Sikorsky's X2, with counter-rotating main rotors and a single rear-mounted pusher propeller. The Mil Mi-X1 has a single main rotor and a pusher propeller with steering vane. In this respect it is a cross between the Sikorsky X2 and the Eurocopter X3.

So is the helicopter market likely to abandon the traditional helicopter design and go decisively high speed? Not likely. Many military and civil customers will be keen to acquire speedier helicopters with higher range and payload capabilities. However, the current configuration although inherently sluggish has stood the test of time and is well-optimised. The introduction of better rotor blades, hubs and fins, as well as the ever-increasing use of composites to reduce weight, can coax a few knots out of the existing machines without significantly increasing their cost. On the other hand it might cost a great deal to change the design and spur the machines to significantly greater speeds as the Sikorsky X2 and Eurocopter X3 are attempting. Some fear that the complexity of such a craft will outweigh its attractions. It is likely to increase acquisition and operating cost and might well sacrifice some payload and range. For potential civilian customers, distance might be decisive. Eurocopter offers the example of an oil company needing a helicopter to transit to and from an offshore rig. If the rig were just 80-100 km offshore, a high-speed helicopter would add cost without significant benefits. But if the oil rigs were 400 to 500 km away, higher speed would be a major advantage and the additional cost worthwhile. As for military forces eager to outrace and outperform the enemy's machines, every knot of extra speed counts. SP

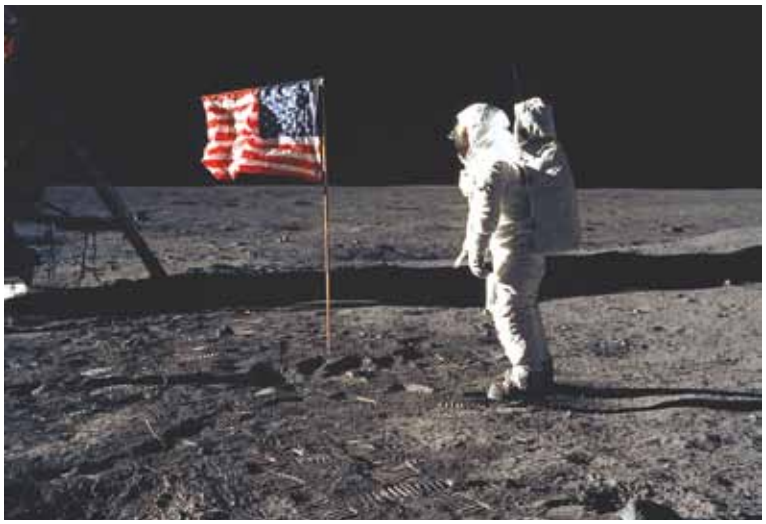
SPACE ODYSSEY

Human spaceflight missions have now been performed by USSR/Russia, USA, China, and by Scaled Composites. Several other countries and agencies, including India, have announced human spaceflight programmes. India had planned its first mission in 2014-15; however, this is likely to be delayed for some time because of a series of unsuccessful tests of the crucial GSLV.

By **Joseph Noronha, Goa**

ON APRIL 12, 1961, the world was stunned by the news that cosmonaut Yuri Gagarin of the USSR had become the first human to cross the threshold of the final frontier—Space. Gagarin's Vostok 1 spacecraft blasted off from Baikonur Cosmodrome, successfully completed one orbit of the Earth and returned safely in 108 minutes. Four years prior to this, the USSR had launched the first unmanned satellite Sputnik 1 on October 4, 1957, heralding the dawn of the space age. While a major part of the world celebrated the achievements, the other superpower, the USA, was filled with a sense of foreboding, even depression. It was during the height of the Cold War rivalry and the Cuban missile crisis was also building up behind the scenes. For the Americans, it was not a happy thought that the Soviets had done it first. However, the US did follow suit on May 5, 1961, when Freedom 7, carrying astronaut Alan Sheppard, was launched from Cape Canaveral. The suborbital flight lasted just 15 minutes 28 seconds—the shortest spaceflight till date. The American public was, however, alarmed that the USSR was surging ahead in the space race. So on May 25, 1961, the US President John F. Kennedy announced an ambitious

PHOTOGRAPHS: NASA



THE PIONEERS:
(LEFT) USSR COSMONAUT YURI GAGARIN WAS THE FIRST HUMAN TO CROSS THE THRESHOLD OF THE FINAL FRONTIER IN 1961; (RIGHT) ON JULY 20, 1969 NEIL ARMSTRONG AND BUZZ ALDRIN BECAME THE FIRST HUMAN BEINGS TO WALK ON THE SURFACE OF THE MOON

plan to land a man on the moon by 1970. On February 20, 1962, with the launch of Friendship 7, John Glenn became the first American to go into the orbit.

The era of solo spaceflights peaked when cosmonaut Valery Bykovsky spent five days in space alone on Vostok 5, launched on June 14, 1963. It remains the longest solo spaceflight ever. In another pioneering feat, the USSR launched the world's first woman cosmonaut, Valentina Tereshkova into space in Vostok 6 on June 16, 1963. This mission is likely to remain forever in the record books as the only solo spaceflight by a female. However, it was purely a propaganda stunt, because almost two decades passed before the second Soviet woman ventured into space. On March 18, 1965, cosmonaut Alexei Leonov became the first human to walk in space during the Voskhod 2 mission. In what was becoming a pattern—the Soviets first, followed by the Americans—the first American spacewalk was performed a few months later by astronaut Edward White during the Gemini 4 mission on June 4, 1965.

The 1960s also witnessed the initial space disasters. As the two superpowers raced to be the first to achieve various space milestones, design defects may have been ignored and some shortcuts taken. On hindsight, accidents were inevitable. On January 27, 1967, the entire three-man crew of the US Apollo 1 were killed in a fire that engulfed their cabin during a ground test. Then on April 24, 1967, cosmonaut Vladimir Komarov was killed in a crash when his landing parachutes tangled after his Soyuz 1 mission was cut short by electrical and control system problems. This was the first publicly acknowledged in-flight fatality in the history of spaceflight. But several triumphs followed the twin tragedies. On December 21, 1968, the US Apollo 8 took off atop the powerful Saturn V with three astronauts aboard for a historic mission to orbit the moon. It was the first human spaceflight to leave the earth's orbit and an impressive demonstration of the US technology. The USSR too was secretly pursuing a moon landing programme. It conducted a successful joint flight of Soyuz 4 and Soyuz 5 in January 1969 in order to test the vital rendezvous, docking and crew-transfer techniques that would be necessary for the moon landing. Later, the LK lunar landing craft was also tested successfully in the earth orbit. However, after four unmanned launches of the super-heavy N-1 rocket failed, the project was abandoned, scotching any hope of the Soviets landing a man on the moon.

The US meanwhile was forging ahead towards the most spectacular space feat ever. On July 20, 1969, the Lunar Module detached from its mother ship Apollo 11 and landed on the moon, thus achieving the goal set by President Kennedy. Neil Armstrong and Buzz Aldrin became the first human beings to walk on the surface of the moon. Armstrong said to millions of awed listeners back on earth: "That's one small step for man, one giant leap for mankind." Working in lunar gravity, one sixth of the earth, the astronauts collected soil/rock samples and conducted scientific experiments. Five other successful moon landings followed the last in 1972. Mission Apollo 13 in April 1970 almost ended in a disaster. But before it was safely recovered, its crew reached the farthest distance of a human being from earth, approximately 3,97,848 kilometres, while on the far side of the moon. Till date, only 12 humans have set foot on the moon—all American males. Three American astronauts—James Lovell, John Young, and Eugene Cernan—made two trips each. Cernan was the last person to leave footprints on the moon on December 11, 1972, during the Apollo 17 mission.

Next began the age of international cooperation in space. From July 15 to 24, 1975, the Apollo-Soyuz Test Project became the first international human spaceflight. On April 12, 1981, the 20th anniversary of Yuri Gagarin's historic first flight, astronauts Robert Crippen and John Young flew the first mission of the US space shuttle aboard Columbia. The space shuttle was to dominate the US spaceflight programme for the next three decades. However, male domination in space still rankled. The Soviet female Cosmonaut Corps had been dissolved in October 1969 and the idea of female space-farers on an equal footing with men was abandoned. Then in 1978, the US selected its first female astronaut, Sally Ride. This was

THE PIONEERS: (LEFT) SPACE SHUTTLES COLOMBIA DOMINATED THE US SPACEFLIGHT PROGRAMME FOR THREE DECADES; (RIGHT) ALL ASTRONAUTS INCLUDING INDIA'S KALPANA CHAWLA WERE KILLED ON FEBRUARY 1, 2003, WHEN COLUMBIA DISINTEGRATED DURING RE-ENTRY

probably the spur the Soviets needed to revive its female Cosmonaut Corps and cosmonaut Svetlana Savitskaya became the world's second woman in space aboard Soyuz T-7 on August 18, 1982. Later, while on the Salyut 7 space station, on July 25, 1984, she became the first woman to perform a space walk. Sally Ride became the first American woman in space aboard space shuttle Challenger on June 18, 1983. Since then women have flown in space fairly regularly.

Challenger itself was destined for a fiery end. On January 28, 1986, it exploded only 73 seconds after lift-off killing all seven astronauts aboard. The cause of the disaster was a faulty rocket booster seal. This accident forced the suspension of the space shuttle programme for many months. Another shuttle disaster, once again killing all astronauts including India's Kalpana Chawla, occurred on February 1, 2003, when Columbia disintegrated during re-entry. The accident was attributed to a piece of foam that broke off during launch and damaged the thermal protection system.

With the dissolution of the Soviet Union in 1991, the Cold War came to an end. On September 2, 1993, the US and Russia signed an agreement to merge the US Freedom and Russian Mir-2 space station projects, clearing the way for the International Space Station (ISS). On February 3, 1994, Sergei Krikalev became the first Russian to fly aboard a US space shuttle. And on March 14, 1995, Norman Thagard was launched aboard a Russian Soyuz to spend 115 days on Mir. But the Russians were not done with setting individual records. On March 22, 1995, Cosmonaut Valeriy Polyakov set a record for the longest stay in space that is yet to be surpassed. He had been launched to Mir on January 8, 1994, and spent a total of 437 days 17 hours and 58 minutes aloft. On the subject of records, two astronauts, Jerry Ross and Franklin Chang-Diaz of the USA, have each logged seven trips into space. Peggy Whitson is the most experienced US astronaut with 377 days in space. However, Russia remains way ahead since 19 cosmonauts have more time in space than the most experienced US astronaut. Cosmonaut Sergei Krikalev has totalled an amazing 803 days nine hours and 39 minutes in space. On November 20, 1998, the first portion of the ISS was launched. On November 2, 2000, the crew of Expedition 1, astronaut Bill Shepherd and cosmonauts Yuri Gidzenko and Sergei Krikalev, docked at the ISS. They became the first human beings to take up residence, staying there for several months. Meanwhile, China was emerging as a space power. On October 15, 2003, it became only the third nation to achieve human spaceflight when the Shenzhou 5 spacecraft carried Taikonaut Yang Liwei into orbit for 21 hours. Then on September 27, 2008, Taikonaut Zhai Zhigang performed China's first spacewalk. But spaceflight cannot remain a government enterprise forever. On June 21, 2004, Scaled Composites' Spaceship One made the first privately-funded human spaceflight. Test pilot Michael Melvill piloted the craft into sub-orbital flight, thus becoming the first commercial astronaut.

Human spaceflight missions (defined as crossing 100 km from earth) have now been performed by USSR/Russia, USA, China, and by Scaled Composites. Several other countries and agencies, including India, have announced human spaceflight programmes. India had planned its first mission in 2014-15; however, this is likely to be delayed for some time because of a series of unsuccessful tests of the crucial geostationary satellite launch vehicle (GSLV).

During the past 50 years, there have been 115 human spaceflight missions by the USSR/Russia, 168 by the USA, and three by China, totalling 286. Out of more than 450 human beings who have ventured into space, 18 have died during actual missions. More than 100 others have died in accidents during activity related to spaceflight missions or testing.

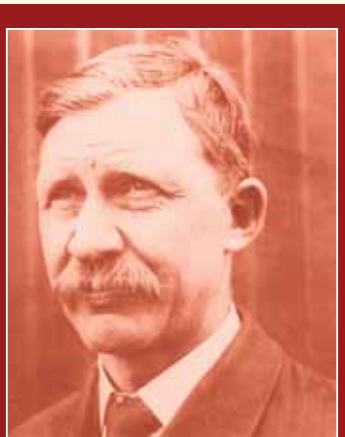
What next for human spaceflight? Mars is likely to be the main objective for years to come. A key early objective will be to retrieve Martian rocks and soil. Cannot unmanned missions with artificially-intelligent robots be mounted with far less cost and complexity without endangering human life? They can. But sending people out into extreme environments is not just for science. It is also in pursuance of a basic feature of the human race—the spirit of adventure. SP

IT TOOK MORE THAN a century of powered flight for Aviation Maintenance Technicians (AMT) to get their special day. National AMT Day has been celebrated in the USA since May 24, 2008, to honour the men and women who toil ceaselessly to keep aircraft flying safely. The date is significant. On that day in 1868, Charles Edward Taylor, recognised as the father of aviation maintenance, was born. Taylor was practically an honorary member of the Wright brothers team—a genius who loved cigars and machinery.

Charlie Taylor's long association with the Wrights began in 1901. His first aeronautical task was to make a wind tunnel for their experiments. He designed a simple rectangular box with a fan at one end, driven by a natural-gas engine. It worked. As the brothers felt they were nearing their goal of powered flight, they sent letters to several manufacturers asking if they could produce an engine that would develop eight to nine horsepower (hp), weigh no more than 180 pounds, and be free from vibration. The manufacturers politely declined. The brothers again turned to Charlie. He had no engine-making experience, but did have a keen mechanical mind. He designed and built an aluminium water-cooled engine, based partly on rough sketches provided by the Wrights. In just six weeks, it was ready. In February 1903, Charlie's engine was mounted on a test stand and ran perfectly, producing 12 hp at full rpm—almost 50 per cent more than the requirement. This permitted the Wrights to strengthen the wings and framework of the aircraft they were building. The engine turned two counter-rotating pusher propellers by means of chains. The brothers tested several different propellers in their wind tunnel in readiness for their pioneering attempt.

And so it happened that the world's first powered, controlled and sustained heavier-than-air flight took place on December 17, 1903. The Kitty Hawk Flyer with Orville Wright at the controls lifted off at 1035 hrs. The flight was over in a jiffy—just 120 seconds—and covered a distance of 120 feet. The speed was 6.8 mph and the average height was 10 feet. Charlie was not present to witness this epochal feat. His absence fit a pattern, since he wanted only to be with his work. He took care of the Wright's airfield and facility while they roamed. In this respect, he was the world's first Airport Manager.

Did Taylor fly? In a 1948 interview, he said, "I always wanted to learn to fly, but I never did. The Wrights refused to teach me and tried to discourage the idea. They said they needed me in the shop and to service their machines, and if I learned to fly, I'd be gadding about the country and maybe become an exhibition pilot and they'd never see me again." On September 17, 1908, Orville Wright finally agreed to take Charlie up for his first flight while demonstrating the Wright airplane for the first Army contract. They were ready for take-off, when a senior officer asked Orville if he would mind taking an Army observer instead. So Lt Thomas Selfridge took Charlie's place. The aircraft crashed soon after take-off, killing Selfridge and seriously injuring Orville. This was the first fatality in a powered aircraft. Everybody has a story of how someone was narrowly saved from an air crash by a last-minute change of plan. Charlie was the first such case. He investigated the crash and found that the new propellers they installed before the flight had delaminated. He reported his findings to Orville, who was in the hospital. Taylor was thus the first person to investigate a fatal air accident. Despite this accident he wanted to become a pilot.



CHARLES TAYLOR
(1868-1956)

'I always wanted to learn to fly, but I never did. The Wrights refused to teach me and tried to discourage the idea. They said they needed me in the shop and to service their machines, and if I learned to fly, I'd be gadding about the country and may be become an exhibition pilot and they'd never see me again.'

In 1911, Calbraith Perry Rodgers decided to make the first flight across the United States and bought an aircraft from the Wright brothers. Orville lent Charlie to Rodgers knowing that he would be the only one who could keep the plane flying for that marathon successfully. Crossing the US took Rodgers 47 days. He crashed 16 times, and the plane was repaired so many times that finally only the rudder, the engine drip pan, and a single strut of the original machine remained—a testament to the skill that Charlie used in keeping it airworthy.

Charlie Taylor became a leading technician in the Wright Company after it was formed in 1909 and worked for the Wright-Martin Company until 1920. He remained in close contact with the last surviving Wright brother, Orville, until Orville's death in 1948. The Wrights were always grateful to Charlie. If not for him, the first Flyer that launched the human powered flight era may never have got airborne. Charlie himself died penniless and alone in a hospital in 1956. Till this day, mechanics like him rarely make it to the history books. SP

—Group Captain (Retd)
Joseph Noronha, Goa

MILITARY

Asia-Pacific

Strengthening US-India defence relations

Robert Scher, Deputy Assistant Secretary of Defense for South and South East Asia, while speaking at the New America Foundation, stated that the US-India defence relationship is a natural partnership created by shared interests and values and driven by increasingly routine day-to-day interactions. The US-India relationship is a priority for the Obama Administration and the Defense Department, Scher said, one that President Barack Obama has called a defining partnership of the 21st century.

South Korea's first surveillance aircraft

South Korea has acquired its first surveillance airplane, the Airborne Early Warning and Control plane, which will add to its military capability. In an effort to establish autonomous early-warning and control system, South Korean military had decided to include E-737 during November 2006 in its inventory. Seoul has planned to acquire four such planes by end 2012. Currently, Korea Aerospace Industries, the nation's leading aircraft maker, is developing advanced multipurpose electronic satellite radar system that will be installed in the second, third and fourth planes.

Americas

US stands by fighter jets in face of big cuts

The US Air Force will never back away from the F-35 joint strike fighter despite fears that America's Defense Department may be asked to find almost $1 trillion in budget savings by Christmas. However, a reduction in the total number of planes to be ordered and the timing of their delivery cannot be ruled out, USAF secretary Michael Donley said while speaking at the Australian Strategic Policy Institute roundtable in Canberra. He was unable to comment on the probable impact of the US defence spending cuts on the price and delivery times for up to 100 planes which Australia wants to buy. Donley foreshadowed an increased level of military cooperation between Australia and the US against a backdrop of growing regional instability and looming defence spending cuts in the US.

Two F-35s arrive at Eglin Air Force Base

Two Lockheed Martin F-35As, AF-10 and AF-11, along with two F-16 chase aircraft ar-

IAF RECEIVES LICENCE TO ISSUE DIGITAL CERTIFICATES

The Chief of the Air Staff, Air Chief Marshal N.A.K. Browne was formally handed over the licence to issue Digital Signature Certificates by the Controller of Certifying Authorities (CCA), Dr N. Vijay Aditya at the Air Headquarters. It was a significant step towards the net-centric vision of the Indian Air Force (IAF).

As part of the Air Force Network (AFNET) project, digital signatures issued by a licence holder would provide the legal recognition to an electronic document under the IT Act 2000. With this, the IAF would be able to put in place a public key infrastructure (PKI), which is a practical strategy for achieving information security in today's highly networked environment. An essential component for providing enhanced information assurance and identity management capabilities, PKI would provide data integrity, user identification and authentication, user non-repudiation, data confidentiality, encryption and digital signature services for programmes and applications on Air Force Network. It would also issue and manage software and hardware certificates on the state-of-the-art Internet protocol/ multi-protocol label switching (IP/MPLS) network of the IAF. With this system in place, the IAF becomes the first defence organisation and the second government body, the first being the National Informatics Centre (NIC) to receive the coveted licence.

Air Marshal K.K. Nowhar, Vice Chief of the Air Staff, Air Vice Marshal Sanjay Sharma, ACAS (Signals and IT), senior Air Force officials and luminaries from academia, private and public sectors were among those who were present on the occasion. •

QuickRoundUp

AEROFLOT

• Aeroflot Russian Airlines has operationalised its second Sukhoi Superjet 100 aircraft (SSJ100 which has been named after the famous Aeroflot pilot Dmitry Ezersky and will perform a scheduled flight on route Moscow-St. Petersburg-Moscow.

AEROTEC

• Premium Aerotec will set up a structure assembly line for the new Russian commercial aircraft programme MS-21 in cooperation with mechanical and plant engineering group Dürr. The order has been awarded to Dürr by the Russian aircraft manufacturer Irkut during MAKS Air Show in Moscow mid-August. Premium Aerotec is Europe's number one supplier of aerostructures and possesses a business unit dedicated to the construction of the relevant production systems.

ALLIANT TECHSYSTEMS

• On August 29, Alliant Techsystems celebrated the grand opening of its new Aircraft Commercial Center of Excellence facility in Clearfield, Utah, less than one year after the announcement of the expansion. The facility serves as the headquarters for ATK's commercial aircraft programmes and supports the manufacturing of composite airframe and engine components for the Airbus A350 XWB, and General Electric and Rolls-Royce engine programmes. As previously announced, ATK has received commercial aircraft component orders exceeding $1 billion over the last several years.

BOMBARDIER

• Bombardier Aerospace has announced that India's number one low-cost carrier, SpiceJet, has taken delivery of the first two of 15 Q400 NextGen turboprop aircraft ordered in December 2010. SpiceJet has also signed a 10-year agreement under Bombardier's comprehensive SmartParts programme that will provide a wide spectrum of cost-per-flight-hour maintenance for the airline's full fleet of Q400 NextGen aircraft.

CHILEAN AIR FORCE

• Six F-16 fighters have been delivered by the Netherlands to Chile as part of a sales agreement signed

APPOINTMENTS

INDIAN AIR FORCE
Air Marshal Jagdish Chandra has taken over as Air Officer Commanding-in-Chief (AOC-in-C), Maintenance Command, replacing Air Marshal P.V. Athawale. The Air Marshal belongs to the electronic stream of the IAF's Engineering Branch.

ITT
Anne Eisele has been appointed global head of external affairs for ITT's Defense and Information Solutions segment, a $6 billion business soon to be spun off as ITT Exelis, based in McLean, Virginia.

BOEING
On August 30, Boeing named Tim Peters Vice President and General Manager of Surveillance and Engagement, a division of Boeing Defense, Space & Security's Boeing Military Aircraft unit.

AIR INDIA
Rohit Nandan assumed charge as the new Chairman and Managing Director of Air India Ltd. He was earlier Joint Secretary, Ministry of Civil Aviation, Government of India.

NORTHROP GRUMMAN
Northrop Grumman Corporation has appointed Prabu Natarajan as Vice President, Tax. Natarajan reports to James F. Palmer, Corporate Vice President and Chief Financial Officer as also train and develop the tax professionals and other talent in the Tax Department.

GENERAL DYNAMICS
General Dynamics has appointed Larry R. Flynn as President of Gulfstream Aerospace Corporation. Flynn has been Senior Vice President of marketing and sales for Gulfstream Aerospace since 2008.

rived at the USAF Eglin Air Base at 1:19 p.m. on August 31. On August 26, the F-35 Joint Program Office had authorised a return to flight operations for F-35 production aircraft. AF-10 and AF-11 completed the 90-minute flight marking the ninth and tenth F-35 contractual deliveries of 2011. The pair of conventional take-off and landing (CTOL) jets will be used for training pilots and maintainers at the new F-35 Integrated Training Center there.

Lockheed completes delivery of C-5M Super Galaxy
Lockheed Martin completed delivery of the third production C-5M Super Galaxy to the US Air Force. The sixth C-5M overall to be delivered to the Air Force, this aircraft will undergo internal paint restoration at Stewart Air National Guard Base, New York, before travelling to its permanent home at Dover Air Force Base.

Northrop Viper Strikes added to KC-130J Arsenal
Northrop Grumman Corporation has been awarded a contract for additional Viper Strikes munitions to equip the US Marine Corps Harvest Hawk aircraft and bring greater utility to the Marines' KC-130J refuelling and cargo aircraft. Viper Strike is a gliding munition capable of precision attack from extended stand-off ranges using GPS-aided navigation and a semi-active laser seeker. Its small size, precision and high agility provide a very low collateral damage weapon that can be used in the difficult operational environments where US troops may be deployed.

ITT wide-area surveillance sensor systems delivered
ITT Corporation's wide area airborne surveillance sensor (WASS) system has been deployed in support of Operation Enduring Freedom. WAAS is a key element of the US Air Force's Big Safari Gorgon Stare wide-area persistent surveillance system. Working closely with the programmes' prime and lead systems integrator, Sierra Nevada Corporation (SNC) and its industry team, ITT has delivered multiple electro-optical infrared (EO-IR) sensor solutions, image compression and dissemination software. Hosted on an MQ-9 Reaper, each Gorgon Stare orbit provides uninterrupted, 24/7 visible and infrared coverage of city-sized areas, giving real-time motion video directly to theatre and tactical forces engaged in combat and support operations.

CIVIL AVIATION

Asia-Pacific

A350 XWB and A320 family's new customer
Thai Airways International Public Company Limited (THAI) has signed a contract with Airbus covering the firm order of four A350-900s and five A320 aircraft, becoming a new customer for both aircraft types. The aircraft have been selected by the airline under its fleet modernisation programme, with the A350 XWB set to operate on long haul services to Europe and the A320s on domestic and regional routes. In addition to the aircraft ordered from Airbus, the airline is also leasing eight additional A350-900s and six more A320s from third party lessors.

Changi Airport enhancing perimeter security
Changi Airport Group (CAG) and ST Electronics' wholly owned subsidiary, ST Electronics (Satcom & Sensor Systems) Pte Ltd announced collaboration on August 3 to implement a Perimeter Intrusion Detection System (PIDS) based on Fibre Bragg Grating (FBG) sensor for Changi Airport's perimeter fence to further strengthen security of the airfield. This is the first time that such technology is being used for perimeter security enhancement anywhere in the world.

QuickRoundUp

between the two governments on June 8, 2009. The first two batches of F-16s, for a total of 12 aircraft, were delivered in November 2010 and April 2011. The 18 fighter planes sold to Chile are a result of the defence policy measures decided in 2007.

DELTA

• Boeing and Delta Airlines have announced an order for 100 Next-Generation 737-900ER (extended range) airplanes. The order, with a list-price value of more than $8.5 billion, is part of Delta's fleet renewal effort to replace its less efficient domestic airplanes.

FRENCH AIR FORCE

• Since August 18, a French Air Force Harfang UAV has been deployed at Sigonella Air Base in Sicily, from where it supports operations in Libya by carrying out reconnaissance missions.

LAOS

• Lao Airlines, the national carrier of the Lao People's Democratic Republic (Laos), has signed a contract with Airbus for the purchase of two A320 aircraft, becoming a new Airbus customer. The aircraft will be operated by Lao Airlines on routes linking Vientiane to key destinations in South East Asia, including Bangkok and Singapore.

LOCKHEED MARTIN

• Lockheed Martin Corporation Missiles and Fire Control has been awarded a $49.95 million firm-fixed-price contract for procurement of 18 AN/AAQ-30 target sight systems (TSS) that will be integrated into the AH-1Z Cobra attack helicopter. The TSS provides target identification and tracking, passive targeting for integrated weapons, including Hellfire missiles and a laser designation capability supporting friendly laser-guided weapons. Work is expected to be completed by August 2014.

NORTHROP GRUMMAN

• Northrop Grumman Systems Corporation has been awarded a $10.5 million cost plus contract for logistics in support of the vertical take-off and landing tactical unmanned aerial vehicle MQ-8B fire scout system. Logistic support services includes logistics management, maintenance support,

13–16 September
DSEI - DEFENCE AND SECURITY EQUIPMENT INTERNATIONAL
ExCeL, London, UK
www.dsei.co.uk

14–15 September
BUSINESS AIRCRAFT EUROPE - INCORPORATING 5TH ANNUAL LIGHT JETS EUROPE
Biggin Hill, UK
www.miuevents.com/bae2011

14–16 September
JET-EXPO AIR SHOW 2011
1 bld.3 Airport VNUKOVO Moscow
www.2011.jetexpo.ru

21–24 September
AVIATION EXPO CHINA 2011
China National Convention Center, Beijing, China
www.beijingaviation.com/en

22–23 September
6TH INTERNATIONAL CONFERENCE ON ENERGISING INDIAN AEROSPACE INDUSTRY
Manekshaw Centre, Swarna Jayanti Marg, Delhi Cantt, India
www.cii.in

27–29 September
MRO EUROPE 2011
IFEMA, Madrid, Spain
www.aviationweek.com/events/current/mew/index.htm

18–23 October
SEOUL AIR SHOW
Incheon International Airport, Seoul, Korea
www.seoulairshow.com

24–26 October
AEROSPACE & DEFENSE PROGRAMS
Arizona Biltmore, Phoenix, AZ, USA
www.aviationweek.com/events/current/ad/index.htm

08–10 November
INTERNATIONAL FIGHTER
Royal Air Force Museum, London, UK
www.international-fighter.com

28–30 November
AIR POWER IN IRREGULAR WARFARE
Aviator Hotel, Farnborough, UK
www.airbournecounterinsurgency.com

INDUSTRY

Americas

Boeing launches 737 new engine family

The Boeing Company's board of directors has approved the launch of the new engine variant of 737, based on order commitments for 496 airplanes from five airlines and a strong business case. The new 737 family will be powered by CFM International LEAP-1B engines optimised for the 737. It will have the lowest operating costs in the single-aisle segment with a seven per cent advantage over the competition. Deliveries are scheduled to begin in 2017.

Northrop delivers 50th centre fuselage for F-35

Northrop Grumman Corporation marked the completion of the 50th centre fuselage for the F-35 joint strike fighter during a ceremony at the company's Palmdale Manufacturing Centre. Company officials praised employees for delivering the centre fuselages on time and on budget—achieving a significant milestone early in the programme while maintaining high standards of performance and affordability.

Boeing 787 receives FAA, EASA certification

Boeing received certification for the all-new 787 Dreamliner from the US Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) during a ceremony at the company's Everett, Washington facility. FAA Administrator Randy Babbitt presented the US Type Certificate, which verifies that the 787 has been tested and found to be in compliance with all federal regulations, to 787 Chief Pilot Mike Carriker and 787 Vice President and Chief Project Engineer Mike Sinnett, both of whom have worked on the programme since the day it began.

Europe

ATR delivers its first ATR 72-600s

Turboprop aircraft manufacturer ATR celebrated in Toulouse the delivery of the first two ATR 72-600s in the presence of a Royal Air Maroc delegation. Royal Air Maroc will be the first operator of the new ATR "-600" series. The 70-seat aircraft will allow the Moroccan national airline to reinforce its domestic and its nearest international network.

SPACE

Americas

USAF's second missile warning satellite

Lockheed Martin has successfully completed acoustic testing of the second Space Based Infrared System (SBIRS) geosynchronous (GEO-2) spacecraft. The US Air Force's SBIRS satellites provide the nation with significantly improved missile warning capabilities and simultaneously support other critical missions including missile defence, technical intelligence and battlespace awareness. The first geosynchronous (GEO-1) SBIRS satellite was launched on May 7, and has since reached orbit, deployed its instruments and activated its sophisticated infrared sensors. •

QuickRoundUp

supply support, air vehicle transportation, training services, logistics management information, technical data updates, flight operations and deployment support. Work is expected to be completed in August 2012.

RAYTHEON

• Raytheon and Boeing have completed a second series of government-funded technology development phase tests of the joint air-to-ground missile's single rocket-motor solution, designed by Boeing and its subcontractor ATK. The Raytheon-Boeing JAGM features a fully integrated tri-mode seeker that incorporates semi-active laser, uncooled imaging infrared and millimetre wave guidance.

RUSSIA

• The Inter-Agency Commission has completed its investigation of the off-nominal orbital injection of Express-AM4 launched on August18, from the Baikonur Cosmodrome and has concluded that in the process of formalising the Breeze M operating timeline, the time interval to manipulate the gyro platform into position was made unduly short. This resulted in an off-nominal orientation of the Breeze M and in injecting the SC into an off-design orbit. All other Breeze M systems have performed within specifications and thus the ban on Proton M/Breeze M ground processing has been lifted.

SAIC

• Science Applications International Corporation (SAIC) has announced that it has been awarded a follow-on task order by the US Naval Air Systems Command to provide technical, engineering, and logistics support to its Air Combat Electronics Programme Office (PMA-209). The contract has a base period and five one-year options, which if fully exercised, will total five years of performance and a total value of more than $45 million, if all options are exercised.

SIKORSKY

• Sikorsky Aircraft Corporation, Stratford, has been awarded a $265.6 million contract for the procurement of 22 UH-60M aircraft and 1 HH-60M aircraft. Estimated completion date of contract is March 31, 2013.

COSMETIC CHANGE

THE AXE FINALLY FELL on the Chairman and Managing Director (CMD) of Air India Arvind Jadav on August 12, when he was replaced by Rohit Nandan, a Joint Secretary in the Ministry of Civil Aviation (MoCA). An officer of the 1978 batch of the Indian Administrative Service (IAS), Karnataka cadre, Jadav, who was appointed as CMD in May 2009 for a three-year term, was reverted to his parent cadre prematurely for "failure on all parameters and lacklustre performance". Rohit Nandan, the third CMD the airline has seen in the last three years, is an Uttar Pradesh cadre IAS officer of 1982 batch. He would be functioning under his mentor Nasim Zaidi, Secretary MoCA, coincidentally also from the UP cadre. Nandan takes over at a time when the airline is in total disarray. Its finances are in a frightening mess with cumulative losses at ₹20,320 crore, loans on working capital and on long-term fleet acquisition amounting to ₹43,200 crore, dues to Airports Authority of India (AAI) and the oil companies pegged at around ₹5,000 crore. With all these, the total liability will stand at an astounding ₹68,520 crore ($15.2 billion). During the last financial year, Air India has lost on an average ₹21.5 crore a day and continues to do so. Today, the airline is not in a position to meet the interest payment liability and is unable to pay on time even the basic salaries due to its employees. The airline has been surviving on periodic dole from the government which has been a debilitating burden on the national exchequer.

Experience shows that so long as its management remains in the hands of a bureaucrat, there is practically no chance of lasting redemption for Air India

Apart from the financial malaise, the legacy bequeathed by the successive managements of the airline in recent years, have been steadily propelling the airline to a certain demise. What is noteworthy is that the downslide acquired unusual momentum during the tenure of the outgoing CMD seemingly on account of the "Don Quixote" type of approach adopted by him towards the employees who struck work three times during his two-year stint. The airline has also been devastated by a number of strategic decisions at the level of the Ministry of Civil Aviation thrust upon the CMD. As a part of a cover up exercise, these could be projected as "innocent blunders"; but are believed to have been driven by vested interests. The question is whether Arvind Jadav was acting on his own or under orders. The exercise to merge Indian and Air India involving enormous expenditure has been a complete failure. Besides, profit-making routes have been surrendered and bilaterals restructured allegedly with devious intent to benefit private carriers. The much touted drive for membership of the supposedly prestigious Star Alliance has run aground. High value real estate owned by the airline is reported to have been sold or leased for a song allegedly to privileged beneficiaries. And worst of all, management-worker relationship has collapsed and employee morale has sunk to perhaps its lowest in its entire history. Air India, which was once upon a time the pride of the nation, is no longer the airline of preference in the country or abroad.

On assumption of office, the new CMD appears embarked on a complete overhaul of the airline's management to put it back on track. To begin with, he has removed a number of senior functionaries in the airline appointed by his predecessor as "Officers on Special Duty" who were either controversial or whose presence was not in the best interests of the airline. In an effort at image makeover, he has stipulated a two-week deadline to flight operations and commercial departments to improve the quality of on-board service and on-time performance initially to 80 per cent going up to 93 per cent as an integral part of the turnaround plan. Other measures under active consideration as enunciated by Vayalar Ravi, Minister of Civil Aviation, are dumping of loss-making routes, rationalisation of projection of growth of fleet size from the current 124 to 245 aircraft by 2018-19 as against the earlier target of 248 by 2015-16, deployment of fuel-efficient aircraft on international routes and enhancement of aircraft utilisation rate. While Minister Ravi's rejection of privatisation and job cuts would be music to the employees' ears, what may not be palatable is the proposal to withdraw concessions currently available to distant relatives for travel by Air India on domestic routes.

From the steps under way, there is little doubt that the government is genuinely concerned about the future of the airline. However, experience shows that so long as its management remains in the hands of a bureaucrat, his impeccable professional credentials notwithstanding, there is practically no chance of lasting redemption for Air India. What the airline really needs is privatisation and professional management which as yet appears outside the realm of possibility. Replacing one bureaucrat by another as CMD might just be a case of "out of the frying pan into the fire". SP

—Air Marshal (Retd) B.K. Pandey

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