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India's HAL plans to produce 100 HTT-40 basic trainer aircraft



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CURRENT AFFAIRS

Mid-air refuelling feat by IAF

For the first time, an IL-78 refueller aircraft of the Indian Air Force carried out air-to-air refuelling of the Embraer transport aircraft that has the indigenous Airborne Early Warning and Control (AEW&C) system Netra mounted on it. "A mere 10-minute in-flight refuelling can generate four more hours of flight. The achievement has given a tremendous boost to the IAF's operational capability," the IAF said in a statement. The AEW&C — also called eye-in-the-sky — is capable of long-range surveillance and a force multiplier. Air-to-air refuelling allows the aircraft to stay airborne much beyond their limits, allowing better exploitation of capabilities. "The 'Probe and Drogue' air-to-air refuelling method, practised by IAF pilots, requires exceptional flying skills as the receiving aircraft has to accurately insert the receptacle probe into the basket-shaped drogue trailing the tanker aircraft, the statement said. During air-to-air refuelling, both aircraft must maintain accurate flying parameters. The IAF is one of the few air forces in the world to operate mid-air refuellers. It now operates six Russian IL-78 refuellers and has been trying to buy six more. The IAF inducted the Netra, developed by the Defence Research and Development Organisation (DRDO), in February this year. Three systems are being built and will be based at Bhatinda, facing the western border. Netra gives a 240-degree coverage of airspace.

Source: <http://www.thehindu.com/>

India's first indigenous aircraft carrier to join Navy by 2022: Sunil Lanba

Revealing that India's first indigenous aircraft carrier will be ready by 2020-end, Navy chief Admiral Sunil Lanba also said that the "form and fit" of the second indigenous carrier with a conventional propulsion has been finalised. "The (project of) indigenous aircraft carrier is progressing well and the ship will join the Navy by the end of 2020," Admiral Lanba said at an annual press conference of the Indian Navy held ahead of the Navy Day on December 4. He said that the process to buy 57 fighter aircraft to operate from an aircraft carrier had been started. About the planned second aircraft carrier, the Navy chief said it will be around 65,000-tonnes vessel. "We have analysed it, and fixed the form and fit. It is going to be about 65,000 tonnes. It will have catapult-assisted take-off and arrestor recovery. "It will be conventionally powered and we are going through the process of taking it to the (Defence) Ministry," he added. As for carrier-borne fighter jets, the Navy chief said a Request for Information was issued and the Navy had received a response from four vendors. He said a RFP (Request for Proposal) would "hopefully" be issued by mid-2018. Admiral Lanba said the indigenous Light Combat Aircraft Tejas is not yet capable of operating from a ship, adding that the Navy remains committed to the project and will induct the fighter jet's naval version when it is ready. "We are committed to indigenisation. We have supported the LCA Navy project and we will continue to support it," he said. Admiral Lanba said the Navy has already paid its share of costs for the LCA Navy programme, which was around 40 per cent of the total project cost for Mark I of LCA, that is around Rs 600 crore. The Navy is supposed to pay 60 per cent of the cost of the Mark II of LCA. He said so far the Indian Navy has given around Rs 300 crore for the project, and the transfer of the remaining money is linked to the project's milestones. "The indigenous aircraft carrier is due to be inducted in 2020. I need deck-based jet fighters by then. The LCA Navy is nowhere on the horizon. At present, it cannot be operated from the deck. It still has to go through carrier compatibility trials; it is underpowered; it cannot take off with ordnance. I need a fighter which can operate from an aircraft carrier and is combat-capable," he said. "It is a good plane to fly, but what I need is a deck-based fighter that is combat-capable. We are committed to this project. As and when the Defence Research and Development Organisation and Aeronautical Development Agency produces an indigenous deck-based fighter jet, we are willing to induct it. The first indigenous aircraft carrier is designed to operate MiG29K and LCA, so we need deck-based fighters for it also," he added.

Source: <http://www.business-standard.com/>

Aerospace sector: ready for take off with Saras?

India's first indigenously built short-haul civilian aircraft Saras is ready to make its maiden test flight. The 14-seater light aircraft successfully completed low-speed and high-speed taxi trials near Bengaluru last week, according to top sources at the National Aeronautical Laboratory (NAL). Saras can be used in a variety of roles such as air ambulance, maritime patrolling and border surveillance operations. The development of the twin-turboprop engine aircraft has been so plagued by problems - its second prototype crashed in 2009, killing the three-man Indian Air Force (IAF) test crew - that the project had been all but written off. And for years, NAL was silent about its intention to give the aircraft a new lease of life. But the engineers and scientists who spent years to bring Saras off the drawing board never really gave up and worked quietly behind the scenes to resurrect the aircraft. According to NAL Director Dr Jitendra Jadhav, the investigation into the 2009

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accident had cleared NAL, a Council for Scientific and Industrial Research laboratory, of any design deficiencies and, instead, blamed “procedural deficiencies” for the crash. He said NAL had made “more than 10 modifications since the accident, and will evaluate the performance of the plane’s systems during its test flights.” With an endurance of five hours and service ceiling of 10 kilometres, the aircraft can cover more than 1,600 km at a maximum speed of 425 kmph. When Saras finally takes to the skies, it will carry with it the hopes of the country’s aviation industry - for at stake is the very revival of India’s national civil aircraft development (NCAD) programme. Started in 1996, the NCAD project, too, seemed jinxed from the word go, with its Russian designers pulling out of the effort. The pitch was further queered when the US slapped sanctions on India in the wake of the 1998 nuclear tests. The project never recovered from these twin blows and was virtually shelved, leaving India’s aviation industry with no major aircraft development programme to speak of, never mind the licence production of several aircraft types in the country under contracts with foreign companies, where no transfer of technology (ToT) was involved. The Hindustan Aeronautics Limited (HAL) manufactured planes like the HS 748 and the Dornier 228 under licence. But in the absence of any ToT worth its name, this merely meant the transfer of production lines by the foreign firms involved. In any case, it didn’t help the domestic industry that HAL was more focused on the manufacture of military aircraft and had little time for its domestic civil aviation obligations. The Indian Navy (IN), for instance, has placed an order with HAL for a dozen Do-228 aircraft maritime surveillance and patrol aircraft, while the IAF has ordered 14 Do-228 aircraft, spare engines and a simulator from the state-run company. Add to this the glaring absence of private participation in India’s limited civilian aircraft manufacturing sector and it is easy to see why the country has yet to take any major strides in this domain. The completion of flight trials and certification of Saras and activation of its production lines alone will not change this inertia in the system. But it will infuse new energy into India’s civil/military aircraft manufacturing sector and prompt it to get off this ‘hamster wheel’ of always depending on licence production. Hopefully, government agencies like HAL, NAL, the DRDO and the Aeronautical Development Agency (ADA) will show some serious resource and research synergies so that a new roadmap could be chalked out. Only then would projects be realised within minimum, if realistic, time frames, instead of sinking under the weight of too many bells and whistles.

Private participation

Experts unanimously suggest a public-private partnership for these agencies to refresh their R&D capabilities and realise new technologies that would translate into the production of new aircraft. On its part, the government should provide technology development funding so that these agencies could partner with private entities to augment manufacturing. Since investment from abroad is crucial for the growth of the domestic industry, it is imperative to provide investors with the best possible business environment, including access to skilled manpower, favourable offset policies and relaxed tax norms. Opening the civil aerospace sector door wider to private players is certainly a game-changing strategy, as Reliance Defence’s JV with the Ukraine-based state corporation Antonov to build 80-seater aircraft in India with ToT proves. The manufacturing facility would be located at Reliance Aerospace Park at Mihan in Nagpur. Meant for military, para-military and commercial use, the aircraft would initially be assembled from knocked-down kits, with completely indigenous production expected by 2033. The joint venture also envisages a tie-up with HAL to manufacture low-cost passenger aircraft for connecting hundreds of small cities in the country as envisaged by the Regional Connectivity Scheme (RCS) announced last year. The NAL, too, has completed design and feasibility studies on a Regional Transport Aircraft (RTA), which can carry more than 80 passengers. The agency is now reportedly in talks with some private entities to fund the project. The airplane’s short take-off capability would be ideal for operating from smaller airports. To facilitate this, the government is expected to give the green light for rebuilding around 350 unused airstrips across the country. Thanks to the top-notch Maintenance, Repair and Overhaul (MRO) facilities for civil and military aircraft in the country, India is an acknowledged fount of engineering and design services. The new ‘Make in India’ initiative provides the country an excellent opportunity to build on this by sprucing up its aerospace manufacturing capabilities. And to finally shrug off the dubious distinction of being the only country that can make and fire rockets for inter-planetary missions, but still cannot develop, build and fly its own aircraft.

Source: <http://www.deccanherald.com/>

Don’t regulate us with stringent drone rules: Aero-modellers

The 32,000-strong collective of Aero- Modellers in the country just got an assurance from the Minister of State for Civil Aviation Mr Jayant Sinha: The government will consider formulating exclusive Civil Aviation Regulations (CAR) to govern the sport, far less stringent than the rules drafted for Unmanned Aerial Vehicles classified as drones. The Aero-modellers had their demands clear at an Open House consultation process arranged here by the Director General Civil Aviation (DGCA): Fixed wing model aircraft (model planes, gliders and model / scale helicopters) used for hobby and recreational flying should not be restricted to a weight below 2 kgs and a height not exceeding 200 ft. Worldwide, the established standard weight for aero-modelling aircraft is 35 to 40 kg. The height (Above Ground Level) restriction is 400 ft. These are currently the practice

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in the United States, Canada, Europe and Australia, the hobby flyers told DGCA. Unlike aero-modelling aircraft, the quadcopters and drones have a highly accurate and precise flight path. Besides, their ability for autonomous flight raises concerns of privacy, safety and security. "Such concerns do not apply in any manner whatsoever to the conventional model aircraft used for hobby, recreation and sports." To regulate commercial drone operations, DGCA's draft rule has mandated that all types of modern aircraft weighing more than 2 kgs (including those for recreational use) should be subject to Unique Identification Number (UIN) and Unmanned Aircraft Operator Permit (UAOP) requirements. Registration and training will be mandatory. These stringent conditions besides the weight and height restriction will affect about 12,000 model aircraft currently in operation countrywide. "These are being flown by more than 8,000 enthusiasts from various walks of life, of all age groups, including students and educational institutes," an aero-modeller elaborated at the Open House. Bulk of the aero-modelling aircraft used for sport / recreation weight from 3 kgs to 30 kgs. The smaller models of 2 kgs are generally flown only in parks or indoors. "In the case of motorised fixed-wing and glider models, it is impractical to manoeuvre the aircraft within a height of 200 ft," says Mr Umesh More, chairman, Wings India Radio controlled Model Flyers Club. The current import restrictions on aero modelling equipment should also be lifted, contended Bengaluru-based aero-modeller Mr Adarsh Nagarajiah. "We can make in India, but the raw materials are just not available. The spares are seized by the Customs the moment they land in India," he noted.

KEY DEMANDS:

- * DGCA should lift blanket ban on flying all types of Unmanned Aerial Systems (UAS); exclude aero-modelling aircraft from restrictions.
- * Allow model aircraft up to a maximum weight of 30 kgs as per global standards. Permit a maximum altitude of 400 ft above ground level.
- * Exempt design, building, assembly of model aircraft from DGCA regulations.
- * Create a separate category in Draft Policy for model aircraft strictly for sports, recreation and educational purposes.
- * Exempt this category from UIN registration, UAOP conditions.

Source: <http://www.deccanherald.com/>

You Only Have to Be Rich, Not Healthy, to Fly in Space

The so-called "space billionaires"—Jeff Bezos, Richard Branson and Elon Musk—imagine a day when people will live and work in space, gradually transforming humanity into a multi-planet species. The next step in that direction is the development of a space tourism industry, and that's about to become a reality. The rich will go first, of course, paying hundreds of thousands of dollars to be astronauts—if only for a few minutes. These extreme-tourism-style flights by Blue Origin, Virgin Galactic and SpaceX are seen as a precursor to an era when blasting to and from space will be considered as routine as flying from New York to Chicago. The preparation needed to make these civilian rides work is also crucial for the kind of point-to-point hypersonic flights that Musk and others have envisioned as a way to shrink travel times across the Earth. Yet, when it comes to actual commercial spaceflight, these space trips will present a demanding environment for anyone who isn't a fighter pilot or a real astronaut. Fleeing and re-entering the atmosphere is a dynamic, stressful experience, thanks to the forces of gravity and millions of pounds of thrust powering an ascent that reaches thousands of miles per hour. "It's not like just walking on an airplane and putting on your lap belt and reading a book or falling asleep," said Dr. James Vanderploeg, chief medical officer for Virgin Galactic, which could begin launching sub-orbital customer flights next year. While that may be true, research does show that space travel will probably be physically manageable for your average, untrained human. "Normal people can go into outer space," Tony Antonelli, Lockheed Martin Corp.'s chief technologist for space exploration and a former Space Shuttle pilot, said in September at the 68th International Astronautical Congress in Australia. Indeed, Americans became aware long ago that scientists, elderly politicians and even school teachers could meet all the requirements of a Space Shuttle mission—having the "The Right Stuff" didn't require you to be Chuck Yeager. But those astronauts still went through NASA's formidable training; much less physical preparation will be provided passengers who hop aboard a commercial flight. And whether they can handle the psychological stress remains an open question. For decades, human space flight has rested squarely in the government's domain. Fewer than 600 people have escaped Earth's grasp, almost all of them public employees. Membership in that exclusive club is poised to surge as entrepreneurs line up to create this new form of adventure ride: the ultimate roller coaster. The U.S. government is giving the nascent industry wide latitude, in part to encourage commercial enterprise and also because there's little stomach for funding a national space program. Congress has allowed companies to devise their own medical screening and training protocols by imposing a moratorium on space passenger regulation until 2023. The Federal Aviation Administration currently requires a license for non-governmental space flights to ensure they don't pose a hazard to public safety. But the FAA doesn't have authority over vehicle design or training—or who springs for a seat on these new space ventures. "It's really up to the company for what kind of screening

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they want to have,” George Nield, the FAA’s associate administrator for commercial space transportation, said at the annual Space Commerce Conference in Houston. If all goes as planned, the commercial space race will introduce scores of new “astronauts” each year: mostly middle-aged and older people with plenty of cash to burn—as well as run-of-the mill maladies that come with age. This situation, novel to space travel, has led researchers to probe the average person’s vulnerabilities in such an environment, contributing to a growing body of research about the stresses of rocket flight for those without a NASA-certified physique. “When I started this 10 years ago, I was pretty skeptical,” said Vanderploeg, who is also executive director of aerospace medicine at Baylor College of Medicine in Houston. After years of study that involved spinning people of all ages in a centrifuge to replicate extreme gravitational stress (or G-force), he said, “What we found was that most people would do just fine.” Does this mean space travelers with heart disease or diabetes, pacemakers or insulin pumps, or any chronic affliction that comes with old age could pass muster? Potentially, yes. The primary medical-screening issue, Vanderploeg said, is whether a flier’s condition is “well-understood and well-controlled” and the person is receiving the appropriate treatment. There’s an economic imperative at work here, too. Holding passengers to the same standards as those that faced traditional astronauts may not result in many paying customers, a critical point when you consider the open question as to whether commercial space flight will ever turn a profit. Nevertheless, Virgin Galactic LLC takes a conservative view toward screening its customers, Vanderploeg said. The first 100 customers, which the company calls “founders,” have received extensive medical scrutiny ahead of the first space flights. “I have never felt any pressure to say yes to fly somebody, or to keep them in the customer queue, who I was uncomfortable with from a medical point of view,” Vanderploeg said. “Flying or not flying a single individual is not financially significant,” he said, given the enormous capital and research investments the industry has made, and the many risks involved. Certainly, an in-flight heart attack or stroke would be a public relations disaster for this new mode of travel, in which safety is already of paramount concern. After all, the track record of U.S. human spaceflight has shown that dying on a rocket is 10,000 times more likely than getting killed on a commercial aircraft, so the physical risk is there for everyone to see. Nevertheless, research shows that the real danger for passengers may not be physical at all. While blood pressure and heart disease can be documented and managed, the larger challenge for newbie astronauts may come from plain old anxiety. Professionals have historically gone through comprehensive psychological vetting, and often come from military backgrounds in which they learned to handle combat conditions. Not so with everyday folks looking for a fun ride: Though commercial trips will initially be short, a passenger “freaking out” on a 20-minute flight could cause serious problems for all aboard. Research has found that “the typical anxiety questionnaires and psychological surveys and so forth that one uses didn’t predict well at all who might be anxious and potentially present a problem,” Vanderploeg said. That means a space carrier will probably need to observe customers closely during pre-flight training, which for Virgin Galactic is expected to last three days at its future home, Spaceport America in New Mexico. Blue Origin LLC—which is backed by the world’s richest person, Amazon.com Inc. founder Bezos—is planning 11-minute flights on its New Shepard autonomous vehicle from its site in West Texas; it has not yet disclosed a fare or when it expects to begin customer trips. The company, based in suburban Seattle, has said its training program will last about 1 1/2 days at its launch facility. Bezos and his deputies expressed confidence that such passenger issues can be avoided. “The system has been designed from the very beginning so that the training can be minimal,” Bezos said in April at an industry symposium. “You have to know how to strap yourself in and a few other things. But it’s not a significant amount of training.” “We think it’s going to cover exactly what you need for the 11 minutes,” Ariane Cornell, Blue Origin’s head of business development and strategy, said at the September space conference in Australia. One thing is for certain: These very short trips into space won’t be priced for the budget-minded. Virgin Galactic is charging \$250,000 for its two-hour journeys, which will carry two pilots and six passengers. Other potential space options aren’t likely to be cheap, either. Boeing Co. is building a human-rated vehicle, the CST-100 Starliner, for NASA supply missions, one that may also be used for future commercial activities. Musk’s SpaceX has a deal with NASA to fly astronauts to the space station aboard its Crew Dragon; it also has contracts with two private citizens to fly them around the moon. SpaceX hasn’t revealed whom it will fly or the price for the lunar trip. Two other human space vehicles are in development, from Lockheed and Sierra Nevada Corp. Both craft are under NASA contract but have potential commercial applications. For Virgin Galactic’s proposed journey, a Virgin aircraft called White Knight Two will carry the vehicle, called SpaceShipTwo, to 50,000 feet before releasing it. A rocket will then ignite to carry passengers roughly 62 miles above Earth, into weightlessness and across what is considered the (somewhat arbitrary) boundary between the atmosphere and space. The launch phase is expected to exert about 3.5G’s of force for 15 seconds, or 3.5 times the weight you feel from gravity while on the planet’s surface. Re-entry stress will be slightly higher, at 4-6G’s for 15 to 20 seconds. Passengers will be trained how to breathe through these periods. Cabin seats will shift for both acceleration and re-entry to mitigate the force of gravity; occupants are not expected to lose consciousness. In a promotional video, Virgin’s chief astronaut trainer, Beth Moses, said the company’s goal is to keep its customers from not “reacting to what has just happened” but rather to be prepared for “savoring everything that’s going on.” One unavoidable sacrifice all passengers will have to make, however, is the ability to relieve themselves. There won’t be a restroom on the Virgin Galactic, Boeing or Blue Origin vessels. “We have many things to offer, but a good commode is not one of them,” said Richard DalBello, Virgin’s vice president of business development and government affairs, during a panel at the September conference. Beyond physical, or even psychological fitness, future passengers will need to consider

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something even more basic: the overall risks inherent to space flight. On the Space Shuttle program, NASA experienced two major fatal accidents—the destruction of the **Challenger** just after liftoff in 1986 and the **Columbia** upon re-entry in 2003—out of 135 launches. NASA's current commercial crew program, which involves the Boeing and SpaceX vehicles, prescribes a 1-in-270 chance of death, estimating it as roughly four times safer than the shuttle, said David Klaus, an aerospace engineering professor at the University of Colorado at Boulder, who has researched space risks. The risk is roughly equivalent to that of climbing Mount Everest, according to an FAA-funded analysis by Klaus and other researchers, which is a little more than a 1 percent chance of not making it back. That's pretty much the same odds American astronauts have faced up until now. In the U.S., 375 human space flights over the past 50 years have resulted in four fatal accidents, including a 1967 crash of the X-15 hypersonic rocket plane, the two shuttle losses and the October 2014 crash of a Virgin Galactic spacecraft in California. That's about a 1 percent fatal accident rate, the FAA's Nield said at the September conference in Australia. "That's something we want to improve upon," he said. Safety isn't likely to be compromised by any of the space-faring upstarts, Klaus said. But the question remains for each business: "How safe is safe enough?" he asked. "There's no good engineering answer to that. It's a question that's easy to ask and very difficult to answer." "I think it's safe to presume that accidents will occur," said Michelle Hanlon, an attorney specializing in aviation and space law with consulting firm ABH Aerospace LLC. Passengers will undoubtedly be required to sign waivers preventing them or their survivors from suing, she said. Part of the notion of "informed consent" is that a participant actually understands the risks before agreeing to accept them, according to FAA regulations for human spaceflight. Nevertheless, Hanlon said, no waiver will prevent someone from trying to sue when the worst happens. Lawyers will argue that "the consent was marred because it didn't explicitly state this or it didn't explicitly state that," Hanlon said. "You're going to end up in court—definitely."

Source: <https://www.bloomberg.com/>

Indian aviation outlook very good; infrastructure worrisome: IATA

The outlook for the fastest growing Indian aviation market is "very good" but infrastructure and taxation issues could be detrimental for its growth, according to global airlines' grouping IATA chief Alexandre de Juniac. Clocking high double-digit growth for more than two years, India's domestic aviation market is one of the fastest growing in the world. Even as he emphasised that the country's aviation market is "promising", the IATA's Director General and CEO said there are concerns with respect to certain aspects. "India outlook is very good because it is the fastest growing market... (but) we have some concerns about the Indian market. Infrastructure, taxes which are too high (and) not totally clear about the new GST," de Juniac told in an interview here. According to him, there are a lot of taxation issues and they could be "detrimental to the development of aviation". With respect to the Goods and Services Tax (GST), de Juniac said it is a better system even though the devil is in the details. Exclusion of airport fee and charges levied on ticket from the transaction value for GST purpose are among the issues being flagged by the IATA. On whether the risks in the Indian aviation market could possibly outweigh its growth potential, de Juniac replied in the negative even as he asserted that the government should take the right decisions in terms of costs, charges and infrastructure. "We think that probably the most worrisome item is infrastructure. If you don't have the capacity or the costs are high, it is an enormous obstacle for the development of aviation which cannot be overcome. Infrastructure is the key issue," he noted.

Source: <https://economictimes.indiatimes.com/>

88 airports to be functional under UDAN, says minister

Union Civil Aviation Minister P Mr Ashok Gajapathi Raju said that a total of 88 airports in the country would be made functional in the next one-and-a-half-years, through two rounds of bidding under the UDAN regional connectivity scheme. Speaking after inaugurating the upgraded Hubballi Airport here, he said only 71 airports had flight operations till the UDAN scheme was launched. "During the second bidding under the UDAN scheme, we are looking at getting air connectivity from Hubballi to Mumbai, Chennai, Pune, Kannur, Hyderabad, Kochi, Goa, Tirupati, Delhi and other places," he said. Civil aviation would get a boost if the state governments keep their taxes on fuel and other materials within reasonable limits. Unfortunately, the trend is that the state governments hand over only loss-making airports to the Centre, he said. "Amphibious aircraft (seaplane) service is also being launched in the country. This has great potential as the country has 7,500 km of coastline and a number of reservoirs," the minister said. India, at present, stands in the third position in terms of growth in the civil aviation sector, mainly due to the increasing number of domestic passengers. Union Chemicals and Fertilisers Minister Mr Ananth Kumar stressed the need to develop the region as an international cargo hub, through the upgraded airport. He suggested that the airport be named after Jagajyoti Basaveshwara. Mr Gajapathi Raju also inaugurated the new terminal and flagged off Air India's A319 aircraft service (tri-weekly) on the Bengaluru-Hubballi-Mumbai route. Union Minister of State for Civil Aviation Jayant Sinha, district incharge Minister Mr Vinay Kulkarni, MP Mr Pralhad Joshi, Leader of the Opposition in the Assembly Mr Jagadish Shettar and others were present.

Source: <http://www.deccanherald.com/>

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HAL to produce 100 of its own trainer aircraft

Military aircraft manufacturer Hindustan Aeronautics Ltd. Said it plans to make 100 of its own product, the basic trainer aircraft HTT-40, over the coming years once the aircraft clears the ongoing critical 'spin' tests. Another immediate goal is to work towards getting the basic flight certification of another home product, the Light Utility Helicopter or LUH, by the middle of 2018, T. Suvarna Raju, HAL's Chairman and Managing Director, told the fifth annual global vendors' meeting here. Updating a gathering of over 80 Indian and foreign vendors of its key projects, Mr. Raju said, "Given our large number of platforms with the Indian Defence Forces, we remain committed to increasing the scope of work for our vendors." HAL is internally developing the indigenous basic military aircraft trainer, HTT-40, for training newbie pilots of the Air Force. The first prototype demonstrated a short flight in June last year. Having spent Rs. 350 crore of its own funds on the project since 2013, HAL had earlier said the project would need another Rs. 200 crore to build three more flying versions.

Source: <http://www.thehindu.com/>

DRDO has key role in 'Make in India' programme, says Nirmala Sitharaman

Minister Ms Nirmala Sitharaman said that the Defence Research and Development Organisation (DRDO) has a great role in realising the 'Make in India' vision of Prime Minister Mr Narendra Modi. She was speaking at a programme organised for 'Transfer of the DRDO Developed Technologies to Industry' at the Naval Science and Technology Laboratory (NSTL). The NSTL is a premier naval systems lab of the DRDO in the port city. Ms. Sitharaman complimented the DRDO scientists for the outstanding work in realising critical defence systems. "The DRDO has a great role to play in realising the 'Make in India' vision of the prime minister," she said. The minister said she was confident that the DRDO will rise to the challenge and transform India into a major exporter of defence systems, according to a release issued by the NSTL. Ms. Sitharaman was the chief guest at the programme. 'Make in India' is a flagship initiative of the NDA government to make the position of the country as a manufacturing hub.

Source: <http://www.thehindu.com/>

Civil aviation ministry may face funding crunch for UDAN

With more routes set to be operational under UDAN, the civil aviation ministry is likely to face paucity of funds in providing viability gap funding to participating airlines, according to a senior official. To connect unserved and under-served aerodromes as well as make flying more affordable, the ministry has launched Ude Desh ka Aam Naagrik (UDAN) and as many as 128 routes connecting 70 airports were awarded in the first round of bidding. A total of 141 initial proposals have been received from various players in the second round of bidding, the results of which are expected to be announced this month. As participating airlines are extended viability gap funding (VGF), the ministry feels that amount that will be available towards it might not be sufficient once more players start operating UDAN flights. The ministry contributes 80 per cent of the VGF amount, while the remaining comes from the state governments concerned and in the case of north-eastern states and union territories, the sharing ratio is 90:10. A senior ministry official said funds available for providing VGF might not be enough as more routes become operational under UDAN. Towards VGF, the ministry is levying Rs 5,000 per flight on key routes and proceeds from this route is estimated to be around Rs 200 crore annually. So far, the ministry has garnered around Rs 70 crore by way of levy for the VGF. In the coming year, all the airports in the first round would be operational, the official said. While a final decision is yet to be taken, the ministry might ask state governments concerned to cough up more money to meet the VGF requirements. Another possibility could be by way of budgetary support, the official added. Under the regional connectivity scheme, VGF will be provided for the flights for three years from the date of commencement of operations. As per the ministry, in the first and second rounds, there are airlines that have not asked for any VGF. A total of 141 initial and 55 counter proposals have been received. There are altogether 18 applicants, including 17 who have put in their initial proposals in the second round of bidding. The initial proposals involve 502 routes that seek to connect a total of 126 airports and helipads. These include 49 unserved and 15 under-served airports as well as 24 helipads, the ministry said last month. Out of them, 108 are for flying fixed wing aircraft and 33 for operating helicopters. The number of UDAN flights to be operated in a week with VGF should be at least three and a maximum of seven departures per week from the same airport.

Source: <https://timesofindia.indiatimes.com/>

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India's HAL plans to produce 100 HTT-40 basic trainer aircraft

India-based Hindustan Aeronautics Limited (HAL) is exploring plans to produce 100 Hindustan Turbo Trainer-40 (HTT-40) basic trainer aircraft. Production of the aircraft is expected to begin after completing spin tests over the coming months. The HTT-40 is intended to replace the Indian Air Force's (IAF) existing fleet of HPT-32 Deepak trainers. The aircraft has been designed for basic flight training, aerobatics, instrument flying and close-formation flights, whereas its secondary roles will include navigation and night-flying. This fixed-wing aircraft has a bubble canopy, T-tail configuration and a retractable tricycle landing gear system with a steerable nose wheel. With a maximum take-off weight of 2,800kg, the trainer can be configured to carry a gun, rockets and bombs to perform light combat and counter-insurgency missions. HAL CMD T Suvarna Raju said: "Given our large number of platforms with Indian Defence Forces, we remain committed to increase the scope of work to our vendors to ensure success of our programmes." The company has invited global vendors to participate in its future projects during a meeting held on 12 December. More than 80 business partners from India and abroad participated at HAL's 5th Global Vendors' Meet. The vendors were briefed about procurement procedures and improvements made by HAL. The company is expected to achieve basic certification of the light utility helicopter (LUH) by mid-2018.

Source: <https://www.airforce-technology.com/>

Powering Up NASA's Human Reach for the Red Planet

NASA is pushing forward on testing a key energy source that could literally "empower" human crews on the Mars surface, energizing habitats and running on-the-spot processing equipment to transform Red Planet resources into oxygen, water and fuel. The agency's Space Technology Mission Directorate (STMD) has provided multi-year funding to the Kilopower project. Testing is due to start in November and go through early next year, with NASA partnering with the Department of Energy's (DOE) Nevada National Security Site to appraise fission power technologies. **Confidence builder** "The Kilopower test program will give us confidence that this technology is ready for space flight development. We'll be checking analytical models along the way for verification of how well the hardware is working," explains Lee Mason, STMD's principal technologist for Power and Energy Storage at NASA Headquarters. The DOE/National Nuclear Security Administration infrastructure and expertise have been instrumental, Mason points out, as have the talents of Los Alamos National Laboratory engineers in New Mexico. NASA's Glenn Research Center in Cleveland has managed all phases of the Kilopower Project, from designing and building the hardware, with contributions from NASA's Marshall Space Flight Center in Huntsville, Alabama, through developing the test plan and operating the tests. The Y12 National Security Complex in Oak Ridge, Tennessee is providing the reactor core. "A space nuclear reactor could provide a high energy density power source with the ability to operate independent of solar energy or orientation, and the ability to operate in extremely harsh environments, such as the Martian surface," notes Patrick McClure, project lead on the Kilopower work at the Los Alamos National Laboratory. "The reactor technology we are testing could be applicable to multiple NASA missions, and we ultimately hope that this is the first step for fission reactors to create a new paradigm of truly ambitious and inspiring space exploration," adds David Poston, Los Alamos' chief reactor designer. "Simplicity is essential to any first-of-a-kind engineering project – not necessarily the simplest design, but finding the simplest path through design, development, fabrication, safety and testing."

Sun-independent power

The pioneering Kilopower reactor represents a small and simple approach for long-duration, sun-independent electric power for space or extraterrestrial surfaces. Offering prolonged life and reliability, such technology could produce from one to 10 kilowatts of electrical power, continuously for 10 years or more, Mason points out. (The average U.S. household runs on about five kilowatts of power). The prototype power system uses a solid, cast uranium-235 reactor core, about the size of a paper towel roll. Reactor heat is transferred via passive sodium heat pipes, with that heat then converted to electricity by high-efficiency Stirling engines. A Stirling engine uses heat to create pressure forces that move a piston, which is coupled to an alternator to produce electricity, similar in some respects to an automobile engine. Having a space-rated fission power unit for Mars explorers would be a game changer, Mason adds. No worries about meeting power demands during the night or long, sunlight-reducing dust storms. "It solves those issues and provides a constant supply of power regardless of where you are located on Mars. Fission power could expand the possible landing sites on Mars to include the high northern latitudes, where ice may be present," he points out.

Power options

NASA has flown a number of missions powered by radioisotope thermoelectric generators (RTGs) over the past five decades, such as onboard the two Viking Mars landers, the Curiosity rover now at work on the Red Planet, the Apollo expeditions to the moon, the two Voyager spacecraft, and the New Horizons probe to Pluto and beyond, as well as the just-concluded Cassini mission at Saturn. RTGs produce electricity passively with no moving parts, using the heat from the

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natural decay of their radioisotope heat source. “What we are striving to do is give space missions an option beyond RTGs, which generally provide a couple hundred watts or so,” Mason says. “The big difference between all the great things we’ve done on Mars, and what we would need to do for a human mission to that planet, is power. This new technology could provide kilowatts and can eventually be evolved to provide hundreds of kilowatts, or even megawatts of power. We call it the Kilopower project because it gives us a near-term option to provide kilowatts for missions that previously were constrained to use less. But first things first, and our test program is the way to get started.” The novel energy-providing technology also makes possible a modular option for human exploration of Mars. Small enough in size, multiple units could be delivered on a single Mars lander and operated independently for human surface missions.

Breadboard test

In step-wise fashion, with safety as a guiding principle, Mason says the Kilopower hardware will undergo a full-power test lasting some 28 hours. Moving the power system from ground-testing into a space system is an achievable objective, says Mr Don Palac, Kilopower project manager. Lead Researcher Marc Gibson adds, “The upcoming Nevada testing will answer a lot of technical questions to prove out the feasibility of this technology, with the goal of moving it to a Technology Readiness Level of 5. It’s a breadboard test in a vacuum environment, operating the equipment at the relevant conditions.” Looking into the future, Mason suggests that the technology would be ideal for furthering lunar exploration objectives too. “The technology doesn’t care. Moon and or Mars, this power system is agnostic to those environments.”

Source: <https://www.nasa.gov/>

Astrophysicists solve mystery linked to neutron star merger

Astrophysicists using radio telescopes, including the one located on the outskirts of Pune, may have resolved some nagging riddles, following the first-ever detection of gravitation waves in August this year, leading to the awarding of the 2017 Nobel Prize for physics to three US scientists. The remarkable discovery of gravitational waves emanating from the merger of two neutron stars – extremely massive celestial bodies created by the collapse of giant stars – named GW170817 (after the day of the discovery) by sophisticated LIGO and VIRGO gravitational-wave observatories in the US and Italy, has created a renewed excitement in the world of astronomy. Gravitational waves are the faint ripples in spacetime, first predicted about a century ago by Albert Einstein. The crash of neutron stars that occurred 12.5 billion trillion km (130 million light years) away from the earth released radiation across the electromagnetic spectrum. Scientists could explain some of these radiations, particularly falling in the ranges of ultraviolet, visible and near-infrared, as the radioactive decay of heavy elements such as uranium and gold during GW170817. But the emissions of gamma-rays, X-rays and radio waves remained a mystery. While one theory on neutron star collisions proposed that they could be the result of narrow, super-fast, jets of radiation that came out during the merger, and thus would eventually weaken over time. However, observations by Mr Mooley and others, including Mr Poonam Chandra at the National Centre for Radio Astronomy at Pune and Mr Varun Bhalerao at the Indian Institute of Technology Bombay, using radio telescopes at multiple locations, detected something which is just the opposite: radio emissions from the GW170817 collision were actually gaining strength over time. “Before GW170817 was detected, astronomers thought that all merging neutron stars produce narrow super-fast jets, similar to those seen in a short gamma-ray burst (GRB),” said Mr Mooley, currently Hintze Fellow at the Centre for Astrophysical Surveys in the Oxford University, UK. Such bursts arise from narrow yet powerful jets that are normally aimed straight at the earth. But when the GW170817 observational data ruled out that possibility, some astronomers said the jet could be pointed slightly away from earth, but their model could not satisfactorily explain the gamma-ray emission, said Mooley, who earlier studied in Pune and at IIT Bombay, before leaving for a PhD at the California Institute of Technology in the US. Instead, “our radio observations suggest that the jet was not pointing towards the Earth (unlike the case of short GRBs) and more importantly that the jet transferred most of its energy to the surrounding neutron-rich material (that was ejected during the neutron star merger event), thus forming a bubble-like structure called a cocoon,” Mr Mooley, who is the first author of the study that appeared in the prestigious scientific journal *Nature*, told *BusinessLine*. “The cocoon scenario can explain the radio light curve of GW170817 as well as the gamma rays and X-rays. It’s the one most consistent with the data,” said Tara Murphy of the University of Sydney, a co-author of the study, in a statement. Apart from radio telescopes located in Australia and the US, the Giant Metrewave Radio Telescope near Pune provided observational data for the study published in the prestigious research journal *Nature*. Their observations suggested that the merger of the neutron stars resulted in an outflow of material in many different directions (a wide-angle outflow), unlike an earlier-suggested narrow jet, as seen in the case of short-duration GRBs. Their observation also pointed out that it was very unlikely that all neutron star mergers would give rise to regular GRBs.

Source: <http://www.thehindubusinessline.com/>

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India successfully test-fires supersonic interceptor missile

India successfully test-fired its indigenously developed Advanced Air Defence (AAD) supersonic interceptor missile, capable of destroying any incoming ballistic missile in low altitude, from a test range in Odisha. This was the third supersonic interceptor test carried out this year in which an incoming ballistic missile target was successfully intercepted, within 30 km altitude of the earth's atmosphere by an interceptor. "It was a direct hit and grand success," Defence sources said after the test launch. The earlier two tests were conducted on March 1 and February 11, 2017, as part of efforts to have a full-fledged multi-layer Ballistic Missile Defence system. "Today's test was conducted to validate various parameters of the interceptor in flight mode and it was all success," the sources said. After getting signals by tracking radars, the interceptor AAD missile, positioned at Dr Abdul Kalam Island — previously known as Wheeler Island — in the Bay of Bengal, roared through its trajectory to destroy the hostile target missile in mid-air in an endo-atmospheric altitude, defence sources said. The interceptor is a 7.5-meter long single stage solid rocket propelled guided missile equipped with a navigation system, a hi-tech computer and an electro-mechanical activator, the sources said. The state-of-the-art interceptor missile has its own mobile launcher, secure data link for interception, independent tracking and homing capabilities and sophisticated radars

<https://timesofindia.indiatimes.com/>

TECHNOLOGY

ISRO Hopes To Launch One Rocket A Month In 2018: Chairman AS Kiran Kumar

India plans to have at least one rocket launch every month in 2018 from its spaceport at Sriharikota in Andhra Pradesh to deploy satellites in orbit, said a top space official today. "We are planning to have at least one launch mission a month in 2018 to deploy satellites in the earth's orbit for various applications," said Indian Space Research Organisation (ISRO) Chairman AS Kiran Kumar. "For 2018-19 and 2019-20 financial years, we are looking to receive increased budgets from the country in view of the missions," he told reporters on the sidelines of the inauguration of a Gallery on Space Technology at Visvesvaraya Industrial and Technological Museum. ISRO was given a budget of about Rs. 9,000 crore for 2017-18. The first of the missions ahead is likely to be the launch of Cartosat-2E remote-sensing spacecraft along with 28 nano- and micro-satellites in early January if delayed from December-end. On Chandrayan-2 mission, Mr Kumar said the work on realising the satellite was in full swing. The launch is likely to take place by the first quarter of 2018. The state-run ISRO is also expected to carry a 600-kg spacecraft designed by TeamIndus on its Polar Satellite Launch Vehicle (PSLV) before March 31, 2018, for the city-based firm to win the Google Lunar XPRIZE. "There are still a lot of discussions that are going on with TeamIndus regarding the launch," the ISRO chief said. TeamIndus is the only Indian team among the five finalists competing for the \$30 million Google Lunar XPRIZE, a competition meant to challenge and inspire engineers and entrepreneurs from around the world to develop low-cost methods of robotic space exploration. At a gathering of students at the opening of the space technology gallery, Mr Kumar said: "You're at the prime moment where India as a country is surging ahead. India has got every potential to be the number one in the world, for which each of you must put in your best efforts." Astrosat, the country's first space observatory, was one of the best satellites in the category providing Indian scientists with access to data about the edge of the universe, he said. "It is never too late to do anything in science and technology. We can always make a mark. When we put in our best efforts, no one can beat us," the ISRO head said. Former ISRO Chairman and National Education Policy Committee Chairman Mr K Kasturirangan, and National Council for Science Museums Director General Mr AS Manekar were also present.

Source: <https://www.ndtv.com>

Three aviation giants are working together to create hybrid electric planes

Airbus, Rolls-Royce, and Siemens are collaborating to create the technology necessary for a hybrid electric plane, the companies said. Known as the "E-Fan X programme," the collaboration started in 2012 as a response to the European Union's desire to reduce carbon dioxide emissions and nitrogen oxide pollution. While the companies want to test a hybrid electric plane by 2020 and have one flying commercial flights by 2025, their goals are more modest in the short term. The first step is creating an electric engine that could be placed on a traditional aircraft, the BAe 146. The most pressing obstacle the companies will have to overcome is the current weight of the batteries and cooling equipment necessary for electric flight. If they're able to do so, it could make life much easier for airlines, who devote a significant amount of their budgets to fuel costs. Electric motors would also reduce the amount of noise airplanes make, which could allow airlines to schedule more evening flights.

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Airbus, Rolls-Royce, and Siemens hope to make hybrid electric flight a reality by 2025.

- **Airbus, Rolls-Royce, and Siemens are collaborating to create the technology necessary for a hybrid electric plane.**
- **They want to test a hybrid electric plane by 2020 and begin commercial flights by 2025.**
- **Electric engines could reduce airplane noise and fuel costs.**

Source: <https://www.businessinsider.in/>

Boeing and MIT Build New Wind Tunnel for Drones and Other Aerospace Ideas

Aerospace giant Boeing will act as the lead donor in an \$18 million project allowing MIT to construct a new, updated wind tunnel. The replacement of the 79-year-old Wright Brothers Wind Tunnel with a new facility will be “the largest and most advanced academic wind tunnel in the United States,” says an MIT announcement. The new facility will be operated by the MIT Department of Aeronautics and Astronautics. The new facility will “improve ability to test autonomous vehicles (drones)” and aerodynamic components including wings, bodies, and wind turbines,” says the announcement. The new tunnel will significantly increase the test area and update the original 2,000 horsepower fan motor to require half of the power. MIT says that the new facility will allow for new classes and areas of research. Boeing Chief Technology Officer and Senior Vice President, Engineering Test and Technology Greg Hyslop says, “Few relationships in aerospace can compare to the ties between MIT and Boeing. We’re thrilled and gratified to be part of this critically important renovation that will launch our relationship into the second century of aerospace.” “... We’ve worked with the great people and facilities at MIT over the decades, and with this gift, we will continue in the years to come,” Hyslop says. The current Wright Brothers Wind Tunnel was finished in 1938. The new facility will be on the same site. Dismantled parts of the current Wind Tunnel will be preserved by the MIT museum. MIT is already a major innovator in the drone industry as in other areas of aerospace. The new Wind Tunnel may help them to move drone development ahead and attract new companies in the drone industry to the MIT environment. “The new Wright Brothers Wind Tunnel will present MIT with a state-of-the-art research and teaching tool for many years to come...” says AeroAstro department head Jaime Peraire.

Source: <https://dronelife.com/>

India Developing Small Rocket To Cash In On Small-Satellite Boom

With the size of earth observation satellites reducing and the future trend moving towards a constellation of small satellites rather than a large one, India’s space agency is developing a smaller rocket that can carry satellites weighing up to 500 kg, a senior official said. India currently gets contracts to launch small satellites largely weighing less than 500 kg and a smaller rocket would be sufficient, he added. He also said 2018 will be an eventful year for the Indian space agency with several notable launches being lined up. “Owing to advancement in technology, the mass of satellites is coming down — including that of communication satellites. A lot of start-ups are building small satellites and they would like to put one in orbit at a lower cost,” K. Sivan, Director, Vikram Sarabhai Space Centre (VSSC), a part of the Indian Space Research Organisation (ISRO), told IANS. According to Mr Sivan, the preliminary design for the proposed four-stage rocket that would weigh around 100 tonnes is ready and its feasibility study has also been conducted. Mr Sivan said the first rocket would be ready in two years once the project gets the necessary approvals. At present ISRO gets contracts from foreign organisations to carry small satellites. These are largely carried piggy-back whenever India launches a bigger satellite for its own use with the rocket Polar Satellite Launch Vehicle (PSLV). The PSLV rocket has three variants weighing between 230 tonnes and 320 tonnes, with a carrying capacity ranging between 1,100 kg and 1,900 kg. Mr Sivan said a smaller rocket will be sufficient to tap the small satellite segment. Looking forward to 2018, Mr Sivan said it is going to be an eventful year with several launches, including the country’s second Chandrayaan moon mission. Mr Sivan said ISRO will be launching a Cartosat satellite and several foreign satellites as piggy-back with the PSLV rocket sometime in January 2018. He said the country’s heaviest communication satellite — the GSAT 11, weighing over five tonnes — would be launched next year by Arianespace’s Ariane rocket.

Source: <https://www.ndtv.com/>

Work to integrate BrahMos on 40 Sukhoi aircraft begins

Work has begun to integrate the BrahMos supersonic cruise missile on 40 Sukhoi combat aircraft which is expected to fulfil critical needs of the Indian Air Force in the wake of evolving security dynamics in the region. The air-launched variant of

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the BrahMos, the world's fastest supersonic cruise missile, was successfully test fired from a Sukhoi-30 combat jet on November 22, marking a major milestone to enhance the precision strike capability of the air force. The work to integrate the BrahMos missile on 40 Sukhoi combat aircraft has begun. A timeline for the project is being set, official sources said without elaborating. It is learnt that the project is expected to be completed by 2020. The fleet of 40 Sukhoi jet will undergo structural modifications at the state-run aerospace major Hindustan Aeronautics Ltd (HAL) for integration of the missile on them. The 2.5-ton missile flies almost three times the speed of sound at Mach 2.8 and has a range of 290 km. The range of the missile, an Indo-Russia joint venture, can be extended up to 400 km as certain technical restrictions were lifted after India became a full member of the Missile Technology Control Regime (MTCR) last year. BrahMos missile is the heaviest weapon to be deployed on India's Su-30 fighter aircraft. Once the project to integrate the weapon on the combat fleet was over, the IAF capability to strike from large stand-off ranges on any target in sea or land is expected to go up manifold. "It is a very important project considering IAF's evolving requirement to boost air power when the possibility of a two-front war cannot be ruled out," said an official. After the test firing of the air-launched version, the IAF had said the missile coupled with the superlative performance of the Su-30 aircraft will give the force a strategic reach and will allow it to dominate the ocean and the battle fields. The integration of the missile on Sukhoi aircraft is a very complex process involving mechanical, electrical and software modifications of the Su-30 jet. BrahMos is a joint venture between DRDO of India and NPO Mashinostroyeniya (NPOM) of Russia.

Source: <https://timesofindia.indiatimes.com/>

India's First Solar Mission Aditya-L1 to be Launched by 2020

The Indian Space Research Organisation (ISRO) is planning to launch the first solar mission, Aditya-L1. The project is approved and the satellite will be launched during 2019 – 2020 timeframe by PSLV-XL from Sriharikota, ISRO mentioned on its website. Aditya-L1 mission is aimed at studying the Sun from an orbit around the Sun-Earth Lagrangian point 1 (L1) which is about 1.5 million kilometres from the Earth. It would carry seven payloads to observe the photosphere, chromosphere and the outermost layers of the Sun, the corona in different wavebands. The satellite will be launched during 2019 – 2020 timeframe by PSLV-XL from Sriharikota ISRO's Aditya-L1 is a fully indigenous effort with the participation of national institutions. Indian Institute of Astrophysics (IIA), Bengaluru is the lead institute for the development of Visible Emission Line Coronagraph (VELC) and Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune is developing the Solar Ultraviolet Imager (SUI) payload for the Aditya-L1 mission. The main aim of the solar mission is to do coronal and near UV studies of the sun and help resolve some unanswered questions in solar physics. In a written reply to a question in Lok Sabha today, Union Minister Dr Jitendra Singh informed that ISRO's Aditya-L1 can provide observations on the corona and in addition can provide observations on the solar Chromosphere using the UV payload and on the flares using the X-ray payloads. Singh further added saying that the particle detectors and the magnetometer payload can provide information on charged particles and the magnetic field reaching the halo orbit around L1. The Aditya-1 mission was conceived as a 400kg class satellite carrying one payload, the Visible Emission Line Coronagraph (VELC) and was planned to launch in a 800 km low earth orbit. A Satellite placed in the halo orbit around the Lagrangian point 1 (L1) of the Sun-Earth system has the major advantage of continuously viewing the Sun without any occultation/ eclipses. Therefore, the Aditya-1 mission has now been revised to "Aditya-L1 mission" and will be inserted in a halo orbit around the L1, which is 1.5 million km from the Earth. The satellite carries additional six payloads with enhanced science scope and objectives. To recall, NASA-ESA mission SOHO was launched in 1995 that made many discoveries. But its coronagraph which was meant to image the sun broke down shortly after the mission commenced. As of now, there is no satellite imaging the sun from space. With the launch of Aditya-L1, the gap will be filled and detailed information about the sun can be traced. Aditya-1 was meant to observe only the solar corona. The outer layers of the Sun, extending to thousands of km above the disc (photosphere) is termed as the corona. It has a temperature of more than a million degree Kelvin which is much higher than the solar disc temperature of around 6000K. How the corona gets heated to such high temperatures is still an unanswered question in solar physics.

Source: <http://www.india.com>

BUSINESS

Godrej Aero gets new BrahMos contract

Godrej Aerospace, a unit of Godrej & Boyce Mfg. Co. Ltd., has won an order for an additional 100 units of airframes for the air launched version of BrahMos missile. The company handed over the 100th set of airframe assemblies to BrahMos Aerospace Pvt. Ltd. (BAPL) for use in its missile systems. "It gives me great pleasure to hand over the completion document for the 100th set of airframe assemblies to Dr. Mishra. This is a proud moment for Godrej, Brahmos and India, and an assertion of our commitment to serve our country through technologically driven solutions and indigenous manufacturing,"

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said Godrej & Boyce CMD Jamshyd N. Godrej, handing over the completion documents of the 100th BrahMos airframe to Dr. Sudhir Mishra, Director General (BrahMos), and CEO BAPL. "I am confident our partnership will continue to set new benchmarks and serve as an inspirational role model for indigenous development and production of sophisticated weapon systems," said Mr. Mishra.

Source: <http://www.thehindu.com/>

Boeing to make aircraft components near Bengaluru

Global aerospace major Boeing would make aircraft components and subsystems at a new facility it would soon set up on the city's outskirts, a senior official said. "The state government approved Boeing's proposal to set up an engineering and technology facility with electronics and avionics manufacturing and assembly at an investment of Rs 1,152 crore," Karnataka Udyog Mitra Managing Director Mr B.K. Shivakumar told IANS here. The facility will be built in 41.7 acres of land the American firm has been allotted in the Aerospace Park at Devanahalli, about 40km from the city, and adjacent to the Bengaluru international airport. "When commissioned, the Boeing facility will provide 2,300 direct jobs and many more indirect or associative jobs," said Mr Shivakumar. The aerospace behemoth, which makes various types of aircraft for civil and military operations worldwide, has a global research and development centre in the city since a decade. The high-level high committee of the state Industry Department also approved the proposal of CDC Development India Ltd to set up a Technology Innovation International Park in the hi-tech, defence and aerospace Park at a cost of Rs 740 crore, with an initial job potential for 25 high-skilled techies. "CDC has been allotted 100 acres of land in the Aerospace Park to build its tech park," said Mr Shivakumar. Universal Builders has been allotted 21.3 acres of land in the hardware park area of the aerospace park at a cost of Rs 525 crore for a housing project. The committee has also cleared the Indian Coast Guard's proposal to set up a training centre at Mangaluru, about 350km from here, at an investment of Rs 1,010 crore. "The training centre will be built in 160 acres of land in the New Mangaluru Port Trust at Panambur and will create 250 direct jobs," added Mr Shivakumar.

Source: <http://www.business-standard.com/>

We are excited about making F-16 aircraft in India: Lockheed Martin Official

Lockheed Martin is excited about the prospect of making F-16 fighter aircraft in India and making India a global manufacturing and supply base for the aircraft, according to Phil Shaw, the Chief Executive of Lockheed Martin India Pvt. Limited. He was speaking here after participating in a programme - Girls in aviation sector - jointly organised by the company and the Airports Authority of India. He said F-16 aircraft was the proven and the most advanced fighter aircraft in the world and "it would be a tremendous boost to the make-in-India initiative of Prime Minister Mr Narendra Modi. We are partnering with the Tata group for the purpose." In response to a query, he said there would be constant improvements to the aircraft and India would be the beneficiary of the technological advancements. He said the company had already supplied 12 numbers of C 130 cargo plane to the Indian Airforce, the aircraft being placed six apiece at two air bases in the country, and the components are manufactured in Hyderabad. He said the company was also promoting innovators in India for the past 11 years in a programme jointly taken up with the Department of Science and Technology, and in association with Tata Trust. "We have chosen 50 promising innovators and given them an opportunity to study in MIT in the USA. During the period, it is estimated that they may have come up with 450 business arrangements, with an estimated value of \$ 1 billion. From this year, we are also taking up seed funding of promising start-ups," he added. Referring to the role of women in aviation sector, he said there were great prospects opening up for them in civil aviation sector in India and the world and "therefore girls should grab the opportunity with both hands. We are conducting such programmes to enthuse them to take to aviation."

Source: <http://www.thehindubusinessline.com/>

Indian Air Force initiates Rs 33,000-cr buy of 83 Tejas fighters

In a big step towards defence indigenisation, the Indian Air Force (IAF) has issued Hindustan Aeronautics Ltd (HAL) a tender for 83 Tejas light combat aircraft (LCA). HAL issued a brief note stating: "HAL has received Request for Proposal (RFP) for 83 LCAs from Indian Air Force." Earlier the defence minister stated in a written reply in Parliament: "Defence Acquisitions Council (DAC) has cleared acquisition of 83 LCA Mk 1A for IAF, production of which is planned from 2019-20..." With HAL sources placing the ticket price of the Tejas Mark 1A at about Rs 400 crore per aircraft, the 83-fighter deal would generate Rs 33,200 crore worth of business to HAL and a range of Indian and foreign upstream suppliers. At present, HAL is struggling to establish Tejas manufacture for 40 fighters already on order – 20 fighters in the initial operational

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configuration (IOC); followed by another 20 in the final operational configuration (FOC), when that is obtained. Acknowledging the manufacturing delay in Parliament, the defence ministry stated: "Out of total 20 IOC aircraft (16 fighters and 4 trainers), 5 fighters have been delivered by HAL to IAF till date. The production of remaining 15 IOC aircraft (11 fighters + 4 trainers) are taken up at HAL." Further, "Production for 20 FOC aircraft, will be taken up after FOC clearance by Aeronautical Development Agency (ADA)." While HAL builds these 40 Tejas Mark 1 fighters, it is also working on four major upgrades that will transform the current version of the fighter into the Tejas Mark 1A, of which 83 will be built. Of the four upgrades, the two most operationally vital involve integrating the fighter with "active electronically scanned array" (AESA) radar, in place of the Tejas Mark 1's manually scanned Israeli Elta EL/M 2032 radar; and integrating a "self-protection jammer" (SPJ) that is carried in an external pod under the Tejas' wing. Two other upgrades – improving the "maintainability" of the fighter, and fitting it with external refuelling capability – are already well in hand. The defence ministry told Parliament today that, to introduce the Tejas into service in larger numbers, a second production line was being set up. "For ramping up production capacity from existing 8 aircraft to 16 aircraft per annum, Government of India has sanctioned Rs 1,381.04 crore in March 2017". Despite these measures, indigenous production of the Tejas would be insufficient to meet the IAF's requirements, given the likely phasing out of ten squadrons (210 aircraft) of MiG-21s and MiG-27s this decade. The ministry told Parliament: "In order to bolster the fighter squadron strength, Government of India has also planned to manufacture fighter aircraft through Strategic Partnership model." The Strategic Partnership model envisages selected private sector firms building defence platforms in India in partnership with a selected foreign vendor that transfers technology to manufacture here. The IAF has already sent out enquiries for building a "single-engine fighter" in India, for which Lockheed Martin is fielding its F-16 Block 70 fighter, and Saab is offering the Gripen E.

Source: <http://www.business-standard.com/>

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PRESS RELEASE

Aeronautical Society calls for higher participation by Women Professionals

The Aeronautical Society of India gave a call for higher participation of women professionals in the aviation and aerospace sectors in India. Dr. R.K. Tyagi, President, This Aeronautical Society of India (AeSI), while speaking at 'International Conference for Women in Aviation and Aerospace' held in Delhi on 19.12.2017 called for policy initiatives and encouragement for higher participation of women professional in all the fields of aviation and aerospace including R&D and defence. The Conference was organised by Indian Women Pilots' Association (IWPA) on the occasion of its golden jubilee celebrations. IWPA was formed in the year 1967 by Capt. Chanda Sawant, Capt. Mohini Shroff and 4 other women pilots. IWPA is a sister society of AeSI and shares a common objective of advancement in the world of aeronautics and aerospace through sharing of knowledge. AeSI was formed in the year 1948 and today has a membership of more than 13,000 aviation professionals. The women pilots today account for 12% share among the Indian pilots which is the highest as compared to any other country in the world. However, keeping in view the Indian aviation today, a fast growing sector where investments of more than 220 billion US \$ are expected in the next 10 years, the regional connectivity scheme expects to open up 70 new airports in the next one year, there is a need of more and more women professionals in the field of aviation and aerospace. For this, requisite policy initiatives need to be initiated by Ministry of Civil Aviation. Even though share of women professionals in Indian aerospace is higher than any other country in the world, Dr. Tyagi wished to see it increase from 12% to 51%. During the conference, the women professionals from various airlines in India, Indian Air Force, Indian Navy, ISRO, DRDO, Indian Railways show cased their contributions and future plans for enhanced women participation in the related areas.



Inaugural photograph (from L to R, Air Chief Marshal B.S. Dhanoa, Capt. Mohini Shroff (founder trustee of IWPA), Dr. R.K. Tyagi, Mrs. Dhanoa (President, AFWWA), Mr. Khwaja (IOC), Ms. Harapreet A.D. Singh, President IWPA and Shri Jayant Sinha, Hon'ble Minister of State for Civil Aviation

INDIA AEROSPACE: THE FUTURE

I am indeed grateful to AESI, the office bearers and others who have given me this unique opportunity to deliver Bharat Ratna Dr. APJ Abdul Kalam Memorial Lecture. I am particularly touched because of his name for the lecture. Another reason is that it is at Thiruvananthapuram, where from 1965 our friendship started as initial seed and sapling to grow into a wonderful tree later. I myself was shaped in my professional career by Space Science & Technology Centre (SSTC) at Thiruvananthapuram, to which I was appointed by Dr. Vikram Sarabhai – it was in the PRL-SSTC account; I worked from Ahmedabad but travelling often to Thiruvananthapuram. There are many other personal items such as Thiruvananthapuram being my mother's birth place, our son's birth place etc. I skip all of them.

Decades have passed since then. There is a good level of achievement in the area of Space Technology: launch vehicles, satellites and various applications. There is a substantial level of indigenization in these fields. The system design and execution have been, since the beginning, fully indigenous.

There are many persons who were and are responsible for these achievements, making India proud, and setting good example for Make in India. Of these many persons, I am choosing two persons about whom I will recall some memories since this event is both Aero and Space. That memory is not for just nostalgia nor is it for filling up a talk with some anecdotes. It is for drawing some lessons especially for Aero part and its future.

While mentioning about some items related to those persons for Aero Part, I am not fully following an ancient dictum: " Satyam Bhryuaat; Priyam bhryuaat; na bruyaat satyam apriyam. (Tell truth; Tell pleasantly; Don't tell unpleasant truths!) I am rejecting the third part. I derive strength from Tulsi Das: " Mantri Guru aru Vaidya piya bolahi bhay aas/ Raja, Dharam aru Tan teenahi beygahi naas"

Adviser to king, guru and physician tell pleasant things out of fear or in the hope (of rewards); (Then) King, Dharma and Body all three get destroyed speedily!" So I seek your apologies, if some of it is hurtful. I say it with the full desire, in fact passion, for a bright future of India aerospace with Aero part equally making India proud; serving Indian people in a major way. I have derived that vision and passion from the two persons I have selected.

They are: Prof. Satish Dhawan (SD) and Dr. A.P.J. Abdul Kalam (Kalam). I need not introduce these persons to this audience. Even when Kalam was working at TERLS, Thumba, as Rocket Engineer, at Vikram Sarabhai's instance, he started working also on RATO (Rocket assisted take off). After some time, it was not pursued by the user. Kalam's involvement in aircraft related work was to come much later though it was in his mind. But launch vehicle and missile dominated his mind during 1960's, 1970's and 1980's, though he worked with aircraft industry-HAL. Thank God, he was with ISRO which gave him the ambience and ecosystem to pursue the space part thanks to SD who took over as Chairman ISRO & Secretary Department of Space since 1972. Even in this position SD's heart was full of aircraft also though he did not have any direct responsibility for it except in a limited way as Director Indian Institute of Science (IISc). Even here, his attempt to nurture an ace

pilot and academic Dr Rustom Damania (RD) in the aeronautics department was a failure, due to rigid norms of IISc in promotion- -with emphasis on papers only. So he moved RD to NAL (National Aeronautics Lab- then called). It was only a limited success with RD flying a small aircraft from Bangalore Delhi. I won't dwell on it. Be it for Avro for which SD led a detailed review, a classic report in those days or for other items, he was striving to create a system and projects for aircraft development, design& production in India – be it a trainer or small aircraft. It was Track-2 effort for him. He would try to influence HAL through some responsive Chairmen & Raj Mahindra, and also enthusing NAL Director & scientists.

India continued to have total turn-key projects and licensing for aircraft production. He used to share with me some of his frustrations in creating an indigenous aircraft industry for industry in India even with a small product. During are such discussions, I mentioned to him (it was during a flight from Delhi to Bangalore, when we were sitting side by side): “Sir may I tell you as to why aeronautics design development and indigenous production is not taking place in India?” Seeing his expression I continued: “ Sir in the field of aeronautics, we have doyens of internationally reputed researchers like you, Drs. Valluri Raj Mahindra, Narasimha etc- So many. Research and scientific papers are the top most priority for them and their colleagues.

“But ISRO was fortunate that it does not have any such persons. They have to prove themselves by doing things, making them in India and producing them in India. So ISRO is project /product oriented!” I stopped there. He was silent and looked at me sharply and perhaps fondly! He appeared to agree with me without telling me. My impertinence to a great academician was tolerated and accepted! But SD for ISRO was a great Systems Manager, and Program Manager who focused and channelized ISRO towards doing concrete products with global standards in mind. He also concentrated on the applications of launch vehicles and satellites. Without end applications, they were irrelevant for him.

Kalam, who openly acknowledged SD as his guru carried those essentials with him while doing SLV-3 and later in missile programme. SD used to tell me in the context of his vision for large scale commercialization of space technology: “It is difficult to develop a space Industry ab initio in a country where there is no established aircraft Industry”. He clearly understood the linkage of aircraft industry and space technology products. But ISRO had to do it mostly alone with some limited assistance of HAL which was obtained after a great deal of persuasion since 1974; I was a direct partly to such struggles! I am glad at least that much of linkage between HAL & ISRO existed from then and also with a number of forward thinking Indian manufacturing private sector industries.

Those linkages were effectively used by Kalam for his missile programme. Kalam inherited a direct mantle for driving Aero part as well when he become Secretary DDRD, SA to RM & DRDO chief, through LCA Programme. By then LCA/ADA had already completed close to decade with limited progress. In the meanwhile TIFAC (Technology Information Forecasting & Assessment Council) for which I was Executive Director/CEO (Kalam being Chairman of Governing Council) had

come up with an excellent forecasting and assessment report about the Civil Aviation Sector in India. It was driven by Satish Chandra of NAL who had returned to India from UK after a good stint in BAE and had joined NAL. The study had the benefit of inputs from many global stake holders as well.

Instead of just producing a report as to how an Indian made aircraft would look like, or about an Indian indigenous aviation sector, the report analyzed the global status and trends. It had done a factual assessment of how India stood in the context of global achievements thus far and how the trends were. This was around the years 1992/1993. The sad fact was that Indian aircraft sector in terms of indigenous development was below even Brazil & China. Even smaller European countries like Spain had global leadership in niche component assembly areas.

Most of the Indian capabilities, be it in manufacturing or simulators for training pilots, were in isolated places without a vision to expand to meet the emerging global needs. HAL was mostly tied up to Indian Air force and had little plans to utilize its excellent hard and soft infrastructure to meet emerging domestic and global needs.

After assessing all these, the report recommended about 30 items in which India can become a global player, though having a full indigenous aircraft was not the top priority due to the then existing Indian capability. Kalam & Narasimha presented the findings to the Civil Aviation ministry requesting them for support action of having “offset manufacturing” when India buys civilian aircraft. This was also a part of the plan in the report. After lots of efforts, typical was the reply from the ministry: “Now the economy has been liberalized. It is left to the market forces. The Boards of Air India & Indian Airlines would have to decide on such matters!” No country in the world had built up its Aerospace or Aeronautics Industry this way!

I don't want to narrate further. On one side we had such ministries/Departments which had no vision on or desire for indigenous development. On the other end we had scientists & academicians who loved their research papers. DRDO was caught in between; itself not clear about a road map to master aviation technology in the country, when decades had passed since 1942 when India established its first aircraft maintenance Industry years before starting automobile industry. I don't want to say anything about what CSIR/NAL did! We are thus confronted with many missed opportunities. To simply go around them or to try to resurrect some of those past skeletons is not the way to go forward. What is lost is lost! What is ahead of us and what can be done to make a reasonable indigenous base, is what we need to think of, now.

THE NEW SITUATION

Some crucial developments for Aerospace Industry in India during the past decade or so present us with opportunities for the new situation. Let me try to list them.

- a. Huge growth of aviation service providers; they depend on foreign procured aircraft and associated equipment. But they are able to provide globally competitive air travel domestic/foreign.
- b. There are now a number of excellent airports in India though most of them are built with imported design and products.

- c. ISRO's space programme has achieved global standards though it needs to expand its capacity (scale of production) to become globally competitive
- d. Down-stream industries related to aviation and space applications have expanded tremendously though many of them are dependent on imports (There is a large scope to increase the Make in India, Design in India, concepts)
- e. Government of India has for the first time recognized the importance of aviation sector in the economy of smaller town/villages and is driving the regional connectivity through UDAAN – Indian aviation is not going to be only metro-and-big city centric.
- f. Culture of START UP is picking up and Indian entrepreneurs are not afraid of entering into aerospace sector though there are several policy uncertainties .
- g. Because of the requirements of Make in India, several foreign big aerospace companies are setting up their joint ventures in India as well as R&D Centres. Some major Indian private players are pro-active in setting up such aerospace companies.
- h. UAV's are opening up entirely new market segments: even agriculture can benefit greatly by judicious use of UAV's
- i. Position location systems and geospatial applications are becoming ubiquitous from ordinary transport to personal use. Though these are closely linked to space and communication technologies, they affect aircraft and aviation sectors in a major way. There will be demands of the consumers to provide such services even while travelling in an aircraft or in air ports. UAV's may need these systems. Many passengers will no longer be comfortable with communication-switch-off-mode!
- j. With increased aviation traffic and large scale use of UAV even by school and college students, accident risks increase. Also there are vital internal security concerns. In the current phase of human society (India not excluded) it is no longer possible to use the license- permit-quota- inspector-raj techniques of denial to consumers. (In 1950's Indians had to have a license to have simple radio receivers at home. Even as late as 1979 ISRO could not use a neck microphone based system for a four language translation required for a prestigious international conference of COSPAR held for the first time in India, at Ashoka hotel in Bangalore; there was no security clearance from Govt. ISRO was forced to wire up the entire hall to reach individual seats!) Solutions for tracking and control for security purposes or accident avoidance have to be based on sophisticated electronics systems and simulated models.
- k. Aerospace manufacturing technologies may have a large scale impact from disruptive technologies of such as additive layer manufacturing or 3D manufacturing, which have entered commercially in Aero Space Sector already.
- l. The omnibus word AI which is popular now would also have an impact on AeroSpace Industry from relatively simple versions of automated manufacturing, robotics to various advanced simulations during design, for crew training or for risk profiling. Complex big data analyses may be useful to enhance air travel comfort to aviation safety by tracking the behavior of passengers, the crew etc. as well as meticulous follow up of all data obtained from a flying aircraft to improve the maintenance protocols.

Thus AeroSpace sector, though in one sense a mature operational sector, is also having a number of new green shoots thus defying its own ageing process. Therefore the AeroSpace

professionals in India have new opportunities to produce things at a world class level excelling in global competition and also serving the people of India.

In the next few paragraphs, I will try to elaborate as to what ought to be done in order to shape the emerging India AeroSpace Future. Invoking from what I said at the beginning of the talk, I am also going to say some “DON'Ts in addition to “DO's” The reason is that India does not have any more new window of opportunity to come by; the luxury of missed opportunities, is no more an option.

THE WAY FORWARD

Having been in the business of foresight (the current popular word for thinking ahead systematically and pragmatically) right from my ISRO days of 1970's, I have seen (painfully) how many excellent opportunities were thrown away in almost all sectors -- from agriculture, to fisheries to animal husbandry to electronics to biomedical to aerospace sectors. Because of that inaction for decades, India cannot now start with ab initio concepts to do things as it would take a decade or more to show first results. Look at what happened to LCA now transformed to TEJAS. I am happy that amid such arid zone, a helicopter from HAL is trying to compete in the global markets.

But let us not resolve- repeat- not resolve to make an India designed civilian aircraft – whatever size. Let the Aeronautics community rally behind a few joint ventures which will manufacture some substantial amount of parts and assemblies in India and if possible even assembly of full civilian aircraft. Let us also at the same time encourage foreign companies who may not be ready to make joint ventures but willing to establish their fully owned manufacturing, design, R &D facilities in India. Though the management may be foreign, for sheer reasons of profitability they will use Indian personnel to work for them in their organizations. That will create a huge human capital in aerospace sector which was not forming well in India, due to the missed opportunities. These companies would source many materials, parts and even designs locally. That process will create ancillary sectors as it happened for automobiles. Also some of our bold entrepreneurs may develop new start ups in such a vibrant ecosystem. Those start ups may be able to sell globally and also to the India located companies fully foreign, fully domestic or joint ventures. In such a process Indian PSU's would also try to rejuvenate themselves, if undue protection is not given to them and if they are allowed to function freely in a professional manner. There may be a number of questions to me when I suggest the about such a strategy. What about the strengths in core technologies? I will be told “Foreign companies will not give such know-how to us either in a JV or in their India operations. They will be several steps ahead of us. Such advanced R&D will be done by them in their companies abroad (USA, Canada, Europe or Japan)”.My answer is: “ Yes, indeed; why should they give away their leadership to anybody else-- be it China, India, Brazil or Israel on a platter? Keeping up leadership in advanced and critical technologies is in their national interest and company's interest.”

Japan or Israel or China has struggled for over two decades to achieve leadership in some special niches. Japan supplies to USA some very advanced aero worthy composite material. When a company located in other countries acquires some special capabilities, aerospace giants from the developed countries won't mind dealing with them. I do not want to flood you with examples even for China. To blame only "technology denial regimes" for delays in Indian R&D projects is like attributing full blame on "climate change" for the recurrent floods in our rivers or for urban flood disasters in Mumbai, Chennai, Bengaluru, etc. I will be the last person to accept a situation where India had to be an eternally dependent nation on foreign companies to manufacture in India. The situation until very recently was that India was importing full systems from abroad being NUMBER ONE in the rank of military systems importer in the world! A wrong place to be number one!

We indeed need R&D in the country. We need some advanced research as well as India designed systems or subsystems which can meet not only just domestic markets but also capture some niche international markets. But it cannot be achieved just by saying that we are second to none and keep funding our academic/ R&D institutions in the same way as we did in the past and are doing now. I am pained to see the brilliant academics chasing only international citations and acceptance by select foreign journals the editorial priorities of which do not match India's developmental and strategic needs. Similarly laboratories of DRDO, NAL, etc should not take pride in spreading thin in all areas. As of now their record of performance in terms output towards commercialization in crucial areas is poor. They need to orient urgently towards a few select gap areas (not full aircraft!) and work on a project mode (I avoid the word Mission mode because that word has been abused and misused!) to deliver products (this word product includes software as well). Most of Govt. R&D grants including that from DRDO should be focused on these projects alone! The projects should be of 3 to 4 years duration only in order to be judged and to keep pace with the challenges ahead.

If necessary two independent R&D groups can be funded for the same product to compete with each other, depending on the criticality of the new product to capture new markets. These R&D groups should work closely with an Industry or a consortium of industries right from the beginning. Fitting into the value chain of global aeronautics industry and also add some additional performance to our own users in military or civil sectors should be the only focus. It should not be a free-wheeling R&D. If we can spot some new domestic or foreign IPR's which show promise of a new technology enhancement, we may even buy them and build further R&D on them.

In short, let us make our indigenous R&D focus on end-use, timely delivery, and rapid commercialization. (I use the word "commercialization" to include even the cost competitive operationalisation if it is going to be Govt. users for tasks in public interest areas). If such deliveries are done on a large scale with high quality, an industry created out of Indian design, development and delivery, will be born soon and grow rapidly. It is possible to do so within a decade if rigorous regime I had described is followed meticulously and the current methods of working are drastically changed.

SOME NEW APPLICATIONS FOR AEROSPACE SECTOR

I had described earlier about the New Situation that has arisen in India. A number of items from (a) to (i) are listed. In each of them there are a number of innovative technologies and engineering challenges. Specialists in this august audience are better placed to disaggregate the details and items on which emphasis had to be given. I also note that a number of speakers in this event are addressing several specialties. My appeal to all of you in the Indian AeroSpace community is: "Please do not keep doing the same thing again and again and expect different results than what we have had during past six decades or so"-- to paraphrase an Einstein quote. That is why I had elaborated DO's & DON'T's in the section "The Way Forward". It is a methodology. The detailed items identified by the specialists have to go through those filters for actual implementation.

I am confident that if you all make up your minds and get into action sincerely, you can achieve a level of world leadership for India AeroSpace in about two decades (at the end of a decade many hopeful signs will emerge). Therefore I am not listing any particular technology or a product (big or small) that would fit into the domestic and global value chains. In this last section I want to stimulate your thoughts towards new application areas, because in our country we are generally tuned to look at AeroSpace as being essentially tied up with military systems and metro connecting high volume aviation. Of course they are big in size and have in them several lakhs of crores of rupees in terms of business and large employment. They are vital; no doubt on that.

But aerospace in the current era can spread to applications for agriculture, water management, continuous monitoring of lakes, disposal solid and liquid wastes, etc; these are also huge in size. Given the easy abundant availability of high resolution satellite based remote sensing data on one side and the miniature sensors and transmission systems which can be fitted on UAV's on the other end, continual monitoring of many agriculture related parameters and their immediate dissemination with user-friendly value addition to the farmers and administrators are possible if India-specific, locale-specific systems are designed and implemented. Some parameters are soil health related. Govt. of India has announced a soil health card programme already. I need not expand on other items like garbage /waste monitoring. Remember that there are about 50,000 colleges in India and a few million higher secondary schools. They are valuable human resource base to build up a huge operational network, on a business scale. Local ground truths can be obtained on smart mobile phones by them with excellent geo-spatial codes. UAV's can periodically have a closer and more intense look of a larger area- call them "UAV cells". For whole of India they can be around 10,000 "UAV cells" something close to the number of blocks about 6000 in India (block is an administrative unit). Earth observation satellite data from Indian or foreign sources can keep on providing a higher aggregation level data. All these can be linked with computer-communication networks. Big Data Analysis based systems can easily disaggregate user friendly messages and send to Indian user in the languages of their choice (even with images and voice); one can build- in a feed back or talk- back features as well to enhance the value to the end users. AeroSpace is the crucial link which will make it possible with great real time speed.

This is not just for fun. If carefully planned along with the real users such as farmers, municipalities, village administrators, NGO's who do something concrete on the ground instead of simply agitating or raising slogans for media (there are a number of them), traders, transporters,

public health sector personnel, etc, such a system can transform India into a prosperous, clean and healthy nation. Nature will then revive with full bloom. Indian people will get out of current hassles. Having worked for many years for the National Natural Resources Management System (NNRMS) I am deeply aware of the current inadequacies in supplying useful data to our people living in villages, towns, forests, marshes, coasts, riverside dwellings etc. Still our high tech applications are not touching their lives as much as they can do like ubiquitous TV and Mobile phones, the only two items which reach most Indians in a major way becoming a part of their lives. Most of us would like to reach them with really relevant Information to improve their economic status, health, local living conditions(Swacch), etc. And we can also enable them to ask back and obtain further information to enhance the value of such information for themselves, in their languages. That will also form one glorious feature of DIGITAL INDIA, which Indian Aero Space sector can deliver easily, say in about 5 years, even while it would take up the challenge of two-decade marathon & sprints to obtain global leadership of India Aero Space.

I am sure that the bright and bold minds here will pick up this Challenge of “India Aero Space Digital Service” to all Indians in addition to the two decade marathon interspersed with sprints described in the earlier part of the talk. Thank you.

(Delivered as the Bharat Ratna Dr. A P J Abdul Kalam Memorial Lecture at the 68th Annual General Meeting of the Aeronautical Society of India with its deliberations focused on “Emerging Trends in Aerospace Technology” held at G V RAJA Conventional Centre, Hotel Samudra, Kovalam, Thiruvananthapuram on 22 September 2017).

Y.S.RAJAN
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