

# COLLABORATIVE PATHWAYS FOR DEFENCE R&D TOWARDS ATMANIRBHARTA

Dr Sateesh Reddy, Secy DoD R&D and Chairman DRDO\*

*“Making India self-reliant is the only way to ensure that the 21st century belongs to India.”*

*—Prime Minister Narendra Modi*

## **Abstract**

*Development of systems based on advanced technologies in all domains of defence like missiles, ground based combat systems, ammunitions, aeronautical systems, naval systems, computing and electronics systems, cyber technologies and life sciences requires the adoption of multiple development approaches. System engineering is to be supported by the growth of all segments of science, technology and industry, leading to the production by the Indian industry. Collaborations with these segments in an integrated and systematic way is the only way to achieve the dream of self-reliance. Multiple strategies are being implemented to increase the pace of defence research and development in the country. Collaborative efforts taken up during the COVID-19 pandemic paid rich dividends in bringing out products and technologies to combat COVID. Learning the new normal and simultaneously keeping the timelines of the project taught us to be more resilient and focused. New policies and methods to engage Users, Academia, other Scientific Organisations and Industry were quickly introduced and streamlined. These consist of increasing both depth and breadth of collaborations with all stakeholders. Implementation of new policies and increased*

*interactions has resulted into multiple projects showing promising results. Building on our existing strengths and working on the advanced and futuristic technologies, DRDO is leaving no stone unturned to achieve its goals of providing cutting edge technologies to armed forces and steadfastly moving towards the goal of AtmaNirbhar Bharat.*

In this era of exponential technology transformation, it has become imperative for research and development organizations to adopt to the new normal of rapid prototyping, accelerated product development and compressing deliverable time lines. Research to mass production needs to be achieved in shorter time spans, meeting the requirements and maintaining the quality. Reduction in the time for product deployment has to be achieved while working towards the national imperatives of Atmanirbharta. As the nation's premier defence research and development organization, DRDO plays the preeminent role in addressing the demanding challenge of not just innovative defence systems towards comprehensive national security but raising to the challenge of meeting the needs of the nation at times of need such as the ongoing COVID pandemic. DRDO being at the forefront of technology and process innovation has leveraged hyper collaborative pathways to achieve significantly compressed timelines.

DRDO has been undertaking the unknown challenges as well as research related to improving known capabilities. Research in areas of cutting edge technologies ensures development of the long term capabilities and assets while incremental research and indigenisation efforts are critical for the present. Both these research perspectives are important and their co-development is necessary for the creation of credible deterrence and maintaining a potent operational defense capability. DRDO has developed processes and mechanisms to create actionable collaborative pathways between Academic Institutions, Labs and Industry to achieve accelerated and tangible output for both the research perspectives.

Balancing the basic and applied research in pursuing technological advances is the most important factor for defining the directions of

defence research. Today's basic research lays the foundation for tomorrow's product developments. For creating maximum options and harnessing majority of technological directions, efforts are required to plan the broad as well as promising focus areas.

With these principles, DRDO is on the mission to design, develop and enable the production of state-of-the-art sensors, weapon systems, platforms and allied equipment for armed forces. DRDO also provides technological solutions to the services to optimise combat effectiveness and to promote well-being of the defence personnel. Development of infrastructure, committed quality manpower and building strong indigenous technology base is taken up for achieving these objectives.

DRDO is a network of 43 laboratories which are deeply engaged in developing defence technologies covering various disciplines, like aeronautics, armaments, electronics, combat vehicles, engineering systems, instrumentation, missiles, advanced computing and simulation, special materials, naval systems, life sciences, training, information systems and agriculture.

Today country is self-reliant in technologies related to Missiles, Radars, Sonars, Main Battle Tank, Fighter Aircrafts, Electronic Warfare Systems, Guns, Torpedoes, Communication Systems and many other defence systems. This has led to the indigenous development and production of these defence systems within the country. DRDO is developing technologies for all major defence domains and with its vast design and development capability, it has formed a strong foundation for Atmanirbhar Bharat. Some of the noteworthy defence products developed by DRDO are Light Combat Aircraft, Tejas; Main Battle Tank, Arjun; Air-borne Early Warning and Control System, Netra; Multi-Barrel Rocket Launcher, Pinaka; Surface-to-Air Systems, Akash, LRSAM/MRSAM and QRSAM; Beyond Visual Range Air-to-Air Missile, Astra; world's longest range artillery gun, Advanced Towed Artillery Gun System (ATAGS); many advanced Armaments and Ammunitions; and a wide range of Radars and Electronic Warfare Systems. These have given quantum jump to India's military might generating effective deterrence and providing crucial leverage.

Several major projects for the development of defence systems are going on with significant milestones already achieved. While defence systems are being developed for the use of armed forces, there is continuous thrust on cutting-edge technologies which have defence applications. Technology demonstrations are the path to adoption into the defence application. Anti-satellite missile test, Hypersonic technology demonstrator vehicle, Quantum communication and Quantum Key demonstration, and LCA landing on Aircraft Carrier Vikramaditya are the mileposts which very few countries in the world have scaled.

The work in multi-disciplinary domains is undertaken as an integrated organisation with the help of various development partners in the country. DRDO has enabled an excellent eco-system within the country wherein it collaborates with academia, industry for the development of systems and sub-systems, armed forces, sister organisations in scientific areas and think tanks to design and develop the systems within the country. DRDO has not only taken up design and development, it has taken up all initiatives to streamline and support the production of systems by the industry.

It was during the pandemic that DRDO team across the country rose to the occasion for the social cause under the circumstances of exigency. DRDO contributed in making many products, technologies, designing innovative hospital aids, drug and diagnostics, providing infrastructure like hospitals and operating test laboratories. DRDO also continuously monitored and did hand holding of industry for realising the crucial systems and equipment. DRDO has worked shoulder to shoulder with departments of central health ministry, state government bodies, industries and medical practitioners in a seamless way to realise covid specific aids, facilities and systems. DRDO while supporting India's fight against corona pandemic never lost the sight of its goals to empower India with cutting-edge defence technologies.

## **Intense Collaborative Efforts during Pandemic**

DRDO by virtue of its expertise and experience in various engineering domains and work in nuclear, biological and chemical (NBC) defence at various life sciences laboratories, has specialised set of equipment as well as expertise which was utilised for Covid testing, PPE testing, Mask design, drug development and many other activities. DRDO scientists also undertook the design of various equipment to arrest the spread of the pandemic. These products and technologies are mostly spinoffs of the existing technologies of defence, or utilizing the expertise of scientists in various fields like electronics, control flow, software and hardware design. A few of the products and the collaborations undertaken thereof are brought out.

Under the aegis of Society of Bio Medical Technology (SBMT) indigenous Critical Care Ventilator (CCV) was developed by DRDO way back in 2004. This expertise and knowhow were utilized to design, develop critical ventilator components and software in a very short period of time. DRDO's facilities were utilized 24X7 during the months of April and May'20 to ensure the final design with all advanced features required for Covid-19 ICU treatment. The production of 30,000 ICU Ventilators was done by BEL along with other industry partners. DRDO also headed the Ventilator Technical Specification clearance committee for MoHFW, to assist the ministry for taking decisions on procurement of ventilators.

DRDO PPE test facility was used extensively to test various indigenous PPEs at a very crucial juncture when only one such facility was available in the country. DRDO developed PPE technology was transferred to industries and production was ramped up to meet the emerging demand. The intense efforts of April-May'20 by Ministries of textile, health along with DRDO made India self-sufficient in the production of PPEs.

DRDO developed a five layered N-99 masks using a nano-web-filter-layer developed and tested in biothreat mitigation project was upscaled during COVID-19 outbreak. DRDO also aided in testing the face masks. Aerosol protection units and face shields were also

designed. DRDO also helped in testing of Sanitizer formulations as per WHO guidelines.

Utilizing the expertise in mist technology for fire/dust suppression and sensor technologies, contactless sanitizer dispenser was developed to meet the prevailing needs of COVID-19 prevention at workplaces/hospitals. Personnel, vehicle and closed/open area sanitization equipment based on different sanitization methods like UV-C, thermal, Microwave, H<sub>2</sub>O<sub>2</sub>, Ozonation and Hypo solution using various dispersion technologies have been configured and realized. Shoes and driveway sanitizers were innovated to aid the prevention of COVID-19. Innovative accessories like pocket sanitizers, touch pen sanitizers and multi-purpose access tools were also developed.

DRDO coordinated with PSA to GoI office and worked with Israel MoD for the conduct of clinical trials of four diagnostic modalities in more than 10,000 subjects. DRDO was also a lead participant in operation 'Khula Asman', which intended to open Indian Sky for foreign travellers amid ongoing pandemic. DRDO built a fully equipped 1000 bed Covid-19 hospital in Delhi within 11 days and set a benchmark.

Surge of second wave of Covid-19 in April'21 assumed a proportion which once again unsettled the medical infrastructure posing serious challenges to the health care sector. It was when the complete lockdown was ordered by the states, DRDO was at the helm of providing scientific solutions to the country in combating Covid pandemic. Role of collaboration with scientific organisations and industry became more prominent during this wave, since the tasks were mammoth and interaction was longer rather than just transferring the technology and expecting the sales to be undertaken by them. DRDO worked hand in hand with many industries of various domains to undertake these mammoth tasks.

DRDO was once again directed by the government to make COVID hospitals at various locations across the country. The specifications of the hospital infrastructure on the ICU Beds, Oxygen Beds, and Normal Beds were worked out in consultation with the Ministry of Health and Family Welfare and state health authorities. Supported by the PM Cares, State

governments and CSR funding, these hospitals were built as per the specified medical standards. DRDO has made a total of 11 hospitals and managed the operations with the support of local administrations, medical care staff was made available by AFMC, CAPF and state governments.

As part of PM Cares funding DRDO was tasked to establish oxygen plants. Pressure Swing Adsorption (PSA) based Medical Oxygen Plant (MOP) technology is an offshoot of the On-Board Oxygen Generation System (OBOGS) project for medical grade oxygen generation. India is the 4<sup>th</sup> country to develop this technology in the world. A total of 866 plants are being installed by DRDO, out of which 120 are being realized through CSIR-IIP industry partners. A low-cost high-performance zeolite alternative for the plants is brought out after extensive testing and benchmarking. Now low-cost, continuous and reliable oxygen supply is available round the clock not only for Medical Oxygen Plants but also for oxygen concentrators.

To avoid the wastage of oxygen from the cylinder-based oxygen support system, an SpO<sub>2</sub> based regulated oxygen cylinder has been designed. Under the PM Cares fund 1,00,000 numbers of manually controlled, 50,000 numbers of automatic control and 10,00,000 Non-Rebreather Masks have been ordered.

An anti-COVID-19 therapeutic application of the drug 2-deoxy-D-glucose (2-DG) has been approved for emergency use. This work was taken up by Institute of Nuclear Medicine and Allied Sciences (INMAS) of DRDO in collaboration with Dr Reddy's Laboratories (DRL), Hyderabad in April 2020 and the approval for use of this drug as adjunct therapy for Covid-19 patients was given in May 2021. The drug is being used to cure moderate to severe patients on prescription.

DRDO has developed SARS-CoV-2 IgG specific ELISA kit, a rapid and reliable antibody test kit. This kit is useful for ascertaining the sero-prevalence against SARS-CoV-2 and for epidemiological purposes in large population of symptomatic/asymptomatic individuals including vaccinated/infected population.

During the time of Pandemic more than 190 number of Technology Transfers (ToTs) have been done for the Covid related products. The process was made easier by empowering directors of the laboratories to clear the ToT documents without Headquarter's intervention. Industries are producing these products in large numbers and supplying them in India and abroad.

The coming together of R&D organisations, PSUs and Private Industries has resulted in increasing the capability and strength of the country. It has established the confidence in the country that unified efforts with unique capabilities of the teams can handle any such future challenges. A vibrant ecosystem has been created within the country for meeting the objectives of "Atmanirbhar Bharat". A zeal to contribute to the society made DRDO scientists go out of their comfort zones and worked shoulder to shoulder with doctors, industry, academia, other ministries and government departments seamlessly and achieved many firsts while serving the Nation during one of the worst calamities of recent times.

### **Technical Milestones of 2020**

Like the entire country, DRDO personnel and its entire ecosystem was affected by the pandemic and disturbances due to lockdowns, but DRDO kept its sight focused on its goals. The year 2020-21 has been extraordinary for DRDO in terms of giving push to the indigenous technologies and products manifestation, of which are the successful test trials of the niche defence systems like, Hypersonic Technology Demonstrator Vehicle (HSTDV), New Generation Anti-Radiation Missile (NGARM) Rudram I, BrahMos Extended-Range Missile with indigenous boosters, Control and Guidance trials of Stand-off Anti-Tank Guided Missile (SANT), Quick Reaction Surface-to-Air Missile (QRSAM), Supersonic Missile Assisted Release Torpedo (SMART) Weapon System, third generation Helicopter-Launched Anti-tank Guided Missile (HELINA) Dhruvastra, Anti-tank Guided Missile (ATGM) for MBT Arjun Mark 2, Man-Portable Anti-Tank Guided Missile (MPATGM), Tactical Missile Prahar, High Expendable Aerial Target Abhyas, Pinaka Rocket System with enhanced range, technical sea trials of Mine Influence Ground Mine (MIGM), Advanced

Lightweight Anti-Submarine Torpedo and Active Electronic Scanned Array Radar 'Uttam' onboard fighter aircraft LCA LSP-2.

Tripod-mounted compact 2 kW Anti-Drone System integrated with jammer, EOTS and NSG radar was successfully demonstrated to representatives of Ministry of Home Affairs, Indian Air Force, Indian Army and Indian Navy. Ground Acceptance Tests of Internal Radar Warning Jammer System for Jaguar DARIN III Upgrade Aircraft was completed in June 2020. Phase-3A trials of Digital Radar Warning Receiver, Dhruvi, were successfully completed with satisfactory detection of all ground and air-borne emitters. User Assisted Technical Trials of Air Defence Fire Control Radar, Atulya, at high altitude low temperature were completed. Carrier landing and take-off of Light Combat Aircraft (LCA) Navy on INS Vikramaditya has been a major milestone for the country.

### **Nurturing Indian Industry for Defence Production**

DRDO is working to make India an advanced technology nation meeting the Prime Minister Narendra Modi's dream of Atmanirbhar Bharat and is helping industry in a big way. New DRDO Procurement Manual PM-2020, released by Raksha Mantri Rajnath Singh, encourages more participation from Indian industry, especially start-ups and micro, small and medium enterprises (MSMEs), for achieving self-reliance in the defence sector.

Indian Industry is a valuable partner of DRDO in its endeavor. They play an important role as development partner and/ or Production agencies. DRDO, over the years, has substantially enhanced the technological capabilities of Indian industry through various policy initiatives, sustained engagements and intense technology transfers. DRDO is taking these efforts to next level to transform India into a hub of advanced defence technologies developing state of the art defence equipment and systems. Recently DRDO has launched a scheme to encourage the defence technology startups in the country.

DRDO has been nurturing as well encouraging industry to take up defence manufacturing. Today, more than 2000 industry partners have joined hands with DRDO in delivery of components, subsystems,

systems, platforms and technologies for Indian Armed Forces. Many industries have achieved the capability and the capacity to become the lead system integrator. The technology of all systems is transferred to the Indian Industry for production and supply

Many of the defence technologies developed by DRDO have good potential and utility for application in commercial market too and are transferred to the industry for commercial exploitation. DRDO nurtured industry partners have become part of global supply chain and have started exports of DRDO developed systems to friendly countries. Some of the initiatives to nurture Indian industry for defence production are mentioned here in brief.

### **Transfer of Technology**

DRDO provides the relevant 'know-how' in the form of Technology Transfer Documents (TTD) and handholding support to Indian industry. Technology is transferred to Development cum Production Partner (DcPP) / Development Partner (DP) / Production Agency (PA) without any ToT Fee and to other industries with a one-time ToT Fee @5% of total project sanction cost. Royalty is not charged on net sales to Indian Armed Forces and other Govt Departments. 2% royalty is applicable for sales in Indian commercial market and exports. Details are available at website <https://drdo.gov.in/transfer-technologies>.

### **Technology Development Fund (TDF)**

In TDF, a corpus fund of Rs. 100 Cr has been created to enable Indian industries, especially MSMEs, for indigenisation of the defence products, sub systems and components. The fund may also be utilised for developing new technologies as required by DRDO, Services and DPSUs. The cost of each project under TDF can be up to Rs 10 Cr. The industry can get funding up to 90% of the project cost. Details are available at website <https://tdf.drdo.gov.in>.

## **DRDO Patents for Indian Industry**

All patents and relevant intellectual publications are available on DRDO website. These can be used by Indian industry free of cost. For any further support, DRDO is ready for handholding and for working out the modalities.

## **Development and Production Partner**

DRDO engages industry as Development Cum Production Partner (DcPP) / Development Partners (DP) / Production Agency (PA) during the execution of its projects and programmes. The selection of industries is carried out based on procurement rules and procedures.

## **Testing Support**

A number of advanced test facilities and equipment are available at the Labs for trial & testing of the products before acceptance by the User. DRDO provides access to the world-class high-end test facilities to Indian industries involved in designing, developing and manufacturing. The list of these Test Facilities is given on DRDO website. This assures development of high-quality defence products.

## **Evaluation and Certification Support**

DRDO provides unique certification services to the niche industry for aerospace and crypto products. CEMILAC provides the certification support to industry for military airworthiness. SAG, Delhi provides testing and certification support for IT and crypto products developed by industries on request of Services.

## **SoP for Export**

A Standard Operating Procedure (SOP) is promulgated to assist Indian Industry to export products developed with DRDO support. An export compendium, comprising of DRDO products having potential of export, has also been prepared along with details of manufacturing industries.

### **Technological and Scientific Support**

Technological and scientific support will be provided to industry through deposit work route by DRDO on need basis. The interested industry may contact DRDO through our website.

### **Systems and Subsystems for Industry to Design, Develop and Manufacture**

Indigenous design, development and manufacturing of advanced defence systems requires vibrant defence ecosystem with industry participation. In line with the aim of 'Atmanirbhar Bharat', it is appropriate that the industry takes over development of technologies and systems where it has developed the capabilities. To this effect, DRDO has identified 108 systems and subsystems which will be designed, developed and manufactured by industry only and will not be taken up by DRDO for development. DRDO may provide scientific/ technological support and testing support wherever required for the development of these systems and subsystems on case-to-case basis. In common terms we call it 'negative development list' for DRDO.

### **DRDO Products for Export**

Many indigenously developed systems are inducted into Indian Armed Forces after extensive field evaluation. In the process, these systems attain benchmarks of international standards and, therefore, become potential systems for export. Export of indigenously developed defence products provides economic and political advantage to a country. In order to articulate the emerging geopolitical compulsions, more and more Nations are utilising "Defence Diplomacy" as a strategic tool. Concurrent to the recent challenges in global economy and geopolitics, India has taken those necessary steps towards converting itself from the world's largest defence importer to the exporter of indigenously developed Defence products. DRDO developed products have created an interest among several Nations. Some of the systems like radars, Akash missiles and simulation systems have been exported.

DRDO supports industry in evolving the specifications of the export variant of the products (based on DRDO technology) to enable industry to respond to the RFPs of friendly nations. DRDO also carries out customization of product to meet the requirement of customer countries. The “DRDO SoP for Export of Military Equipment” facilitates Indian industry and DRDO labs to provide necessary technical support for responding to request for information before necessary approval from MoD is obtained by the industry. The DRDO SoP for exports is in line with the MoD SoP for exports and provide assistance to Indian industry to address the export needs of the products designed and developed by DRDO.

### **Engagement with Academia**

DRDO has been working with academia for more than 50 years. DRDO has networked with 300 Academic Institutes which work on the basic research problems of relevance to defence applications. Till date academic projects of approximately Rs 1100 Crores have been sanctioned under various mechanisms operated by DRDO. Various vehicles of research and development have been instituted to undertake the defence specific research. Contract for Acquisition of Research Services (CARS) is to enable Lab/Estt Directors to engage academia as per requirement and select the academia to acquire the specified R&D activity. Projects through Extramural Research Sanction are for strengthening and nurturing defence R&D capability to develop technologies in diversified fields, create suitable infra-structure and committed quality research manpower in the country for defence related domains.

Four boards namely, Aeronautical Research & Development Board (AR&DB), Naval Research Board (NRB), Armament Research Board (ARMREB) and Life Sciences Research Board (LSRB) have been operating multiple projects since multiple decades. Under these boards, many impressive contributions have been made by academia to solve various scientific and technology problems of defence domains. Our recent initiative for promoting M Tech in defence technologies in Indian universities is an attempt to lay a strong foundation for a vibrant defence R&D and manufacturing ecosystem.

DRDO has been strategically endeavouring to establish the ecosystem for Directed Research through academic collaboration with a vision to make India a global technology leader and attain self-reliance in next generation defence technologies. DRDO provides support to academia to carry out Directed Research in the identified research areas related to defence application through Advanced Technology Centres (ATC) and Centres of Excellence (CoE). These centres are established to harness & synergize the combined strength of academia, student community, research fellows, niche technology industries & DRDO scientists to provide impetus to research & innovations. These centres focus on conducting directed scientific and technology based research in the advanced areas of technologies with multi-institutional collaboration. Strengthening the research centres at various universities is for accelerating the research of TRL1 topics to TRL3 and TRL3 to TRL6.

### **Bracing the Disruptive Research**

DRDO is working on the next generation defence systems in the areas of missiles, fighter aircrafts, tanks, radars, sonars, artillery and other warfare components. The advancements in the constituent technologies are being incorporated in the designs. Adoption of new technologies requires establishment of advanced testing facilities and ground work for this has started. Hypersonic wind tunnel, aeronautical test range and shore based test facility are some of the examples which are sound foundations for advanced defence systems development. Many other facilities are in pipeline for the testing of systems for higher performance and different parameters of effectiveness.

DRDO is also working on the disruptive technologies like artificial intelligence, cyber technologies, space defence and networking of systems for high level of integration. Adoption of these technologies to defence is of utmost importance while meeting the stringent operational requirements and quality. Efforts have been initiated to streamline the development of these systems and integration with the defence systems. Undertaking these activities requires skill development, infrastructure development for prototyping and testing, adopting new

paradigms of development specific to these new technologies and incorporating modern practices to accelerate the development. Whether it is the establishment of compute and data management expertise or the requirement of highly mathematical and analytical research expertise, many new initiatives are being taken in each and every laboratory which are being monitored closely to overcome hurdles and find the ways to achieve the tangible results.

DRDO has formed Young Scientist's Laboratories for undertaking the deep research into the advanced topics. DRDO has realigned its laboratories to take up the challenges of this decade such that the resources and efforts can be optimized. These young scientists have been given challenging assignments related to the areas of quantum technologies, advanced materials, cognitive systems, artificial intelligence and asymmetric technologies.

Formation of new laboratories, administrative merging of various laboratories undertaking similar research and revision of charter of various laboratories based on the Ram Gopal Rao committee are steps in the direction of optimal utilization of resources for undertaking new challenges. Encouraging startups in the area of defence technology developments is another step taken firmly to encourage the budding ideas and innovative thinking in the defence areas.

## **Conclusion**

While DRDO is investing its efforts towards research and development of advanced defence systems, it is also strengthening the ecosystem by promoting industry, interacting with academia and engaging with other research organizations in the country. The resources required for the next leap are in terms of money for the technology development, advanced test facilities, trained scientific as well as technical manpower, investment by industry in defence production and promoting basic research in defence areas with academia. The requirement also spans the mature industrial support from the non-defence manufacturing. For example, cyber security and semiconductors are required by many

other sectors equally. Similarly, information technology, AI/ML, energy and materials are also common to many other sectors but specific customization is required to meet the defence needs.

In this time of geopolitical uncertainty, India is facing complex challenges as seen never before: internally, to maintain public health and control the spread of pandemic as also rejuvenate the economy; and externally to defend sovereignty and territorial integrity on land and sea both. During his address at CII, Prime Minister Narendra Modi listed out five 'I' to make India a self-reliant economy. The intent, inclusion, investment, infrastructure and innovation are utmost importance to make a self-reliant India.

Country is seeing a major shift towards indigenisation. Some of the important developments like approval of Akash Missile system for export to friendly countries, IAF Order of 83 numbers LCA Tejas on HAL worth Rs 83000 Cr, an order of 110 numbers of MBT Arjun Mk1 on OFB-HVF Avadi and SDR-Tac Order worth Rs 1000 Cr on BEL are due to strong foundations of design, development and production within the country. These will further accelerate the developments and will propel a technology driven economy.

While the industry and academia are tapped for helping the defence technology development, fresh talent is important for infusing energy into the new technology initiatives. The economic investment in defence research will result in better and faster turnaround of the projects which have been envisaged and are raring to go. The march towards becoming a developed nation is to be augmented with commensurate intent and efforts of all stakeholders. DRDO is proactively involved in fulfilling the vision of the Government by taking up challenging assignments of advanced defence technology development and will continue to evolve new initiatives for collaborating with academia and industry for a vibrant environment and inclusive development.

**\*Dr Sateesh Reddy** is Secy DoD R&D and Chairman DRDO, New Delhi