

Contribution of DRDO and ISRO in India's Tech Revolution – Renuka Joshi

ISRO and DRDO are the torchbearers in India's technological growth. Both organizations are working hard to establish a world-class science and technology base for India.

Defence Research and Development Organization (DRDO) is the research and development wing of the Ministry of Defence, Government of India, to make India self-reliant in critical defence technologies and systems. Formed in 1958, DRDO has its firm determination to design and develop state-of-art defence systems and technological solutions to the services along with committed quality manpower.

DRDO's technology includes a spectrum of defence equipment from aeronautics and naval systems to materials and life sciences and from soldier selection and protection to complex ballistic missile defence systems.

The Indian Missiles are the pride of DRDO. DRDO has developed a family of missiles ranging from the strategic Prithvi and Agni to the tactical Trishul, a low-level quick reaction Surface to Air Missile (SAM), Akash – a medium-range air defence SAM, and NAG, a top-attack anti-tank missile. This cluster has provided the country a range of technologies driven by the perfect breadth of platform requirements – from underwater and ship launch to ground and air launch resulting in a multitude of technologies.

Systems and Technologies produced by DRDO

1. Aeronautics

a. System / Product

- Combat Aircraft: LCA Tejas ;
- Unmanned Aerial Vehicle (UAV): Lakshya, Nishant
Aerostats Avionics

b. Technologies

Control laws for Unstable Aircraft, FBW DFCS, Open Architecture Avionics, Composite Structure, Mobile launch / Recovery Mechanism, Jam Resistant Data Links, Image Processing.

2. Missiles

a. System / Product

- Strategic: Agni, Prithvi, Dhanush.
- Tactical: Akash, Trishul.
- Cruise: BrahMos.

b. Technologies

Re-entry vehicle Structure, Liquid Propulsion, Autonomous Navigation, Stabilisation or launch from moving platform, Multi-target Tracking, Command Guidance, Folding Fin Mechanisms.

3. Naval

a. System / Product

Sonars: Humsa, Nagan, Ushus, Mihir; Torpedoes; Processor-Based Mines; Naval paints.

b. Technologies

Transducer Arrays, Signal Processing, Techniques, Homing Technology, On-Board Computers Fire Control, Propulsion Systems, Platform Interface, Non-Skid and Corrosion Protection

Paints.

4. Electronics

a. System / Product

- EW Systems: Samyukta, Sangraha.
- Radars: BattleField Surveillance Radar(BFSR), 3D CAR, Rajendra C4I Systems, Communication, and Lasers.

b. Technologies

Direction Finding, Jamming Techniques, Voice Recognition, Secrecy Systems, Network Centric Information Fusion, High Accuracy Trx / Rx Modules.

5. Armaments and Combat Vehicles

a. System / Product

Combat Vehicles: MBT Arjun, Bhim, Tank Ex MBRL Pinaka, Sarvatra Bridging Systems, BLTs, AERVs, and ICVs.

b. Technologies

Hydro-Gas Suspension, Composite Armour, Flow Formed Rocket Motor, Launcher Mechanisms, Propellants, and Warheads.

6. Materials

a. System / Product

Composites, Rare Earth magnets, Special Steels, Carbon Nanotubes, and Nanocomposites.

b. Technologies

Titanium Sponge Extraction Technique, Aerofoil, and Super Alloy Castings, Multi walled Carbon Nanotubes, Thermal Protection for Structures, and Conducting Polymers.

7. Life Sciences

a. System / Product

Selection, Protection, Nutrition packages for Soldier, Bio-Waste Management, High Altitude Agro-tech, and NBC Systems.

b. Technologies

Psychometric Tests, Hapo Management, NBC Sense / Detect Technologies, Integrated Life Support Systems, Diagnostic Kits, Pre-Processing for Extreme Conditions Use.

DRDO's forthcoming challenges include the development of advanced surveillance platforms, extended reach next-generation combat aircraft, enhanced air defence, ballistic missile defence capability, and autonomous unmanned systems for land and water. Some of the breakthrough technologies required to develop these projects include Hypersonic Vehicle Technology, Network Centric Warfare Components, Directed Energy Weapons, Nanotechnology, and more.

DRDO's contribution to fight against COVID-19

DRDO has made strong efforts to fight against COVID-19:-

1. DRDO used a special sealant for submarine applications

DRDO has designed a bio-suit for medical professionals to help them fight the COVID-19 pandemic. DRDO made a special kind of sealant that joins a sealing tape based on the sealant used in submarine applications.

2. DRDO turned the fire fighting equipment to spray disinfectants

DRDO turned the firefighting equipment into machines to spray disinfectants on the roads and other surfaces. The spray is

made of 1% Hypochlorite solution for the sanitization of suspected areas.

3. DIAT designed a microwave sterilizer

Defence Institute of Advanced Technology (DIAT) has built a microwave sterilizer named “ATULYA” capable of disintegrating coronavirus through differential heating at 56°C – 60°C temperatures.

Upcoming Projects

DRDO is planning to make Direct Energy Weapons (DEWs) using high-energy lasers and microwaves. Since Beijing is growing in military power involving the domains of space, cyber, and electronics, therefore, DEW has become a crucial project for India in context with its security.

DRDO is developing a STAR (Supersonic TARget) sea-skimming target drones to hit a speed of Mach 2.4, that will help surface ships to practice and target supersonic anti-ship systems.

1. Systems Engineering Panel –

- Robust and Optimal Strategies for Multi-agent Swarm Design in respect of Urban Search and Rescue Missions.
- Automated Landing of Rotorcraft on Moving Platform.
- Integrated framework for Gearbox Prognosis with Multiple Sensors.
- Developing Non-Flammable Hydrogen Using Selected Inhibitors and Study of its Lifting Ability.
- High-Performance Math Co-processor for Aeronautical Applications, and more.

2. Materials and Manufacturing Panel –

- Deformation Behaviour and Control of Microstructure and Texture in Gamma Based TiAl Intermetallic for Gas Turbine Applications (GTMAP).

- Sensing CO, NO₂, and NO with Plasmonic Materials for High-Temperature Applications.
- Manufacturing Gas Turbine Engine Components by Diffusion Bonding and Superplastic Forming Process (GTMAP).
- Life Prediction of Turbine Blades Under Coated and Uncoated Conditions (GTMAP), etc.

3. Aerodynamics Panel –

- An experimental study of the Blockage and 3-D Effects in the Wake Structure of a Rotationally Oscillating Circular Cylinder.
- Ferroelectric metal-organic materials supported by cationic phosphorus moieties for potential sensor applications.
- Development of inexpensive primary lithium batteries for defence applications, and more.

Role of ISRO to make India technologically advanced

Indian National Committee for Space Research (INCOSPAR) was established in 1962 by the Government of India to elevate India in the space field. Indian Space and Research Organization (ISRO) is the Indian Space Agency formed in 1969. Vikram Sarabhai, recognizing the role of space technology in the nation's development, provided ISRO the initial directions for growing.

ISRO's mission is to provide the Nation space-based services and developing cutting edge technologies to achieve self-reliance in terms of broadcasting, communications, weather forecasts, disaster management, geographic information system, navigation, telemedicine, cartography, dedicated distance education satellites, etc.

To make India self-reliant in these applications, ISRO developed a Polar Satellite Launch Vehicle (PSLV). The PSLV is

a favorable satellite carrier for different countries because it is reliable and cost-effective. On the other hand, the Geosynchronous Satellite Launch Vehicle (GSLV) was designed for the more demanding and heavier Geosynchronous communication satellites.

ISRO has also played a significant role in promoting scientific education through its own Lunar and interplanetary missions. ISRO is developing faster with the making of heavy-lift launchers, reusable launch vehicles, human spaceflight projects, semi-cryogenic engines, single-stage to orbit (SSTO), and two-stage to orbit (TSTO) vehicles, developing composite materials for space applications, and many more.

Upcoming Missions of ISRO

1. RISAT-1A

RISAT, abbreviated as Radar Imaging Satellite is an Indian radar imaging reconnaissance satellite that provides weather-related data using synthetic aperture radars (SAR).

Radar Imaging Satellite – 1A (RISAT-1A) is a remote sensing satellite with its aim in terrain mapping applications and to analyse land, water, and ocean for soil moisture. RISAT-1A will be the 6th satellite in the RISAT series.

2. Chandrayaan – 3

In 2019, Chandrayaan – 2 (C2) was launched making ISRO popular across the country. To make the Chandrayaan mission successful which remained incomplete due to C2's failure to conduct a soft landing on the moon's surface, Chandrayaan – 3 (C3) is going to launch soon.

C3 will keep the configuration of its predecessor that will make it a robust model having enhanced capacity. C3 will only include a lander and a rover that will sum up to ₹ 615 crores to India making it less expensive as compared to ₹ 970 crores

invested in C2. Chandrayaan-3 is expected to launch in early 2021.

3. Gaganyaan

Gaganyaan is the first crewed orbital spacecraft jointly developed by ISRO, DRDO, and Hindustan Aeronautics Limited (HAL). After stepping into the field of unmanned space exploration, ISRO is planning to launch an Indian Human Space Flight Programme through the “Gaganyaan” mission.

Gaganyaan is a 3.7-tonne capsule that will orbit the Earth at an altitude of 400 km for around 7 days. Before launching Gaganyaan, ISRO has planned to fly “Vyommitra”, a half humanoid as a trial to space. The first flight of Gaganyaan will be in December 2020 and the second in July 2021.

4. Aditya-L1

The first Indian Solar Coronagraph spacecraft, Aditya-L1 will be launched by January 2022 to study the outermost part of the Sun’s atmosphere. ISRO initially visualized Aditya – L1 as a small low-Earth orbiting satellite with a coronagraph. But now, the space agency is planning to make it a large scale, solar, and space environment observatory.

5. NISAR

The NASA-ISRO Synthetic Aperture Radar (NISAR) is the first-ever dual frequency synthetic aperture radar, developed combinedly by ISRO and NASA. NISAR is going to be the most expensive satellite ever with an estimated cost of \$ 1.5 billion.

NISAR’s main objective is to notice the complex natural processes of Earth including the evolution of Earth’s crust, ecosystem disturbances, changing climate, collapsing of ice-sheets, natural disasters like tsunami, earthquakes, flood, volcanic eruptions, etc. To observe all these processes, NISAR will use advanced radar imaging, mapping the elevation of the

land on earth and ice masses at 5 to 10 meters resolution. It will be launched on a GSLV in September 2022.

Artificial Intelligence (AI) has a strong capability to transform the fields of machinery, military, mining, space and atomic energy, and power distribution systems. AI's self-controlling machines can help humans in combat tasks. There is a wide range of AI applications that will emerge in the future. Therefore, DRDO and ISRO are making every effort to integrate AI in their upcoming projects. DRDO's AI-based systems for geo-computation can help the armed forces to make crucial decisions during attacks. Also, AI's self-controlling machines can help humans in combat tasks. The Ministry of Defence is planning to integrate AI strategically thereby revolutionizing India's technical systems.

ISRO is also inclined to use AI in space technology. Last year, ISRO successfully deployed "Pragyan", an AI-powered vehicle on the moon. This year also ISRO is planning to launch "Vyom Mitra" before launching Gaganyaan in 2021. This humanoid will sense the surroundings with its 3D vision and its handy manipulative abilities to perform defined crew activities in the unmanned mission.

Both organizations are working hard to establish a world-class science and technology base for India.