DRDO – Industry -Academia Synergistic Research & Development for Advanced Defence Systems & Technologies

Dr Chandrika Kaushik, DS & DG (PC&SI)

Today’s R&D is not just an investment
It is tomorrow's sovereignty.

Synergy between Defence R&D –Academia – Industry is the blueprint for that sovereignty

Viksit Bharat @2047

India's roadmap to becoming a developed nation — powered by deep-tech, strategic autonomy, and industrial transformation.

Macro-Economic & R&D Targets

$30T

GDP Target

Economy by 2047, requiring 7–10% sustained annual growth

3-4%

R&D / GDP

GERD target by 2047, up from current 0.64%

>60%

Private R&D

Flip ratio to match global leaders (currently ~36% private)

Strategic Autonomy: Space, Defense & AI

Defense

Global leadership in non-kinetic warfare, hypersonics & AI by 2045.

Space Vision 2047

Antariksh Station by 2035. Moon landing by 2040. ₹1,000 Cr VC Fund for space startups.

Manufacturing GDP

Target: **25% by 2035** (up from ~17%)

AI Economy

Projected to add **USD 967 Billion** by 2035. Sovereign compute as strategic asset.

High-Tech Mfg

46.3% of manufacturing GVA from medium & high-tech industries

Intellectual Property & Innovation Indices

Global Innovation Index: Top 5 by 2047

Current rank: 39th (2024)

Patents: 6th Globally

105,157 filings in 2024; 60.1% by Indian residents

3rd in Publications

Also 3rd in S&E PhDs awarded globally

Investment for R&D & Manufacturing in Industry

Investment Landscape: Capital & PLI

$81B

Total FDI (FY25)

14% increase year-on-year

$19B

Manufacturing FDI

18% growth in FY25

₹1.46L Cr

Actual Investment due toPLI

Created ₹ 12.5L Cr production output; 12.6 lakh jobs created

30%

GFCF / GDP

FY26, with 7.1% growth in FY25

Manufacturing Capability

Industrial Growth

Industry sector grew **7.0%** in H1 FY26. Manufacturing grew **9.13%** in Q2 FY26.

High-Tech Share

Medium & high-tech industries: **46.3%** of manufacturing GVA.

MSMEs

Exporting MSMEs jumped from ~52K (FY21) to **1.73 lakh** (FY25), contributing 45.79% of total exports.

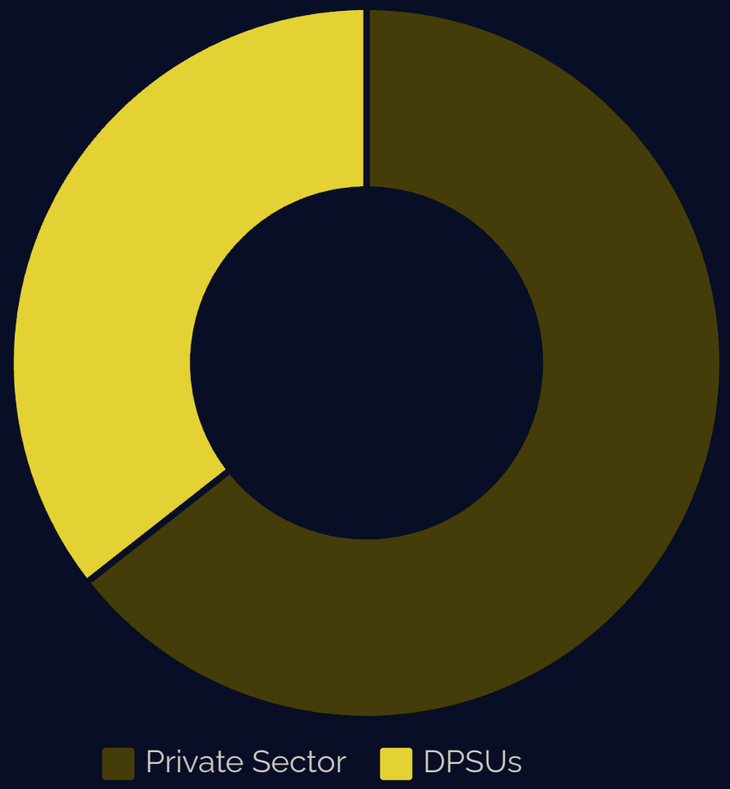
📱 Electronics

Mobile production: **30-fold increase** — ₹18K Cr (FY15) to ₹5.45L Cr (FY25). 60% import substitution in telecom.

🧪 Chemicals

8.1% of manufacturing GVA. Production: 58,617 thousand MT (FY25), 2.8% CAGR since FY16.

Defence Export Performance & Targets



FY25 Total Defence Exports

₹23,622 crore (~$2.76B) — a **12.04% YoY increase**.

Private sector contributed ~64.5%; DPSUs ~35.5%.

FY26 Target

₹30,000 Cr

2029 Target

₹50,000 Cr

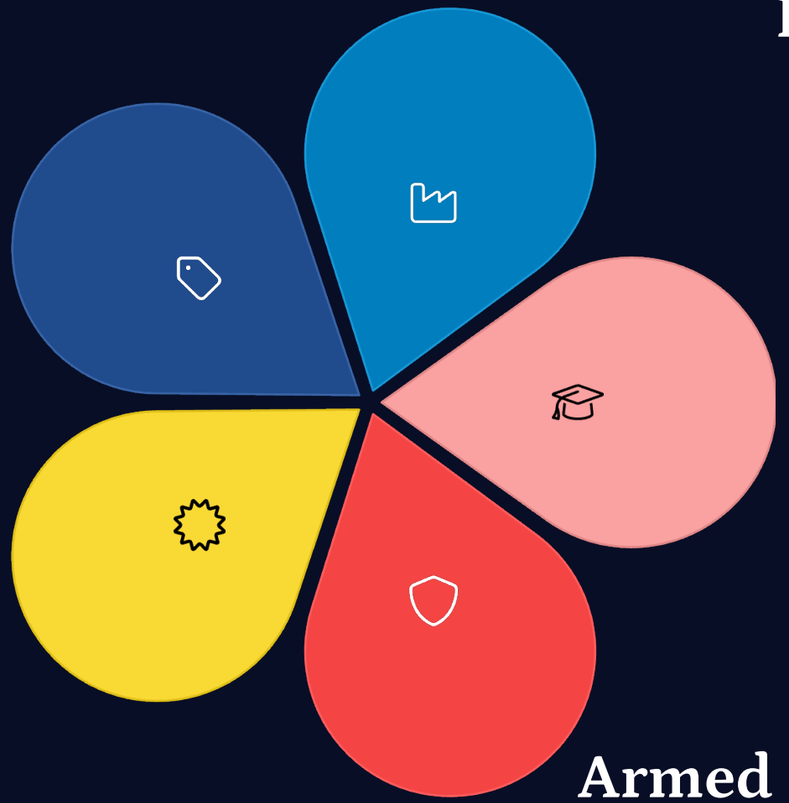
Defence R&D Ecosystem: A Whole-of-Nation Approach

DRDO Labs

Driving Defence R&D across domains

Industries

Private & Public Sector partners; Startups & MSMEs supported via TDF, Dare to Dream, iDEX, and DCPP schemes



Academia

Centers of Excellence in IITs/IISc/NITs; Sponsored research under ERIPR, CARS

Certification

CEMILAC, DGQA, DGAQA, etc: Type approval, QA protocols, airworthiness

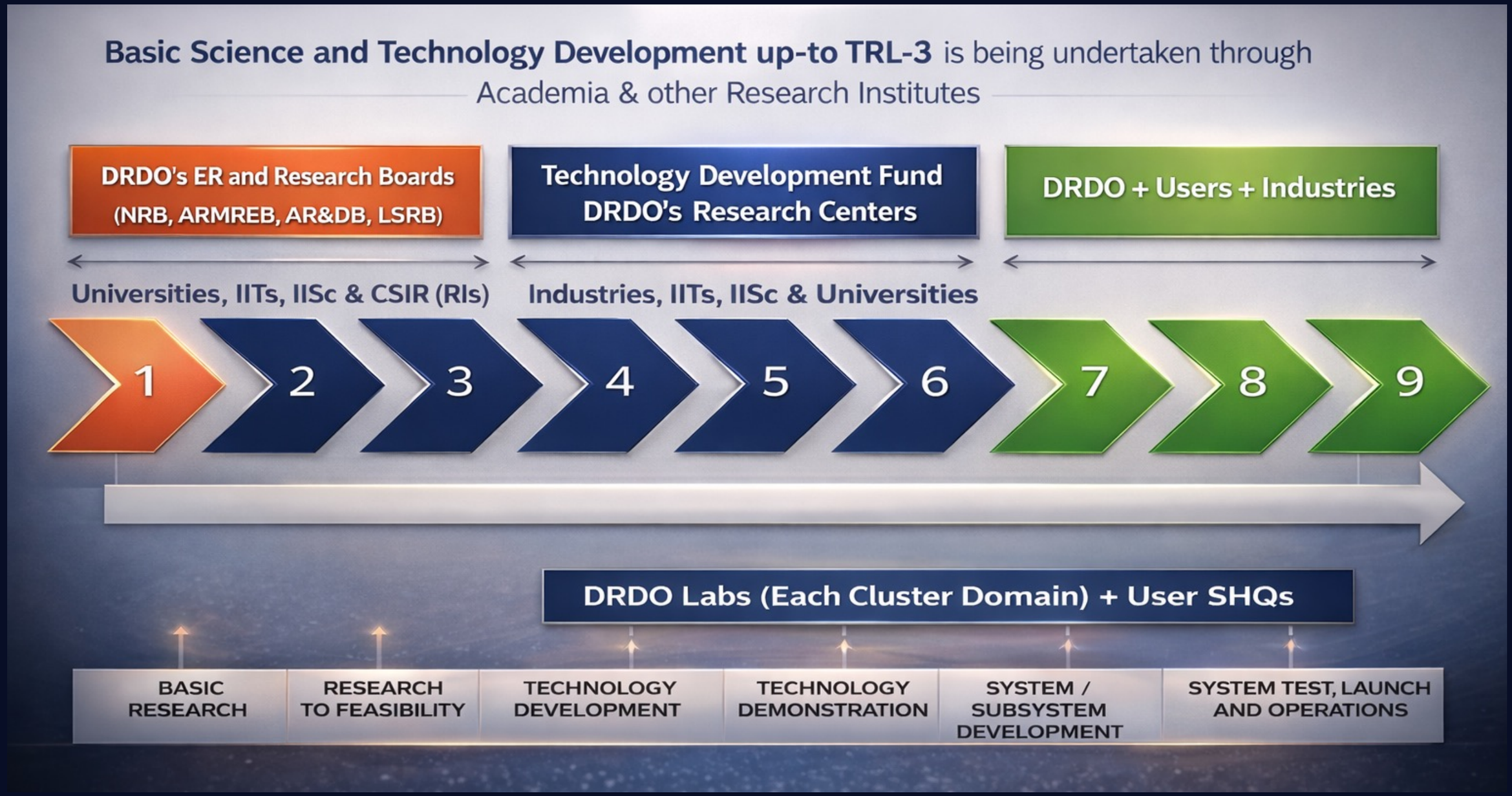
Armed Forces

Operational Requirement, Testing & Trials , Induction

India's Deep-Tech & Defense Ecosystem: SWOT

Entity	Strengths	Weaknesses	Opportunities	Threats
Academia	Deep theory; top young talent; cost-effective research	Low TRLs; papers over products; disconnected from field needs	DRDO collaboration; global partnerships; deep-tech focus	Brain drain; equipment obsolescence
DRDO	Domain expertise; massive D&D infrastructure; strategic alignment	Manpower shortage; rising niche tech demand	Shift to ecosystem facilitator; export indigenous tech; Aatmanirbhar push	Rivals outpacing R&D cycles
Large Industry	Mass manufacturing; supply chain; quality control	Risk-averse to fundamental R&D; ToT-dependent	Positive indigenization lists; growing export markets	Policy fluctuations; global disruptions; foreign OEM competition
Startups	Agility; rapid prototyping; disruptive tech focus	Capital constraints; lack of heavy testing infra	iDEX; DRDO TDF (up to ₹50 Cr); rising VC interest	Long procurement cycles; "valley of death"; regulatory complexity

Defence Systems / Technology Development



Development of Advanced Systems and Technologies

Role of Academia and Industry

Missiles Systems

Strategy Systems
- Missile systems
- Strategic weapon systems
- Strategic deterrence
- Precision strike systems

Propulsion Systems
- Solid propulsion
- Liquid propulsion
- Hybrid propulsion
- Ramjet propulsion
- Scramjet propulsion

Guidance, Navigation & Control
- Aerodynamics
- Guidance systems
- Navigation systems
- Control systems
- Seekers
- Sensors
- Actuation systems

Payload
- Warheads
- Payload integration
- Detonation systems

Infrastructure & Operations
- Flight testing
- Test ranges
- Launchers
- Ground systems
- Command networks

Missile & Strategic Systems

🎓 Academia

Advanced aerodynamic models, high-energy propellant chemistry, AI-driven multi-spectral seekers, metamaterials for stealth.

🏭 Industry

Precision machining of airframes, mass production of rocket motors, ruggedized seeker electronics, heavy launch systems.

AERO Systems

Platforms

- Airborne platforms
- Unmanned aerial vehicles
- Lighter-than-air systems
- Aerostats
- Balloons

Structures & Delivery

- Aerostructures
- Parachutes
- Aerial delivery systems

Avionics & Systems

- Avionics
- Flight control systems
- Airborne surveillance systems
- Airborne communication systems

Propulsion

- Aero gas turbine engines
- Propulsion systems

Testing & Certification

- Flight testing
- Airworthiness certification

Aerospace & Aviation Technologies

Missile Systems
Multi-mission, agile, precision-strike missile platforms with networked targeting

Seeker Technologies
Multi-spectral, AI-driven seekers for all-weather, countermeasure-resistant targeting

Hypersonic Technologies
Boost-glide and scramjet-based high-speed delivery systems for strategic superiority

Space Technologies
Small satellite constellations for ISR, comms, and kinetic/non-kinetic operations

Space Situational Awareness
AI-enabled debris tracking, space threat detection, and orbital warfare readiness

Parachute Technology
High-altitude precision airdrop and automated recovery systems

Aerospace & Aviation Technologies

Aero Structures
Lightweight composite aero-structures for stealth and high-maneuverability platforms

Aerodynamics
Advanced CFD-driven aerodynamic design for hypersonic and stealth vehicles

Aeromechanical Systems
Smart flight control and morphing wing systems

Alternative Power Plant
Hybrid-electric and hydrogen-based propulsion for next-gen aircraft

UAV
AI-enabled autonomous drones with swarm and combat capabilities

Guidance & Navigation
GNSS-denied navigation, AI-based precision targeting, and autonomous guidance

Aero Systems & UAVs

🎓 Academia

CFD for hypersonic designs, AI logic for drone swarms, hybrid-electric propulsion, lightweight composites.

🏭 Industry

Composite aero-structures at scale, ruggedized avionics, automated UAV assembly lines, flight testing infrastructure.

Land Systems

Weapon Systems & Mechanics

- Armament systems
- Artillery
- Guns
- Launchers
- Recoil mechanisms

Munitions & Energetics

- Ammunition
- High-energy materials
- Explosives
- Propellants
- Warheads
- Fuzes
- Initiation systems

Vehicles & Combat Engineering

- Combat vehicles
- Tracked vehicles
- Wheeled vehicles
- Amphibious vehicles
- Bridging systems
- Field engineering systems

Safety & Protection

- Blast protection systems
- Explosive safety
- Environmental safety

Land Systems & Ground Combat Technologies

Armoured & Combat Vehicles
Modular, electric-drive combat vehicles with active protection systems

Gun Technology
Electro-thermal and smart gun systems with programmable munitions

Guided Artillery
GPS/INS-guided precision artillery with loitering and retargeting capabilities

Multi-Barrel Rockets
Network-enabled MBRLs with precision pods and remote launch options

Mines & Mines Detection
Smart mines and AI-driven UGV-based mine detection and neutralization

UGV
Combat-ready autonomous ground platforms for logistics and ISR in Contested zones

Land Systems & Ground Combat Technologies

Warhead/Explosive & Ballistic Protection

Smart reactive armour and next-gen explosive mitigation materials

Swarm Technology

Collaborative drone swarms for saturation attacks and distributed sensing

Counter Swarm Technology

AI-based electronic and kinetic neutralization systems against drone swarms

Camouflage Technology

Adaptive camouflage using metamaterials and multispectral concealment

Passive Countermeasures

Decentralized sensor decoys and electromagnetic signature masking systems

Weapons, Munitions & Effectors

Warhead/Explosive & Ballistic Protection

Tunable yield warheads and advanced blast-absorbing composites

Munition/Ammunition

Precision-guided, programmable and sensor-fused ammunition

EM Rail Gun

High-energy railgun systems for kinetic kill strikes

Directed Energy

High-power microwave and laser systems for drone and missile neutralization

Detonics & Mechanisms

Micro-electromechanical detonation systems with electronic safing

Decoys

Multi-domain decoys (IR, RF, sonar) with dynamic signature replication

Land Systems, Munitions & Ground Combat

1

2

🎓 Academia

Smart reactive armor materials, robotic path-planning for UGVs, programmable smart munitions logic.

🏭 Industry

Heavy engineering for combat vehicles, artillery barrel machining, bulk explosive filling, active protection integration.

Electronics, Communication, Micro Electronics, Computational systems and Cyber

Radar, RF & Electronic Warfare

- Radar systems
- Electronic warfare systems
- Signal processing
- Antennas
- Microwave electronics
- Millimetre-wave electronics
- RF systems

Electro-Optics & Directed Energy

- Optronics
- Electro-optical sensors
- Laser range finders
- Target designators
- Directed-energy systems
- Surveillance sensors

C4I & Communications

- Communication systems
- Networking systems
- C4I systems
- Command and control systems
- Secure communication

Microelectronics & Fabrication

- Microelectronics
- Semiconductor devices
- VLSI design
- VLSI fabrication
- MEMS sensors
- NEMS sensors
- Embedded systems

Computing, AI & Robotics

- High-performance computing
- Artificial intelligence
- Machine learning
- Robotics
- Autonomous systems
- Quantum technologies
- Modelling and simulation
- Decision-support systems
- Data analytics

Cybersecurity & Information Safety

- Cryptography
- Cyber defence
- Information security

Communication, Radar & Electronic Warfare

Electronic Devices
GaN-based RF systems and ruggedized SoCs for harsh military environments

Electro Optics
Multi-sensor EO/IR systems with target recognition and tracking

Electronic Warfare
AI-enabled offensive and defensive EW systems for spectrum dominance

Sensors/Detectors
Distributed sensor networks with fusion for ISR and NBC detection

Surveillance and Tracking
Persistent surveillance using AI and satellite-integrated tracking systems

Communication, Radar & Electronic Warfare

Communication

Quantum-resilient, jam-resistant tactical mesh networks

Antennas

Smart conformal antennas with multi-band capability and beam steering

Radar Technologies

AESA and passive radars for stealth detection and drone tracking

Radome Technologies

AI-optimized radomes for broadband stealth and environmental adaptabilit

C4ISR, Cyber & AI-Enabled Systems

Control Systems

Resilient autonomous control architectures with real-time reconfigurability

Cyber, Information & Communication Security

Offensive cyber tools, post-quantum cryptography, and cyber resilience tech

High Performance Computing

Edge-based and cloud-integrated HPC for surveillance and reconnaissance

Quantum Technologies

Quantum sensing, secure communication, and computing for strategic advantage

C4ISR, Cyber & AI-Enabled Systems

C4ISR

Integrated battle management systems with real-time multi-domain awareness

AI/ML Technology

Decision-support AI for threat prediction, battlefield autonomy, and ISR analysis

Autonomous Systems and Robotics

Fully autonomous multi-domain systems for combat, logistics, and rescue

Embedded Systems

Secure, real-time embedded platforms for avionics and tactical edge computing

C4ISR, Radar, EW & Microelectronics

🎓 Academia

- VLSI architecture design
- Post-quantum cryptography
- Quantum sensing research
- AI/ML for battlefield decision-support

🏭 Industry

- Semiconductor fabs for military-grade SoCs
- AESA radar manufacturing
- Jam-resistant tactical mesh networks
- Ruggedized HPC servers

Naval Systems

1

Weapons

- Underwater weapons
- Torpedoes

2

Sensors & Surveillance

- Sonar systems
- Acoustic sensors
- Ocean surveillance
- Naval sensors
- Ship-mounted optronics

3

Materials

- Stealth materials
- Composites
- Metallic materials
- Non-metallic materials

4

Protection & Maintenance

- Signature management
- Corrosion control
- Coatings
- Radiation shielding

5

Systems

- Control systems

Naval & Underwater Technologies

1

Sonar Technologies

AI-enhanced low-frequency sonar for deep-sea target detection and classification

2

Underwater Defence Technologies

Unmanned underwater vehicles (UUVs) systems

3

Ocean Profiling

Oceanographic sensors for Real-time tactical underwater mapping

4

Hydro Structures

Smart naval infrastructure for stealth ports and dynamic docking platforms

Materials & Manufacturing Technologies

1

Materials

Smart, lightweight composites and metamaterials for survivability and stealth

2

Additive Manufacturing

On-demand 3D printing of mission-critical spares and structures

3

Bio Remediation

Eco-safe battlefield clean-up and bioprocesses for hazard mitigation

Energy & Power Systems

1

Electric Power Technology

Compact energy storage and wireless battlefield power distribution

2

Propulsion

Hybrid and high-efficiency battlefield propulsion systems

Naval & Underwater Technologies

Academia

Acoustic wave propagation modeling, AI-enhanced low-frequency sonar, next-gen oceanographic sensors.

Industry

Pressure-resistant UUV hulls, ruggedized deep-sea acoustic sensors, smart naval port infrastructure.

Soldier-Centric Systems

Soldier Support

Smart soldier systems with health monitoring, situational displays, and comms

Protective Clothing & Gears

Lightweight, thermally adaptive, and blast-resistant combat gear

Respiratory Management

Smart respirators with NBC filtration and biometric feedback

Behavioural Analysis for Soldiers

AI-assisted monitoring for stress, fatigue, and cognitive readiness

Biomedical Engineering & Technologies

Wearable biosensors and battlefield diagnostics for trauma care

Life Support

Modular life support kits for high-altitude and CBRN environments

Materials, Manufacturing & Soldier Systems

🎓 Academia

Smart biomaterials synthesis, wearable biosensors for trauma diagnostics, bio-remediation for hazard mitigation.

🏭 Industry

Industrial-scale 3D printing for mission-critical spares, mass-produced combat gear/respirators, specialized stealth coatings.

India's Key Technology & Deep-Tech Missions

IndiaAI Mission
Sovereign AI via high-end compute (GPUs), indigenous models & datasets.

Semiconductor Mission
Global hub for electronics manufacturing & chip design.

National Quantum Mission
Quantum computing, communication & sensing leadership.

Supercomputing Mission
National grid of HPC for multi-disciplinary grand challenges.

Cyber-Physical Systems
Robotics, AI & IoT for socio-economic challenges.

Deep Ocean Mission
Matsya 6000 submersible; deep-sea minerals & Blue Economy.

MAHA MedTech
Indigenous medical tech; affordable healthcare globally.

Biopharma Mission
Affordable vaccines, biosimilars & medical devices via industry-academia collaboration.

DRDO Engagement with Industry

Nature of Engagement & Modus Operandi

Research and Development Collaboration

DcPP (for AON Accorded systems), Development Partners (for Sub Systems / Techs) , Joint Ventures

Commercialization

Technology Transfer (ToT), Production Agency Selection, Licensing, Patents, Production Handholding, Exports

Capacity Building and Skill Development

Consultancy, Seminars and Workshops, Skill Development

Testing, Validation, and Quality Assurance

SAMAR QA Analysis, Testing, Validation & certification Support, Standards

Financial and Promotional Support

Technological Development Fund, Promotion of Indigenous Content, Open Challenge Prgs (Ex: 'Dare to Dream')

& many more

The End Vision: A Future-Ready Force

The ultimate goal is to equip the Indian Armed Forces with a decisive, asymmetric edge.

By aligning national Defence R&D, Academia, Industry, and acquisition, we can develop "First of the Kind " Systems and Technologies aligning the operational requirement of Armed Forces

Features of First of the Kind Systems

- Technologically Superior
- Fully Networked
- Multi-Domain Capable
- Strategically Autonomous
- Future-Ready

Thankyou