

# DRDO



बलस्य मूलं विज्ञानम्

*Current & Futuristic*

## Materials for Defence Systems

Dr Arvind Bharti

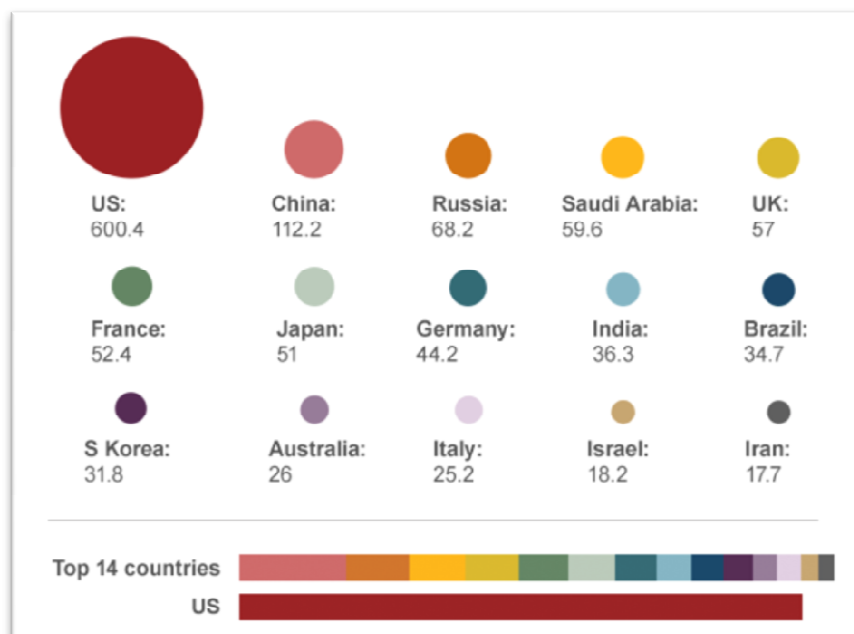
Defence Research and Development Organization

IIM Delhi Chapter 16 May, 2015

# Indian Armed Forces Inventory and Budget Allocation

Indian Armed Forces having an inventory of around 6 Lakhs items like Aircraft, Unmanned Aerial Vehicles, Warships, Missiles, Submarines, Tanks, Nuclear warheads, Bullet proof jackets, Boots, Combat dress etc.

Top 15 Countries expenditure 2013 ( US \$ bn)



Defence Budget allocation of 15 major countries

Biggest defence budgets 2012		Biggest defence budgets 2021(Expected)		
United states	\$ 656 billion	United States	\$472 billion	Down 28%
China	\$126 billion	China	\$207 billion	Up 64%
Japan	\$66billion	Russia	\$106 billion	Up 80%
U.K	\$61 billion	Indian	\$68 billion	Up 54%
Russia	\$ 59billion	Japan	\$66 billion	No change
France	\$51 billion	U.K	\$61billion	No change
India	\$45 billion	France	\$53 billion	Up 3%
Germany	\$41 billion	Brazil	\$42 billion	Up 37%
Saudi Arabia	\$36 billion	Saudi Arabia	\$40Billion	Up 12%
Australia	\$30 billion	Germany	\$38 billion	Down 7%

Expected Defence Budget allocation of 10 major countries by 2021

# Defence R&D Organization (DRDO)

**From being nowhere on the World defence map till the 1980's, India has come a long way and is today:**

- ✓ **One of 5 countries with its own Ballistic Missile Defence Program**
- ✓ **One of 6 countries with its own nuclear powered submarine**
- ✓ **One of 7 countries with its own Main Battle Tank**
- ✓ **One of 7 countries with its own 4<sup>th</sup> generation Combat Aircraft**
- ✓ **One of 4 countries to have a multi level Strategic Deterrence Capabilities**

*DRDO: The largest R&D Organization in the Country (57 years old) working in a vast spectrum of technologies to serve the operational requirements of the Indian Armed Forces*

# Defence R&D Organization (DRDO)

## Vision

Empowering India with cutting - edge Defence technology and **provide our Defence Services the decisive edge by equipping** them with internationally competitive systems and solutions.

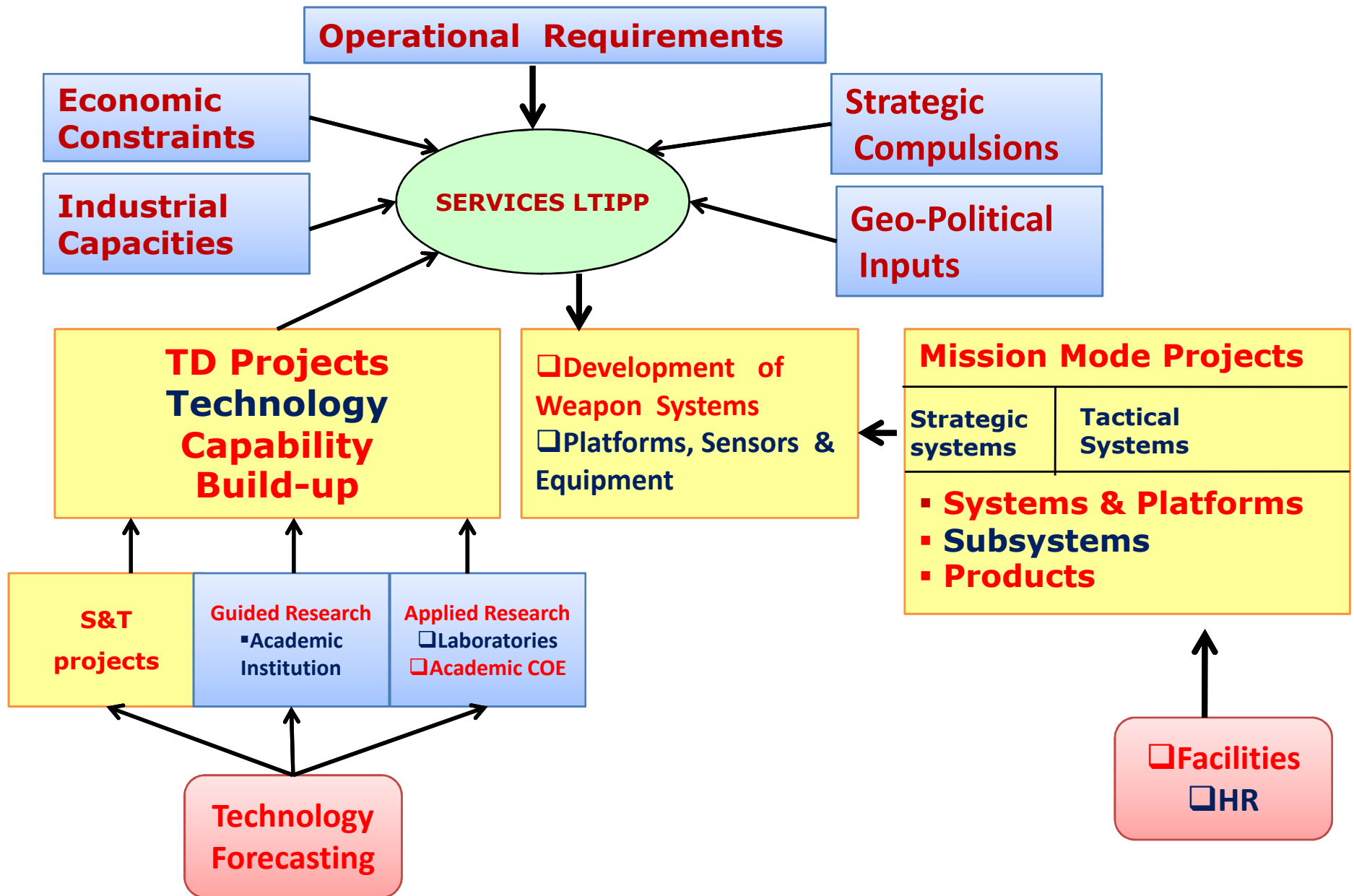
## Mission

- Design, develop and lead to production of state-of-the-art defence systems and technologies
- **Provide technological solutions to the Services to optimize combat effectiveness**
- Develop infrastructure and committed quality manpower and build strong indigenous technology base

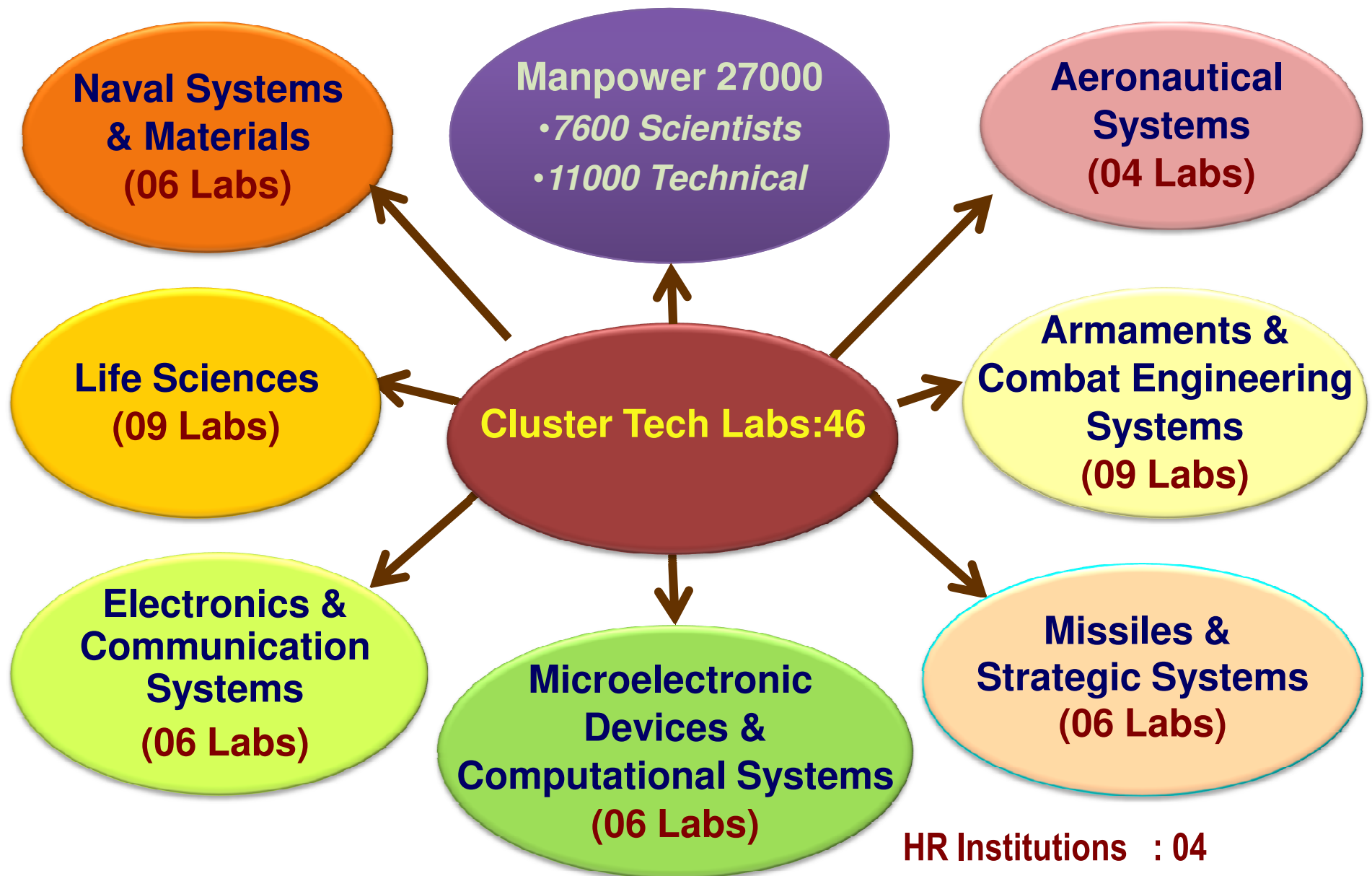
## Strategy

Mostly in-house abinitio development, Involvement of Pvt Sector working productively feasible and Collaborations

# Development Strategy of DRDO



# Technology Clusters



# Indian Missile Showcase



**Prithvi I**  
150 km



**Prithvi II**  
250 km



**NAG 4 km**



**Brahmos**  
290 km



**Trishul 12km**



**Dhanush**  
350 km



**Akash 25km**



**Agni 1**  
1000 km



**Agni 2**  
2000 km



**Agni 3**  
3500 kms



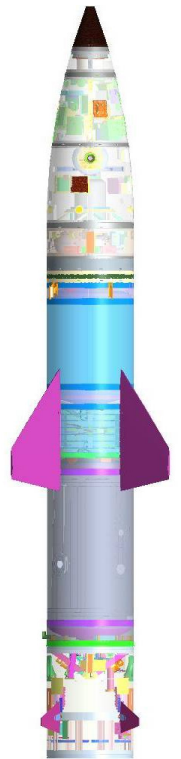
**Agni 5**  
5000 km



**Astra 45km**



**LR SAM 70km**



**PAD**

## Materials required:

- Materials for Radome
- Materials for Hypersonic Cruise
- Smart Material based Actuation
- Material for IR Domes
- Materials for Magnets



# Aeronautics



## Systems

Light Combat Aircraft - Tejas  
UAVs- Lakshya, Nishant, Rustom  
Mission Computers & Avionics  
Lighter than air systems- Aerostats  
AEW&C



## Materials required

- Materials for Aircraft Structural Applications
- Materials for improved propulsion technology
- Material for sintered brake pads for high energy dissipation for aircraft arrestor gears
- Material for thermal barrier coatings



# LIGHT COMBAT AIRCRAFT

## Air Force (MK1)

- ❖ Fourth Generation Aircraft
- ❖ 12 Aircraft have logged more than 2000 flights

### Status:

- ❖ IOC I completed
- ❖ IOC II Completed in Dec 2013
- ❖ Final Operational Clearance – 2015
- ❖ Order for 40 A/C from Air Force
- ❖ Production commenced at HAL



LCA - TEJAS

## Materials required

- ❖ Materials for Aero Gas Turbines
- ❖ Fibres for Composites
- ❖ Super alloys
- ❖ High Strength Low Weight (HSLW) Composite fabric Material
- ❖ Material for thermal barrier coatings
- ❖ Self-healing and self-diagnosing Materials
- ❖ Stealth materials

# COMBAT VEHICLES & ARMAMENTS



MBT Arjun



INSAS family



Pinaka MBRL



Tank - Ex



Bridging System

## Materials required

- Steels for combat vehicle
- Aluminum Alloys for combat vehicle
- Titanium Alloys for combat vehicles
- Magnesium Alloys for combat vehicle
- Polymer Matrix Composites for combat vehicle



# Main Battle Tank (MBT) -Arjun

## Arjun Mk 1

- Excellent fire power- 120 mm Rifled Gun; Firing on Move Capability
- High mobility
- Excellent protection

### Materials required

- Polymer Matrix Composites for combat vehicle
- Composite material for suspension
- Grapen and Nano materials for EMI shielding
- Nano fluids for Engine cooling
- New light Weight Materials, Coatings for IC Engines
- Light weight material for launch structures
- High-strength Weldable Aluminum Alloy
- Material for Protection against Blast



Arjun Mk-I





# Propellants & Explosive for strategic systems

- 2 Regiments Operational Launcher – 40, Command Post-16, LCR-40, RV-20; PA : L&T /TPCL, BEML
- Order for 3<sup>rd</sup> & 4<sup>th</sup> Regiments in process
- Present Rate of Production of Rockets at OFB 1000/ annum and planned to enhance to 5000/annum in 2 years
- Action initiated by OFB for additional capacity of Rockets 7000/annum with Incendiary and Sub-munition warheads



## Materials required

- Ultra high strength steels, Refractory & ceramic coatings, Technical ceramics and Advance composite materials
- Material for Reactive Armour, Weapon platforms, artillery rockets, warheads and projectiles
- Material for withstand temperature and high energy density material

# Bridging & Mine flailing Systems

SARVATRA



Bridge Laying Tank – T72



Modular Bridge



Counter Mine Flail



# Unmanned Ground Vehicles



## MUNTRA (Tracked --BMP-II)

- All terrains ( 08 Hrs endurance)
- Tele operation upto 5 Km
- Speed of 20 Km/hr
- Day and night operation

### Materials required

- Material for Transparent Armour
- Material for Reactive Armour
- Material for structure
- Material for sensors
- Materials for Protection
- Epoxy hardeners



## UGB (Wheeled – TATA Stallion)

- Tele operation upto 5 Km (10 Km with Repeater)
- Speed of 25 Km/hr
- Range – 80 Km ( 8 hrs endurance )



## DAKSH

- Cross Country, Stair Climbing Capability
- Range : 500 m LOS (03 hours)
- Built-in X-Ray, Water Jet Disrupter



# Electronic Systems

Design & Development of:

- EW Systems- Samyukta, Sangraha, Divya Drishti
- Command Control & Comm. Systems;
- Supercomponents & SATcom systems;
- Radar, microwave tubes, optical & electro optical instrumentations
- High power laser sources & devices



## Materials required

- Electronic and photonic materials for high-speed communications
- Materials for sensor and actuator
- Material for fast-warm-up and high-emission density cathodes
- Smart and structured materials

# RADARS Inducted



**ROHINI: Medium Range Surveillance Radar**  
**(45 Nos for IAF)**

Range: 200 Km Elevation : 30°



**3D Tactical Control Radar**  
**(29 Nos for Army)**

Range: 90 Km, Elevation: 50°



**Weapon locating Radar**  
**(30 Nos for Army)**

To locate Mortars, Guns, Rocket Launchers up to 40 km



**ASLESHA: 3D Low Level Light Weight Radar**  
**(21 NOS for IAF)**

Range: 60 Km, Weight : 190Kg

**Comparable to world class system**

**Battle Field Surveillance Radar**  
**(1492 Nos)**

Weight: 30 Kg, Range 5 km



## Material required

➤ Microwave tube materials

➤ Super Insulating Material

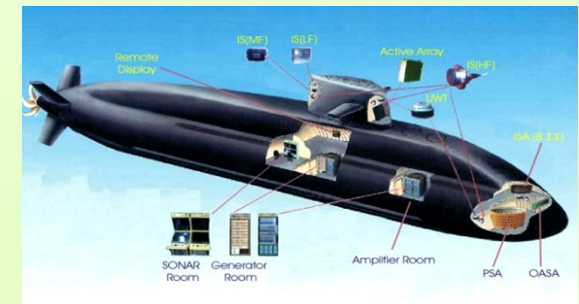
➤ Materials for sensor and actuator

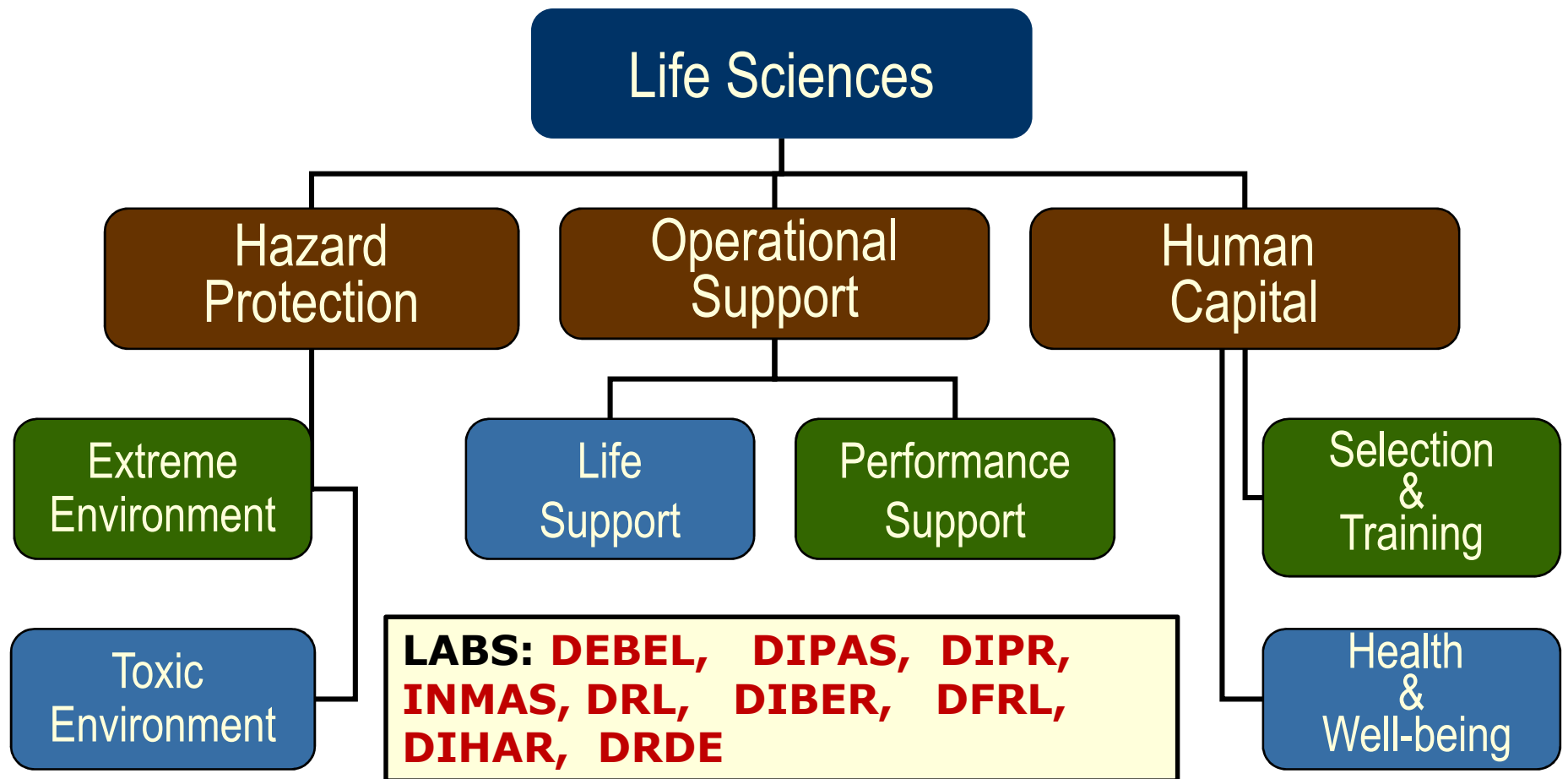
➤ SiC material and devices



# Materials required

- Polymers for Sonar domes, acoustic windows
- Composites for Parts of hulls of smaller vessels
- Steels for hulls
- Materials for propulsion systems
- Material for improving Stealth reduction
- Materials for high power and high energy electrode
- Material for thermally conductive potting
- High temperature insulating Materials
- High strength light-weight alloy





### Materials required

- Material for CBRN
- Barrier material for clothing
- Haemostatic materials
- Food packaging materials
- Decontamination materials

- Shelter barrier material (fabric, composite and concrete)
- Materials for individual and collective protection against NBC agents
- Biomaterials/ tissue engineering for Artificial Organs

# Life Support System

- Combat Free Fall System (30000 ft altitude)



- ILSS - OBOGS for LCA & Helicopter Oxygen System



- Submarine Escape Set
- Personnel Oxygen Enrichment System

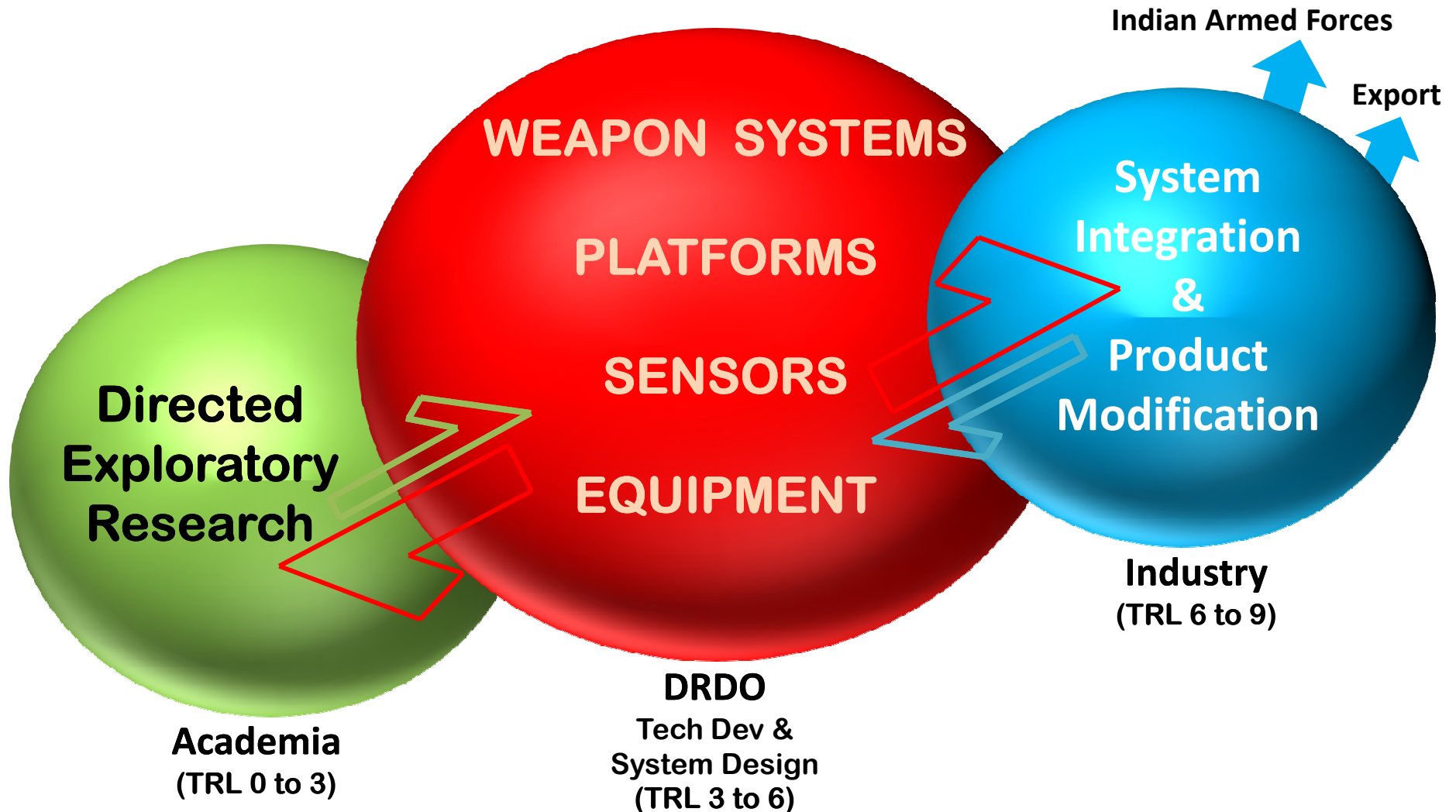


## Material required

- New generation sensing material based on molecularly imprinted polymers (MIP) Nano material
- New hybrid materials for respiratory protection

# DRDO vision Self Reliance in Defence Hardware

Seamless overlap of academic and Industrial domains with DRDO is necessary for effective development of indigenous defence hardware







**Join us in our Mission.....**

*Thank You*