Office of the Principal Scientific Adviser
to the Government of India

Anthology of Science and Technology Activities
(Office of PSA)

www.psa.gov.in

Produced by :
The Office of PSA

Compiled By:
**Communications Team,
Office of PSA**

Designed by:
**Impact Science,
Cactus Communications**

Contents

List of Abbreviations

A

AARDO: African-Asian Rural Development Organisation
AEC: Atomic Energy Commission
AEDs: Anti-Epileptic Drugs
AFMC: Armed Forces Medical College
AGNIi: Accelerating Growth of New India's Innovations
AI: Artificial Intelligence
AIM: Atal Innovation Mission
AIIMS: All India Institute of Medical Sciences
APPI: Animal Pandemic Preparedness Initiative
ARAI: Automotive Research Association of India
ARTPark: Artificial Intelligence & Robotics Technology Park
AYUSH: Ayurveda, Yoga, and Naturopathy, Unani, Siddha, and Homoeopathy

B

BARC: Bhabha Atomic Research Centre
BBMP: Bruhat Bengaluru Mahanagara Palike
BCAS: Bureau of Civil Aviation Security
BCKIC: Bhubaneswar City Knowledge Innovation Cluster
BeST: Bengaluru S&T Cluster
BHEL: Bharat Heavy Electricals Ltd.
BSF: Border Security Force

C

CAPFs: Central Armed Police Forces
CBC: Capacity Building Commission
CBRI: Central Building Research Institute
C-DAC: Centre for Development of Advanced Computing
CDSCO: Central Drug Standard Control organisation
CeNSE: Centre for Nano Science and Engineering
CET: Critical and Emerging Technologies
CGeM: Consultative Group on e-Mobility
CII: Confederation of Indian Industry
CISF: Central Industrial Security Force
CMC: Christian Medical College
CoE: Centres of Excellence
CPWD: Central Public Works Department
CRPF: Central Reserve Police Force
CSR: Corporate Social Responsibility
CSIR: Council of Scientific and Industrial Research
CSTIS: Centre for Science, Technology, and Innovation Statistics
CTIER: Centre for Technology, Innovation, and Economic Research

D

DAE: Department of Atomic Energy
DAHD: Department of Animal Husbandry and Dairying
DAY-NRLM: Deendayal Antyodaya Yojana and National Rural Livelihood Mission
DBT: Department of Biotechnology
DDH: Dholera Drone Hub
DDWS: Department of Drinking Water and Sanitation
DHE: Department of Higher Education
DFI: Drone Federation of India
DoPT: Department of Personnel and Training
DoS: Department of Space
DoT: Department of Telecommunication
DPCC: Delhi Pollution Control Committee
DPIIT: Department for Promotion of Industry and Internal Trade
DPR: Detailed Project Report
DRDO: Defence Research and Development Organisation
DRE: Drug-Resistant Epilepsy
DRIIV: Delhi Research Implementation and Innovation
DSIR: Department of Scientific and Industrial Research
DST: Department of Science & Technology

E

EAC-PM: Economic Advisory Council to the Prime Minister
ECAH: Empowered Committee for Animal Health
ECIL: Electronics Corporation of India Limited
EFC: Expenditure Finance Committee
EJH: Electronic Jacquard Handloom
ETG: Empowered Technology Group
EV: Electric Vehicle

F

FBR: Facility Booking Record
FCD: Focal Cortical Dysplasia
FDI: Foreign Direct Investment
FICCI: Federation of Indian Chambers of Commerce & Industry

G

G20-CSAR: G20-Chief Science Advisers Roundtable
GeM: Government e Marketplace
GERD: Gross Domestic Expenditure on R&D
GNCTD: Government of the National Capital Territory of Delhi
GST: Goods and Services Tax

H

HEMRL: High Energy Material Research Lab
HESCO: Himalayan Environmental Studies and Conservation Organisation

List of Abbreviations

I

IB: Intelligence Bureau

ICAR: Indian Council of Agricultural Research

iCET: Initiative on Critical and Emerging Technologies

ICMATS: Innovation Challenge for the Development of Machine-Aided Translation System

ICMR: Indian Council of Medical Research

IFFI: International Film Festival of India

IGCAR: Indira Gandhi Centre for Atomic Research

IGNCA: Indira Gandhi National Centre for Arts

IIA: Indian Institute of Astrophysics

IIM: Indian Institute of Management

IISc: Indian Institute of Science

IIT: Indian Institute of Technology

IIIT: Indian Institute of Information Technology

Indo-EU TTC: Indo-European Union Technology and Trade Council

IMS: Ion Mobility Spectrometry

INFLIBNET: Information and Library Network Centre

INSA: Indian National Science Academy

INYAS: Indian National Young Academy of Sciences

IRDE: Instrument Research Development Establishment

I-STEM: Indian Science, Technology and Engineering Facilities Map

IoT: Internet of Things

ISRO: Indian Space Research Organisation

ISI: Indian Statistical Institute

ITBP: Indo-Tibetan Border Police

ITMA: Integrated Threat Management Appliance

IVRI: Indian Veterinary Research Institute

J

JCKIF: Jodhpur City Knowledge and Innovation Foundation

JJM: Jal Jeevan Mission

JNVs: Jawahar Navodaya Vidyalayas

K

KVIC: Khadi and Village Industries Commission

L

LASTEC: Laser Science and Technology Centre

LIGO: Laser Interferometer Gravitational-wave Observatory

M

MCD: Municipal Corporation of Delhi

MDoNER: Ministry of Development of North Eastern Region

M

MDP: Multi-Dimensional Poverty

MeitY: Ministry of Electronics and Information Technology

MGB: Mission Governing Board

MHA: Ministry of Home Affairs

MIB: Ministry of Information and Broadcasting

MIDHANI: Mishra Dhatu Nigam Limited

ML: Machine Learning

MoA&FW: Ministry of Agriculture and Farmers' Welfare

MoCA: Ministry of Civil Aviation

MoE: Ministry of Education

MoEFCC: Ministry of Environment, Forest, and Climate Change

MoES: Ministry of Earth Sciences

MoHFW: Ministry of Health and Family Welfare

MoHUA: Ministry of Housing and Urban Affairs

MoPR: Ministry of Panchayati Raj

MoRD: Ministry of Rural Development

MoRTH: Ministry of Road Transport and Highways

MoSJE: Ministry of Social Justice and Empowerment

MoMSME: Ministry of Micro Small and Medium Enterprises

MoTA: Ministry of Tribal Affairs

MPLADS: Members of Parliament Local Area Development Scheme

MSME: Micro Small and Medium Enterprises

MSV: Mega Science Vision

MSW: Municipal Solid Waste

MTRC: Mission Technology Research Council

MUHS: Maharashtra University of Health Sciences

N

NAC: National Advisory Committee

NARFI: National Air Quality Resource Framework of India

NASSCOM: National Association of Software and Service Companies

NCERT: National Council of Educational Research and Training

NCSM: National Council of Science Museums

NDRF: National Disaster Response Force

NDSTP: National Deep Tech Startup Policy

NEC: North-Eastern Council

NEDFI: Northeastern Development Finance Corporation Limited

List of Abbreviations

N

NER: North Eastern Region

NERCoRMP: North Eastern Region Community Resource Management Project

NERLP: North-East Rural Livelihood Project

NFTDC: Nonferrous Materials Technology Development Centre

NGO: Non-Governmental Organisation

NHS: National Health Service

NIAS: National Institute of Advanced Studies

NIMHANS: National Institute of Mental Health and Neurosciences

NITI Aayog: National Institution for Transforming India

NISTIS: National Initiative of Science, Technology, and Innovation Statistics

NLP: Natural Language Processing

NPCIL: Nuclear Power Corporation of India Ltd.

NQM: National Quantum Mission

NQCO: National Quantum Coordination Office

NRLM: National Rural Livelihood Mission

NSCS: National Security Council Secretariat

NZ: Net Zero

O

ONOS: One Nation One Subscription

OTP: One Time Programmable

P

PEC: Planning and Execution Committee

PKC: Pune Knowledge Cluster

PLI: Production Linked Incentive

PMO: Prime Minister's Office

PM-STIAC: Prime Minister's Science, Technology, and Innovation Advisory Council

PMU: Programme Management Unit

PMILP: Pradhan Mantri Innovative Learning Programme

PRMC: Project Review and Monitoring Committee

PSA: Principal Scientific Adviser to the Government of India

Q

QETCI: Quantum Ecosystems and Technology Council of India

QED-C: Quantum Economic Development Consortium

QIST: Quantum Information Science and Technology

R

RBI: Reserve Bank of India

R&D: Research and Development

RICH: Research and Innovation Circle of Hyderabad

RRCAT: Raja Ramanna Centre for Advanced Technology

RuTAG: Rural Technology Action Group

S

S&T: Science and Technology

SAB: Scientific Advisory Board

SAMEER: Solutions for Air-Pollution Mitigation Through Engagement, Engineering, and Research

SCL: Semi-Conductor Laboratory

SDGs: Sustainable Development Goals

SETS: Society for Electronic Transactions and Security

SFF: Special Frontier Force

SHG: Self Help Group

SPG: Special Protection Group

SSB: Sashastra Seema Bal

SSF: Swachhta Saarthi Fellows

STI: Science, Technology, and Innovation

SWM: Solid Waste Management

T

TAG: Technology Advisory Group

TAN: Technology Advisory Notes

TPD: Tonnes Per Day

ToT: Transfer of Technology

U

USOF: Universal Service Obligation Fund

V

VCI: Veterinary Council of India

W

W2W: Waste to Wealth

WOW: Wellbeing Out of Waste

Z

ZET: Zero Emission Trucking

About the Office of the **Principal Scientific Adviser** to the **Government of India**

The Government of India established the Office of the Principal Scientific Adviser (Office of PSA) in November 1999. The Office of PSA aims to provide pragmatic and objective advice to the Prime Minister and the Cabinet in matters of Science and Technology. The Office of PSA has been placed under the Cabinet Secretariat since August 2018.

Professor Ajay Kumar Sood currently serves as the Principal Scientific Adviser (PSA) to the Government of India.

The Office of PSA plays an important role in the following:

1. Science and Technology (S&T) fundamentals with applied research in collaboration with multiple stakeholders, both in central and state governments
2. Enabling future preparedness in emerging domains of science and technology
3. Formulating and coordinating major inter-ministerial S&T missions
4. Providing an enabling ecosystem for technology-led innovations and techno-entrepreneurship
5. Driving innovation and technology delivery towards solving socio-economic challenges for sustainable growth
6. Fostering effective public-private linkages for driving research and innovation

This Anthology showcases the activities of this office under various thematic areas as listed in the next section.

Theme 1

Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC)

2018

Prime Minister's Science, Technology, and Innovation Advisory Council

The Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC) was constituted in August 2018 as an overarching council to assess the status of specific science and technology domains, comprehend challenges, formulate interventions, develop a futuristic roadmap, and advise the Prime Minister accordingly. The first PM-STIAC meeting was held in October 2018 wherein nine national missions were finalised.

PM-STIAC is chaired by the PSA to GoI, and its members are:

- Dr. V. K. Saraswat, Member, NITI Aayog & former DG, DRDO
- Shri A. S. Kiran Kumar, Former Chairman, ISRO
- Lt. Gen. Dr. Madhuri Kanitkar, Vice-Chancellor, MUHS, Nashik
- Prof. Sanghamitra Bandopadhyay, Director, ISI, Kolkata
- Dr. Manjul Bhargava, Professor, Princeton University, Fields Medal
- Dr. Subhash Kak, Professor, Oklahoma State University
- Shri Baba Kalyani, Managing Director, Bharat Forge

In addition, PM-STIAC has the following special invitees:

- Secretary, Department of Atomic Energy
- Secretary, Department of Science & Technology
- Secretary, Department of Space
- Secretary, Department of Defence Research & Development
- Secretary, Department of Biotechnology
- Secretary, Department of Scientific and Industrial Research
- Secretary, Department of Agricultural Research & Education
- Secretary, Department of Health Research
- Secretary, Department of Higher Education
- Secretary, Ministry of Environment, Forests & Climate Change
- Secretary, Ministry of New & Renewable Energy
- Any other person with the permission of the chair

The Office of PSA also oversees the implementation of such interventions by concerned S&T departments, agencies, and other government ministries. The other important terms of reference of the council are to formulate, converge, collaborate, coordinate, and implement multi-stakeholder policy initiatives, mechanisms, reforms, and programmes aimed at synergising collaborative science and technology; enabling future preparedness; formulating and coordinating S&T missions; providing an enabling ecosystem for techno-entrepreneurship; driving innovation, technology, and skill; developing innovation clusters; fostering effective public-private linkages.

Nine missions, aligned with the national interest, have been approved by PM-STIAC till date. Four of the nine missions, Deep Ocean Mission, Natural Language Translation mission, AI (Artificial Intelligence) Mission, and Quantum Frontier Mission have been approved for implementation. Recently, two more missions; National One Health Mission and National Livelihood Mission have also been approved by PM-STIAC for its implementation.

Since 2021, eight PM-STIAC meetings have taken place in which the following topics have been discussed:

22 January 2021

- End-to-End E-Waste Management and Circular Economy
- Technological Initiatives of MeitY
- Presentations by Industry/ Start-ups working on E- waste Management

31 March 2021

Trans-Himalayan Research for Informed Decision making to predict and mitigate disasters

25 June 2021

The possibility of establishing a Government-Industry–Academia consortium, to lead a quantifiable Mission on "Photovoltaic and solar cell manufacturing in India

1 September 2021

- Nano Electronics: The National Centres for Semiconductor Electronics R&D: Past, Present, and Future
- Electronics Manufacturing: Discussions on the possible roadmap and implementation plans for setting up of a Semiconductor R&D Centre (Fab) in India

30 November 2021

Mathematics and Computer Science: Expansion of Competence and Excellence in India

7 July 2022

- One Health – Surveillance & Preparedness, Regulation & Response - improving the health, productivity, and conservation outcomes
- Technology-led / Deep Tech Start-up Ecosystem

19 January 2023

- National Livelihood Mission
- Update on PM-STIAC Missions

14 July 2023

- Biotechnology for Economy, Environment and Employment (BioE3) policy
- Empowered Technology Group
- National Research Foundation Bill

Table 1: Topics covered in PM-STIAC meetings since 2021

Some of the important missions and activities under PM-STIAC including the most recent topics discussed in 2022 and 2023 are detailed ahead. Figure 1 depicts the 21st PM-STIAC meeting chaired by the PSA.

Figure 1: Prof. Ajay Kumar Sood Chairs 21st PM-STIAC meeting

2022

1.1 National One Health Mission

One Health is an integrating idea that brings different sectors together to solve the health, productivity, and conservation challenges and, it has major implications for India. India, with its diverse wildlife, one of the largest livestock populations and high density of human population, poses heightened risks for inter-compartmental spread of diseases.

There are many One Health efforts underway in various ministries of the Government of India, private organisations, and a range of activities globally. This presents a prospect to review the areas of focus underlying each effort, identify opportunities for collaboration and work towards bridging any remaining gaps. In the light of this, the PM-STIAC, in its 21st meeting on 7th July 2022, approved to set up the National One Health Mission with a cross-ministerial effort that will serve to coordinate, support, and integrate all the existing One Health activities in the country and bridge gaps where it is appropriate.

Goals of the National One Health Mission

The mission aims to build integrated disease surveillance, joint outbreak response, and pandemic preparedness (for both human and animal pandemics) in India.

The major goals of the mission are:

1

Create a comprehensive pandemic preparedness plan for human and animal diseases by:

- Developing and implementing a framework for integrated disease surveillance system by linking together human, animal, and environmental sectors informed by emerging scientific approaches and tools.
- Developing targeted R&D roadmap for critical tools such as vaccines, diagnostics, and genomic surveillance technologies for all three compartments.

2

Implement an integrated disease surveillance within and across the human, animal, and environmental sectors to address communicable diseases of zoonotic, transboundary animal diseases and diseases of epidemic/pandemic potential.

3

Build a joint outbreak response system for robust and timely response to disease outbreaks. This response mechanism will ensure cross-compartmental information flow and data exchange as and when required.

4

Coordinate data/database related linkages for seamless information sharing across sectors for strengthening routine prevention programs and develop evidence-informed control programs.

5

Streamline regulatory/approval process to create a robust yet nimble approach to handle the preparedness for emerging diseases.

Stakeholders of the National One Health Mission

The National One Health Mission has several stakeholders like government ministries/departments, multilateral agencies, Non-Governmental Organisations (NGOs), private sector, and others, as depicted in Figure 2.

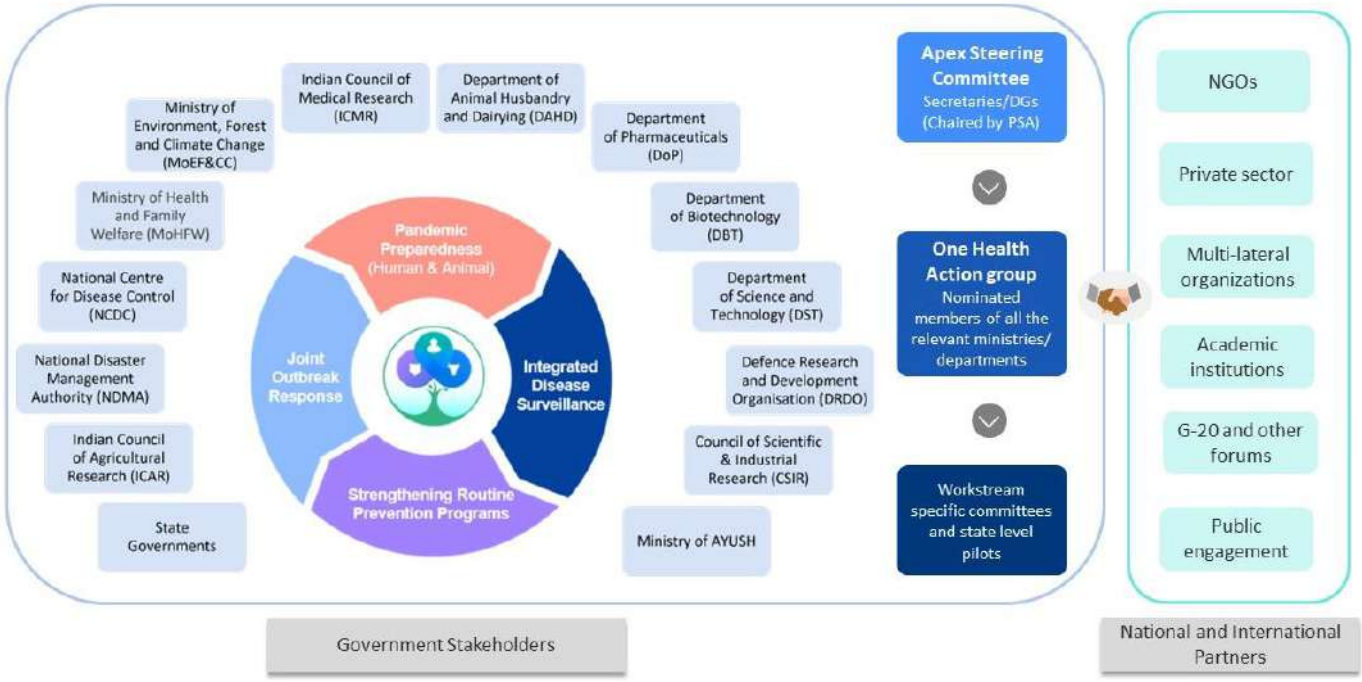

Figure 2: Stakeholders Of National One Health Mission

Milestones

Some of the milestones under National One Health Mission are highlighted below:

- PM-STIAC approved the establishment of the mission in July 2022. Since then, the participating institutions have come together, and created two levels of governance structure to ensure collaboration:
  - The "Steering Committee on One Health"–an apex committee of the Secretaries of the participating departments/ministries and chaired by the PSA, GoI.
  - The "Cross Ministerial One Health Group"–a working committee of the nominated members by the participating departments/ministries and chaired by the Scientific Secretary, Office of PSA.

Milestones

The committees have convened multiple times to define the objectives of National One Health Mission.

For more information, scan:

The mission document outlining the vision, goals, and activities has been developed in closed consultation with all the stakeholders.

Work on all priority areas has been initiated. These areas include disease gap prioritisation, targeted R&D for creating solutions for priority diseases, approaches for integrated disease surveillance, pandemic preparedness (human and animal), data and database-related integrations, and streamlining of regulatory and approval processes.

A workshop on 'Environmental Surveillance for One Health' was organised on 9th February 2023 by the Office of PSA in collaboration with Artificial Intelligence & Robotics Technology Park (ARTPark) at Indian Institute of Science (IISc) Bengaluru. The workshop aimed to develop a shared understanding of the current state of research, policy, and implementation of environmental surveillance across sectors.

Animal Pandemic Preparedness Initiative (APPI) was launched by Department of Animal Husbandry and Dairying (DAHD) on 14th April 2023, under the umbrella of the One Health Mission.

For more information, scan:

A Project Management Unit (PMU) has been set up by the Office of PSA to support the mission.

Milestones

The G20 forum under the Chief Science Advisers Roundtable (CSAR) track discussed various aspects of One Health and the absolute necessity for adopting the One Health approach. There was complete convergence across all the G20 countries for co-operation on One Health. Some of the proposed areas of collaborations and further deliberations on One Health, as discussed in the meeting were:

– Technologies for disease surveillance,

– Disease modelling and other analytical tools,

– Capacity building and other related areas,

– Uniform data standards for interoperability and accessibility,

– Uniform data standards for the data collected.

The One Health initiative is comprehensive and encompasses the health of all living beings as well as the environment. This includes issues such as food security, water quality, antimicrobial resistance, and climate change. The mission aims to take up the specific issues of integrated disease control and pandemic preparedness within the broader landscape of One Health. Achieving meaningful progress in a focused manner will not only help in addressing this important topic but will also provide valuable insights and lessons to further take up other issues of One Health.

2022

1.2 National Deep Tech Startup Policy

A Deep Tech startup develops early-stage technologies based on scientific or engineering breakthroughs that are yet to be commercialised. They typically produce a solution along a previously unexplored pathway based on new knowledge within a scientific or engineering discipline or by combining knowledge from multiple disciplines. Deep tech startups can create and own Intellectual Property because of these two factors, which distinguishes them from other startups. Deep tech startups experience significant technical/ scientific uncertainty and present a significant opportunity or risk depending on whether they succeed. They are distinguished by lengthy development timelines and high capital intensity.

The National Deep Tech Startup Policy (NDTSP) aims to serve as a comprehensive framework for addressing the challenges faced by deep tech startups and providing definitive policy interventions to improve the ecosystem. Recognising the importance of deep technology in driving innovation, economic growth, and societal development, the NDTSP presents the vision for the Indian Deep Tech Ecosystem. India's deep tech vision is built on four pillars: securing India's economic future, transitioning to a knowledge-driven economy, strengthening national capability and sovereignty through the Atmanirbhar Bharat imperative, and encouraging ethical innovation.

As recommended by PM-STIAC in its 21st meeting (7th July 2022), a NDTSP Consortium and a working group were formed to propose a comprehensive policy framework to address the needs of the deep tech startup ecosystem. This apex-level, multistakeholder consortium, chaired by the PSA comprises thought leaders from industry associations like the Federation of Indian Chambers of Commerce & Industry (FICCI), Confederation of Indian Industry (CII) and the National Association of Software and Service Companies (NASSCOM), government departments and agencies such as Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Electronics and Information Technology (MeitY), and Department of Biotechnology (DBT) from Ministry of Science and Technology, Indian Space Research Organisation (ISRO), National Security Council Secretariat (NSCS), and Defence Research and Development Organisation (DRDO). The working group functions under the direction of the National Consortium and is chaired by the Scientific Secretary Dr. Parvinder Maini with members coming from all key stakeholder groups.

Objectives of the National Deep Tech Startup Policy

The National Deep Tech Startup Policy aims to foster innovation, spur economic growth, and promote societal development by harnessing cutting-edge research-based deep tech inventions. Furthermore, the policy endeavours to provide robust support to deep tech startups, ensuring India's financial stability and facilitating progress towards a knowledge-driven economy, thereby enhancing overall productivity. Through unleashing the potential of technological growth across all sectors, the policy seeks to catalyse multiplier effects and create new industries, ultimately bolstering India's capabilities and global competitiveness.

Consultation and Drafting Process

A draft version (V2.0, dated 24th July 2023) of the National Deep Tech Startup Policy has been developed through a series of consultations with various stakeholders in the deep tech startup ecosystem. The consultations saw active participation from startups, venture capitalists, academia, industry bodies, technology incubators, and relevant government departments. The National Consortium meeting was held on 24th July 2023, under the chairmanship of PSA Prof. Ajay Kumar Sood, to finalise the policy draft and discuss the adoption and implementation of the same, as shown in Figure 3.

Figure 3: NDTSP Consortium, led by Prof. Ajay Kumar Sood, PSA to GOI, meets to finalise Deep Tech Startup Policy draft

Noteworthy experts from different deep tech domains, such as semiconductors, cyber-physical systems, advanced materials, life sciences, quantum technology, etc., have contributed their unique and diversified perspectives during these consultations. The discussions revolved around identifying the pain points and challenges faced by these stakeholders. The approach taken for this process has been completely stakeholder-led, with a focus on end-users' needs and challenges. Individuals with different roles and responsibilities within the deep tech startup ecosystem were approached to gather their insights on the current situation, key challenges, and priority areas. Based on these inputs, possible interventions and recommendations were discussed to address the challenges and pave the way for progress towards the desired objectives.

Draft National Deep Tech Startup Policy

The Draft National Deep Tech Startup Policy captures more than eighty policy instruments to strengthen the deep tech startup ecosystems under the following thematic sections:

- Nurture Research, Development, & Innovation
- Strengthen Intellectual Property Regime
- Facilitate Access to Funding
- Enable Shared Infrastructure and Resource Sharing
- Create Conducive Regulations, Standards, and Certifications
- Attract Human Resources & Initiate Capacity Building
- Promotion of Procurement & Adoption
- Ensure Policy & Program Interlinkages
- Sustenance of Deep Tech Start-ups

The draft is currently being circulated for additional feedback and public consultation. The final document is due in September 2023.

2023

1.3 National Livelihood Mission: Science & Technology (S&T) for Sustainable Livelihood System

Livelihood practices are derived from resource flows and services based on the five capitals. These are: Natural, Physical (Facilities, Infrastructure and Livestock), Financial (Money and Loan facilitation), Human (Skills, Knowledge, Education, Abilities and Health), and Social (Strength and Connectedness). Physical, financial, and human capitals are observed to be main drivers for people to pursue new livelihood opportunities. Climate change, pandemic-affected lives, and the depletion of natural resources have negatively affected livelihoods in terms of declining production and sustainability, especially in agriculture, fisheries, and forestry sectors. This negative impact disturbs socio-economic life, and the community becomes vulnerable to poverty and hunger.

Vision of National Sustainable Livelihood Mission

Science, Technology & Innovation (STI) can offer choices for natural resource management, value added products, opportunities, measures for resilience, strengthening the current systems. Climate change, food security, SDGs, biodiversity, and people are all interrelated and there is an urgent need to join forces to restore degraded natural ecosystems and build sustainable supply chains to improve the livelihoods of rural communities. Appropriately linking STI with the existing efforts in a mission mode would contribute towards sustainable livelihoods and SDGs, and efforts could be initiated.

The livelihood and technology development for rural communities are already being supported by various ministries, such as:

- Deendayal Antyodaya Yojana and National Rural Livelihood Mission (DAY-NRLM): Ministry of Rural Development (MoRD)
- Smart Village Panchayat: Empowering Rural Communities and Leaving No One Behind: Ministry of Panchayati Raj (MoPR)
- Biodiversity Conservation & Rural Livelihood Improvement Project: Ministry of Environment, Forest, and Climate Change (MoEFCC)
- Scientific Sericulture – Enhancing Livelihood, Mahila Kisan Sashaktikaran Pariyojana: Ministry of Health and Family Welfare (MoH&FW)
- Uplifting Farmers Livelihood through Scientific Agricultural. Interventions-cum-Input Distribution: Indian Council of Agricultural Research (ICAR)

Technologies for rural areas are being developed through research projects supported by the Department of Science and Technology (DST), Office of PSA (via Rural Technology Action Group (RuTAG), Department of Biotechnology (DBT), Council of Scientific and Industrial Research (CSIR), Ministry of Micro Small and Medium Enterprises (MoMSMEs), Ministry of Education (MoE), Ministry of Social Justice and Empowerment (MoSJE), Ministry of Tribal Affairs (MoTA), MeitY, Ministry of Food Processing Industries, NITI Aayog, Ministry of AYUSH etc. and through Corporate Social Responsibility (CSR) support like Tata Trust, Coal India, Bharat Forge etc. Despite efforts being made, a few gaps have been observed. Appropriate technology as per livelihood systems, knowledge and communication in the local language, manufacturing at local level, quality assessment, technology scaling & deployment, expanding the use of digital infrastructure and building STI capacities of communities, among other issues, need to be addressed.

Therefore, the National Livelihood Mission: Science, Technology & Innovation for Sustainable Livelihood System is expected to help to increase the STI outreach to rural areas, build capacity, and create overall resilience, providing better opportunities for sustainable livelihoods.

The mission aims to build up five capital assets of livelihood: Human, Social, Physical, Natural, and Financial with a focus on factors affecting the Multi-Dimensional Poverty (MDP), such as education, health, nutrition, water, energy, and infrastructure, by mapping the corresponding livelihood capitals and their impacts on the overall development goals. It plans to align appropriate technologies as per livelihood practices, enhance the traditional knowledge base, provide required training skills, resource management and cross-bridge collaborations with potential stakeholders involving ministries/departments, knowledge organisations, NGOs, custom hiring centres, community service centres, technology providers, etc.

The proposed mission was presented to the PM-STIAC on 19th January 2023, jointly by DST and the Office of PSA. After careful consideration, the committee approved the mission with recommendations for its implementation in phases and piloting it in select villages.

The Office of PSA will play a coordinating role to synergize the efforts done by various ministries. The livelihood mission will leverage various ongoing programs of the Office of PSA, such as RuTAG, AGNIi, and City S&T Clusters.

2019

1.4 Waste to Wealth Mission

The Waste to Wealth (W2W) Mission, spearheaded by the Office of PSA, aims at strengthening the waste management system in India by demonstrating innovative technology solutions and models to achieve a zero landfill and zero waste nation. In line with its vision, the mission has taken several initiatives in different areas of waste management, including technology demonstrations in multiple waste management domains, community engagement, and the development of an online portal that will act as a reference for all stakeholders including urban local bodies, government departments, technology companies, investors and citizens looking for comprehensive information on waste management technologies, policies and investment opportunities.

During the 10th PM-STIAC meeting, held on 10th December 2019, it was agreed that the W2W Mission shall work under the Office of PSA. The W2W Mission was launched on 17th August 2020. The PMU of the mission is housed at Invest India.

Milestones

In the last three years, the mission has achieved the following milestones:

Ten technologies identified and demonstrated as pilots for:

- Decentralised waste management in East Delhi,
- Cleaning of Barapullah drain in South Delhi,
- Biomedical waste treatment in Bihar,
- Torrefaction for conversion of paddy waste to bio coal in Mohali.

Two open dumpsites converted into waste processing sites.

More than 3000 tons of waste were removed from drains.

Two technology challenges for cleaning water bodies and biomedical waste treatment conducted.

Over 800 technologies in different waste sectors were evaluated by experts in various technology calls.

379 SSF fellows engaged across 27 states.

More than 3.1 lakh citizens sensitised through over 2500 awareness sessions/workshops.

Over 25 field visits conducted throughout the country.

Over 100 stakeholder engagements organised.

Over 150 technologies displayed on the portal.

More than 64 policies and guidelines uploaded to the W2W portal.

Cleaning of Barapullah Drain

The Barapullah drain in South Delhi is blocked at various locations with sewage, trash, and debris, resulting in foul odour, vector-borne diseases, unhygienic conditions, and flooding in the monsoons.

To address this critical problem, the W2W Mission, one of the ten scientific missions of the Office of PSA, collaborated with South Delhi Municipal Corporation (now Municipal Corporation of Delhi (MCD)) to jointly pilot an indigenous, customised excavator - Drain Master DM-80, designed and developed by M/s Cleantec Infra Pvt. Ltd., Mumbai.

The DM-80 unit was selected to address the critical gap area of technologies for cleaning congested urban drains clogged with mixed waste including construction and demolition debris which are very hard to dislodge and remove (Figure 4). The DM-80 unit was in operation for a duration of one year from 3rd January 2022 to 2nd January 2023 (Figure 5). During this period, Cleantec Infra operated the unit to clean and desilt approximately a 3 km stretch of the Barapullah drain starting from Sundial Park to Jangpura, removing approximately 3000 tonnes of waste in the process.

Figure 4: Desilting of Barapullah drain

Figure 5: Drain master DM-80 unit in action at Barapullah drain

An event was organised to commemorate the successful cleaning of 3 km stretch of Barapullah drain in South Delhi, as shown in Figure 6.

Figure 6: The PSA office and W2W team come together to commemorate the successful cleaning of a 3 km stretch of the Barapullah drain in South Delhi

Decentralised Waste Management Technology Park

Considering the challenges faced by urban and rural local bodies, the W2W Mission of the Office of PSA, in collaboration with the erstwhile East Delhi Municipal Corporation (now MCD) set up a Decentralised Waste Management Technology Park in New Jaffrabad, East Delhi for onsite processing of fresh Municipal Solid Waste (MSW). Five technologies including a semi-automated waste segregator, a plasma pyrolysis unit, a gasifier, and a decentralised sewage treatment plant are deployed at the site. At the Technology Park, 10 tonnes per day (TPD) municipal waste is segregated and treated, resulting in volume reduction and conversion into 1 TPD compostable fractions, 2 TPD combustibles fractions, 1.5 TPD recyclables. The facility also has a waste compaction unit for reducing the volume for handling & transportation, as depicted in Figure 7. The combustible waste will then be processed onsite, leaving only 5-10% of inerts reaching landfills. In addition to incoming MSW, floating waste from the adjacent 52-cusec drain is also collected and processed onsite

This decentralised approach not only ensures compliance with Solid Waste Management Rules 2016 but also reduces the burden on landfill sites without requiring new land for setup and disposal. It is a significant step towards achieving a "Zero Landfill" goal and minimising waste transportation.

Figure 7: Decentralised Waste Management Technology Park

2019

1.4.1 Waste to Wealth Mission's Collaboration with Jal Jeevan Mission

The Jal Jeevan Mission (JJM) envisions to provide safe and adequate drinking water through individual household tap connections by 2024 to all households in rural India. The programme implements source sustainability measures as mandatory elements, such as recharge and reuse through grey water management, water conservation, and rainwater harvesting.

To achieve its goals, JJM invites applications for innovative technologies and R&D proposals on a rolling basis in drinking water, sanitation, and grey water management sectors through the online portal of the Department of Drinking Water and Sanitation (DDWS). The Office of PSA through its W2W Mission PMU at Invest India supports DDWS in managing the calls for innovative technologies and R&D proposals on a rolling basis and knowledge management. Technologies and R&D proposals are evaluated by two expert committees. The first committee is the Technical Unit (TU), which is led by the Programme Head, W2W Mission. The second committee is the JJM Technical Committee (TC), chaired by the PSA. The PMU coordinates the selection and review process of the technologies and R&D proposals with all stakeholders including applicants, members of TU and TC, peer reviewers, and officials of JJM. The complete process is explained in Figure 8.

Milestones

- W2W PMU under the guidance of the Office of PSA has facilitated eight meetings of TU and seven meetings of the JJM TC to date.
- 26 technologies have been recommended to date for uploading on the JJM portal after a two-stage evaluation process based on their suitability towards the goals of JJM.
- Out of 124 R&D proposals submitted on the JJM portal, eight R&D proposals have been funded under JJM.

The W2W PMU has also supported JJM in organising two consultative meetings with state governments on behalf of Ministry of Jal Shakti & the Office of PSA. The meetings were aimed at discussing state-specific field implementation issues in assured water supply and possible technology solutions.

Collaborating Agencies

- DDWS, Ministry of Jal Shakti
- Invest India

Figure 8: Technology evaluation/recommendation process in JJM

2021

1.4.2 E-Waste Management

Advances in electronics, communication, and information technologies, and increased consumers' affordability have made Electrical and Electronic Equipment indispensable. The waste arising from end-of-life electronic and electric products, referred to as Waste from Electrical and Electronic Equipment or simply e-waste, is one of the fastest-growing waste streams in the world. When managed responsibly, e-waste can serve as an important source of secondary raw materials.

Initiatives of E-Waste Management

The Office of PSA has launched several policy-level initiatives to manage this waste stream scientifically. Some of these initiatives include:

- A dedicated PM-STIAC meeting was organised on 'End-to-End E-Waste Management and Circular Economy'. All major stakeholders were represented in the meeting, along with industry representatives.
- Organising technology webinars to provide a common platform to indigenous technology developers and towards having a collaboration mechanism in place.
- Development of a dedicated e-waste technology catalogue on the I-STEM national web portal.
- Facilitating technology transfers in e-waste reclamation.
- Coordination with the Government of the National Capital Territory of Delhi (GNCTD) and other important stakeholders for developing India’s first e-waste management eco park. The GNCTD has identified land in Holambi Kalan, Narela, Delhi.
- In addition to this, a sustained and concerted effort was undertaken for streamlining e-waste management in the smart city solid waste management stream.

Figure 9: Advisory on E-waste management in smart cities

The following section delineates engagement with Smart City Mission:

Advisory for E-Waste Management in Smart Cities

Smart cities are important stakeholders in the e-waste management ecosystem. The integration of e-waste management practices in regular solid waste management routines is fundamental to sustainable smart cities.

The technological maturity of smart cities can enable them to work as live laboratories for testing innovative methods involving several stakeholders to create a strong supply chain for the disposal and recycling of e-waste.

Based on regular interactions with Smart City Missions, a stakeholder workshop on E-waste Management in Smart Cities was organised on 10th May 2022. The participation included officials from stakeholder ministries, Smart Cities Mission, private sector, and S&T clusters.

The workshop was divided into five sessions:

Session 1:
E-waste value chain: Challenges and recommendations

Session 2:
Reclamation of e-waste: Industrial Activity and the Role of Technologies

Session 3:
Smart Cities perspective on e-waste management

Session 4:
Policy, regulations, and guidelines

Session 5:
Engaging the informal sector: Social, environmental, and health aspects.

Detailed inputs were sought from experts to develop an advisory for e-waste management in smart cities.

The advisory was officially released in April 2023, and it has been circulated by the mission to all the 100 Smart Cities for adoption (Figure 9).

The advisory can be accessed at:

2018

1.5 Accelerating Growth of New India's Innovations (AGNIi)

The AGNIi Mission is a programme of the Office of PSA, under the PM-STIAC and is executed in partnership with Invest India. It was approved by PM-STIAC in its first meeting held in October 2018. The mission has been instituted to engage with Indian STI ecosystem for aligning with major national priorities and scouting solutions to persistent challenges through Indian technological innovations. Since its inception, AGNIi Mission has evolved to address current problems through innovative technological interventions. In its current form, AGNIi Mission, along with its sub-initiatives, intends to collectively capture the value of the Indian STI ecosystem by working in an integrated fashion to precisely address priority problem statements via Indian technologies, having a digital platform (Manthan) in place for scale up, and parallelly strengthen the capacity of the government to engage the STI ecosystem.

Levers of AGNIi:

Presently, AGNIi is scaling its mandate through three important levers:

i. AGNIi Technology Advisory–Driving Technology Exemplar Projects

AGNIi Technology Advisory team develops and showcases precise technology options to solve India's greatest challenges (from ready and near-ready startups and lab technologies) in a way that these are ready for emulation across all other relevant government institutions and geographical regions of the country. At the same time, the mission also extends support for specific policy interventions such as deep tech startup policy which are meant to address ecosystem-wide challenges.

ii. Strategic Alliances–Industry-Academia connect and Providing a Platform for Scale

Strategic Alliances Team and its Manthan platform aim to provide the scale and ease of collaboration between ecosystem actors, technology seekers and suppliers. Many opportunities have been posted on the Manthan platform for researchers and individual innovators and academic institutes. As a result, the strategic alliance stream, have so far channelised a total of 254 opportunities, for 31 academic institutes and startup by engaging more than 175 industries. Besides, the platform has been conferred the 'Dun & Bradstreet Business Excellence Award' for the Best Tech initiative of the year 2022. Manthan initiative is discussed in further detail under Theme 14, Outreach.

iii. STI Capacity Building Cell (STI CBC)–Strengthening Government's STI Innovation Capacity

STI CBC builds institutional and individual capacity within STI government departments for navigating and engaging the STI ecosystem better. The cell in partnership with the Capacity Building Commission (CBC) has initiated the competency need analysis of six departments (ISRO, MoES, DBT, DST, DAE and CSIR) and is curating an Annual Capacity Building Plan (ACBP) with training need assessment and a plan of action for implementation for all level of scientific and non-scientific staff.

The STI CB stream has partnered with Indian Institute of Management (IIM) Vishakhapatnam for designing a foundation training course for scientists. STI CBC initiative is discussed in further detail under Theme 9, Science and Technology Capacity Building.

AGNIi Technology Advisory Notes (TAN):

AGNIi establishes technology advisory partnerships with pioneering Union & State government departments/agencies on themes like climate change, counterinsurgency, disaster response, and human and rural development. The AGNIi team interacts with partner agency and follow a standard systematic process flow of; problem identification, pain points centralisation, defining problem statement in a solvable manner, doing an on-ground assessment, identification of technology array, arranging field showcases, and finally creating TAN for further implementations.

AGNIi proposes technology stacks comprising Indian startups/laboratory innovations, demonstrates and consequently conducts on field technology showcases as a confidence-building exercise. In this endeavour, AGNIi, since 2021, has collaborated with multiple agencies.

A summary of such engagements and associated outcomes are as follows:

Border Security Force (BSF): AGNIi arranged technology showcases Demonstrating the above 15 technologies with Border Security Force BSF 95th Battalion at Bhondsi, Haryana on tech. stack such as AI, seismic sensing, thermo-optic imaging, infiltration detection, counter-drone technology, nanomaterial-based lightweight ballistic protection for infantry, counter-terror facilities, etc. Field Technology Showcase was also conducted in Srinagar, Jammu and Kashmir demonstrating eight high-calibre technologies, Virtual Reality and Augmented Reality training for combat training and battlefield scenario recreation, as shown in Figure 10. Other technologies showcased included weapons training simulators for target practice and marksmanship and simulation tools for battle scenario recreation.

Figure 10: Field technology showcase to BSF Inspector General in Srinagar

Outputs as Technology Advisory Note for BSF:

- Technology Advisory Note on Counter Terror Facilities Defence
- Technology Advisory Note on Counter Infiltration
- Technology Advisory Note on Forces Personnel Training

All above advisory notes also have potential application across other forces with the counter-infiltration mandate such as Assam Rifles, Indo-Tibetan Border Police (ITBP), CISF (Central Industrial Security Force), SSB (Sashastra Seema Bal), etc.

National Disaster Response Force (NDRF): Field Technology Showcase on flood disaster rescue involving live exercises with Unmanned Systems (submersible, surface, aerial), Resilient Communications Technologies, and AI-based autonomous systems was conducted with NDRF 5th battalion at Jadhav Wadi Dam, Sudumbre, Maharashtra, as depicted in Figure 11.

Figure 11: Demonstration of unmanned underwater system to NDRF for flood rescue

In addition to this, technology showcases urban fire and earthquake disasters exoskeletons for enhanced rescuer performance, unmanned firefighting systems, robotics for hazardous environments post-earthquake urban rescue, smart textiles and exoskeletons for enhanced human performance, and Virtual Reality for field officer situational training have been also arranged for National Disaster Response Force/ State Disaster Response Force battalions (Figure 12).

Outputs as Technology Advisory Note for NDRF:

- Technology Advisory Note on Enhanced Personnel
- Technology Advisory Note on Unmanned systems for hostile environments

Figure 12: Disaster rescue technologies showcased to the Principal Secretary to Prime Minister and DG NDRF

Government of Uttarakhand - Uttarakhand State Council for Science & Technology:

AGNIi arranged multiple field technology showcases in the Champawat district of Uttarakhand, demonstrating more than 10 technologies in the domains of AI and machine vision, advanced sensing, unmanned systems, Internet of Things (IoT), blockchain, and cyber-physical systems for Uttarakhand State Council for Science and Technology (UCOST), district administration, civil society, and adopter rural communities.

Technology Showcase at Uttarakhand Rural Science Congress, Dehradun demonstrated technologies in the presence of the Hon'ble Chief Minister of Uttarakhand (Figure 13). AGNIi Mission have presented a roadmap for leveraging emerging technologies to accelerate climate adaptive agriculture, water management, forestry, and livelihoods. Pathways to scale this across the Himalayan states have also been proposed.

Figure 13: AGNIi Mission Members with Hon'ble Chief Minister of Uttarakhand at Rural Science Congress, Dehradun

Outputs as Technology Advisory Note for the Government of Uttarakhand:

- Technology Advisory Note on Climate Adaptive Water Management
- Technology Advisory Note on Climate Adaptive Agriculture

Ministry of Health for creating Healthcare Infrastructure: Seven rapid-construction healthcare demonstrator facilities were constructed across locations in five states, totaling over 350 beds. These facilities were deployed in peri-urban and remote areas (Haryana, Nagaland, Punjab, Assam, Meghalaya).

Output: Detailed Scaling Guidebook on hospital infrastructure augmentation has been prepared based on AGNIi's experience in creating modular hospitals in the Northeast region. The guidebook is meant to scale such efforts in a methodical way in other regions of the country.

Other Important Collaborations:

The AGNIi mission is also partnering and collaborating with other agencies for suggesting innovative technological solutions. Some important agencies worth mentioning are:

- Delhi Police
- Ministry of Development of North-Eastern Region (MDoNER)
- Additionally, the mission partners with Indian Public R&D and Innovation ecosystem for expertise, partnerships, and innovation sourcing. Some of the organisations include Startup Centres of Excellence (CoEs) and Incubators (T-Hub, MakerVillage, ARTPark, Society for Innovation and Development-IISc)
- Pre-eminent academic centres (Indian Institute of Technology (IIT) Delhi, Madras, Bombay, and Indian Institute of Information Technology (IIIT) Hyderabad, Allahabad)
- Pre-eminent Public R&D and Technology institutions (ISRO, Bhabha Atomic Research Centre (BARC) and various CSIR institutions)
- RuTAG centres at IIT Madras, Delhi, Roorkee, and Guwahati for technology co-development primarily in the areas of labour productivity and Pashmina and Carpet quality

2019

1.6 Innovation Challenge for the Development of Machine-Aided Translation System (ICMATS)

In March 2019, the Office of PSA announced nine national S&T missions on the recommendations of the PM-STIAC. One of these nine missions, Natural Language Translation Mission aims to make opportunities and progress in science and technology accessible to all citizens in their mother tongue. Using a combination of machine and human translation, the mission is aimed at enabling access to teaching and research material bilingually–in English and one's native Indian language.

Under this mission, several initiatives have been launched, including the Innovation Challenge for Machine-Aided Translation System (ICMATS). The ICMATS aims to involve industry/startups in developing machine-aided translation systems using open-source translation tools and publicly available text corpora, including resources from the language technology platform, Bhashini (https://bhashini.gov.in), developed by MeitY.

ICMATS aims to develop usable and scalable text-to-text machine-aided translation systems for both English to any Indian language and vice-versa, utilizing open-source Machine Translation platforms and text corpora. To customise the system for the domain of the user agency (National Council of Educational Research and Training (NCERT), Vigyan Prasar), the participating teams are creating additional parallel text corpus using the content made available by the user agencies.

Milestones

ICMATS was launched by the PSA on 26th August 2022, as depicted in Figure 14). The three stages of ICMATS are scheduled to be culminated by October 2023.

More than 60 startups & Industry Organisations from the field of Natural Language Processing (NLP)/ AI & Machine Translation have registered for ICMATS.

Six teams have qualified to the Prototype Stage.

Post successful completion of Stage 1 (Ideation Stage), the teams are at the culmination phase of Stage 2 (Prototype Stage). Figure 15 depicts a banner floated on social media prompting startups to register for Stage 1.

In the Final Stage 3 (Solution Building Stage), at most three out of these six startups will build solutions for the user agencies NCERT & Vigyan Prasar in dedicated domains of education and science communication.

Collaborating Agencies

- NCERT
- Vigyan Prasar
- MeitY
- Invest India

Figure 14: PSA Prof. Ajay Kumar Sood and ICMATS team at the launch

Figure 15: ICMATS banner prompting startups to register for stage 1

2023

1.7 National Quantum Mission

National Quantum Mission (NQM) is one of the nine missions of national importance, being driven by the PM-STIAC to leverage cutting-edge scientific research for India's sustainable development. The NQM received approval from the Government on 19th April 2023 at a total cost of Rs. 6003.65 crores. It is to be led by DST, in partnership with Department of Space (DoS), Department of Telecommunication (DoT), DRDO, DAE as well as MeitY.

Through NQM, India seeks to further build the national quantum technology ecosystem to foster research, development, and deployment of quantum infrastructure for practical use. We aim to create a dynamic and innovative ecosystem by bringing together the existing national and international expertise and infrastructure utilizing novel consortia models. This will help drive the collaborative efforts of government, industry and academia, to leverage the quantum-enabled technological advantage for novel and advanced applications.

Objectives of NQM

The key objectives of the NQM are:

- Develop intermediate-scale quantum computers with 20-50 physical qubits (3 years), 50-100 physical qubits (5 years) and 50-1,000 physical qubits (eight years) in various platforms like superconducting and photonic technology.
- Develop satellite-based secure quantum communications between two ground stations over a range of 2,000 kilometres within India as well as long-distance secure quantum communications with other countries.
- Develop inter-city quantum key distribution over 2000 km with trusted nodes using wavelength division multiplexing on existing optical fibre.
- Develop a multi-node Quantum network with quantum memories, entanglement swapping and synchronised quantum repeaters at each node (2-3 nodes).
- Develop magnetometers with 1 femto-Tesla/sqrt (Hz) sensitivity in atomic systems and better than 1 pico-Tesla/sqrt (Hz) sensitivity in Nitrogen Vacancy-centres; Gravity measurements having sensitivity better than 100 nm/s^2 using atoms and atomic clocks with 10-19 fractional instability for precision timing, communications, and navigation.
- Design and synthesis of quantum materials such as superconductors, novel semiconductor structures, and topological materials for fabrication of quantum devices for the development of qubits for quantum computing and quantum communication applications, single photon sources/detectors, entangled photon sources for quantum communications, and sensing and metrological applications.

NQM also lays emphasis on the overall development of the Quantum Technology Ecosystem in the country. The mission aims to seed, nurture, and scale up research and development activities in academic institutes/universities, government laboratories and industries to strengthen indigenous capabilities and mark India's presence in the global quantum technology space.

The aim of NQM is to enhance scientific and industrial research and development to help accelerate economic growth and overall national development through various Quantum Technologies. The aim is to position India as a leading nation in this field.

The implementation of NQM envisages well-orchestrated and synergistic efforts through a hub-spoke-spike model, involving CoEs, consortia projects, individual scientist-centric projects etc. These will be overseen by a Mission Governing Board (MGB) at the apex level. MGB will be assisted by a Mission Technology Research Council (MTRC) as the top-level scientific and technological body.

The PSA will be the Chair of MTRC and a member of the MGB. As a result, the Office of PSA is being closely consulted by DST while setting up the foundational structures of NQM. The Office of PSA has, inter alia, advised DST to hold National State-of-the-Art Discussion Meetings on Quantum Computing, Quantum Communication and Quantum Sensing and Metrology. These meetings, attended by all active researchers from academic and R&D institutions of the country, will help gauge the level of existing national expertise in these different verticals vis a vis the NQM goals so that realistic and concrete R&D Action Plans can be worked out. The Office of PSA has also been interacting with some national and international players in Quantum Technologies to help evolve a realistic roadmap for the country in this important domain.

Theme 2

Empowered Technology Group

2020

2.1 Empowered Technology Group

Through an approval of the Cabinet in February 2020, an Empowered Technology Group (ETG) has been constituted as an institutionalised structure to proactively lay down, coordinate and oversee national-level policies relating to procurement and induction, and R&D in technologies that require large outlays in resources both financial and human and to render sound and timely advice for determining direction and trajectory of Government's R&D and Technology Development Programmes. The PSA is the Chair, and his Office serves as the ETG Secretariat. The ETG comprises of the following members:

- Chairman, Atomic Energy Commission (AEC)
- Chairman, Space Commission
- Chairman, Defence Research and Development Organisation
- Secretary, Ministry of Electronics and Information Technology
- Secretary, Department of Telecommunication
- Secretary, Department of Science and Technology

Milestones

The ETG meets regularly for the evaluation of Cabinet/Expenditure Finance Committee (EFC) notes and policy documents which are sent by various ministries and departments. Till March 2023, the ETG has had 45 meetings in which 66 Cabinet/EFC proposals and other documents have been considered. These include proposals for Deep Ocean Mission, Quantum Mission, Indian Space Policy, BSNL Tender, Laser Interferometer Gravitational-wave Observatory (LIGO) Mega Science Project, Semiconductor Mission, defence procurements and defence R&D proposals, etc.

The ETG Secretariat undertakes evaluation of these notes in the form of expert consultations and discussions on these proposals with stakeholders, prior to the ETG meetings.

Milestones

After a review held on 1st January 2023 by the Prime Minister's Office (PMO) of ETG's activities, a Self-Appraisal Proforma has been introduced in the format for Cabinet Notes. The proforma indicates the self-appraisal to be done by the Ministry/Department about the technology/technology product procurement or R&D component of its proposal. The important appraisal parameters which are included in the proforma are given below:

- Technology indigenisation plan
- Critical technologies being imported
- Global benchmarking
- Technology obsolescence
- Technology commercialisation plan
- Synergy with other national initiatives/projects
- Involvement of Academia and Industry
- Impact of the proposal in terms of import substitution, indigenous manufacturing, export promotion, supply chain self–sufficiency, national security
- Capacity building

Apart from proposal evaluation, the other activities which have been undertaken as part of ETG include active engagements with various ministries and departments in shaping their policies and programmes with focus on adoption of latest and emerging technologies for governance, thrust on indigenous technology development and manufacturing capabilities, and technology commercialisation. Some of these activities since 2020 have culminated in significant outcomes as given below:

- Formulation of Technology Transfer policy and Space Communication policy of DoS.
- Thrust on the indigenisation of 4G/5G core in the procurement and R&D programmes of DoT.
- Facilitation of improvements in the Pension Disbursal and Grievance Redressal mechanisms of the Department of Pension & Pensioners' Welfare for civilian and defence pensioners.
- A series of six national-level training programme on AI for Technology Officers from various ministries/departments, in collaboration with NASSCOM.
- Allocation of 5% of annual collections from Universal Service Obligation Fund (USOF) of DoT for funding R&D and technology commercialisation in the Telecom sector.
- Creation of a Digital Catalogue of indigenously developed technologies on the I-STEM portal. Approx 730 technologies from several academic and R&D institutions are showcased in the digital catalogue.
- Release of e-waste management advisory for Smart Cities.
- On-boarding of 21 indigenous technology products on Government e-Marketplace (GeM) portal.

To access I-STEM Dashboard, scan:

Technology Advisory Group for ETG

A Technology Advisory Group (TAG) for ETG has been formed as per the provisions of the constitution order of the ETG, for providing expert advisory support to the ETG, as and when required, on matters of national importance relating to science, technology, innovation, and R&D. The TAG members may be requested to participate in ETG meetings, on the specific request of the Chair, on needbased requirements depending on subject/agenda of deliberations. The first meeting of the extant TAG was held on 25th July 2023 in which areas of Carbon Capture Storage and Utilisation; Alternate Battery Technologies and Artificial Intelligence were discussed with a focus on technology roadmap development (Figure 16).

Figure 16: 1st Extant TAG Meeting takes place at Vigyan Bhawan, New Delhi

The TAG currently comprises the following members i.e., nine members from the Private Sector who have investments in Research and Development and nine members from Academia (University or Technical Institute Sector)

TAG members from Academia

1. Dr. Shailesh Nayak, Director, National Institute of Advanced Studies
2. Dr. Renu Swarup, Former Secretary, Department of Biotechnology, Government of India
3. Prof. Abhay Karandikar, Director, IIT Kanpur
4. Prof. V. Kamakoti, Director, IIT Madras
5. Prof. Bhaskar Ramamurthy, Former Director, IIT Madras
6. Prof. Chintan Vaishnav, Mission Director, Atal Innovation Mission, NITI Aayog
7. Prof. Navakanta Bhat, Professor, IISc. Bengaluru
8. Dr. Anil Prabhakar, Professor, Department of Electrical Engineering, IIT Madras
9. Dr. Ashish K. Lele, Director, CSIR-NCL

TAG members from Industry

1. Ms. Debjani Ghosh, President, NASSCOM
2. Shri Vipin Sondhi, Former MD & CEO Ashok Leyland and JCB India; Former Chairman IISER, Bhopal; Chairman CII Mission on Tech, Innovation & Research and Future Mobility; Chairman National Board for Quality Promotion
3. Dr. Vibhav Sanzgiri, Executive Director R&D, Hindustan Unilever Limited and Co-Chairman of the Science and Technology Committee of FICCI
4. Ms. Mahima Datla, MD and CEO, Biological E
5. Dr. Debashish Bhattacharjee, Vice President, Technology & New Materials Business, Tata Steel Limited
6. Shri Vineet Mittal, Chairman, Avaada RJHN Private Ltd.
7. Dr. S.S.V. Ramakumar, Director(R&D), Indian Oil Corporation Limited (IOCL)
8. Shri Pramod Verma, Chief Architect Aadhaar & India Stack, CTO EkStep Foundation, Cofounder Beckn.org, Volunteer Ispirt
9. Mrs. Rashmi Urdhwarshe, President, SAE INDIA

Theme 3

City Science and Technology (S&T) Clusters

2020

3. City Science and Technology (S&T) Clusters

Science & Technology Clusters (S&T Clusters), a flagship initiative of the Office of PSA, were established after the recommendation of the PM-STIAC. The S&T Clusters operate in a three-tiered pyramid approach. The bottom tier involves creating a shared ecosystem among the institutions, the second-tier places focus on becoming a regional solution provider, and the topmost tier is aimed at the clusters becoming nationally and globally competitive. By working together and leveraging their collective strengths, the clusters aim to bring positive impacts on the economy and society at large. Each cluster has a unique area of focus, R&D activities, and collaborations with industry partners, academic institutions, and government agencies.

Presently, six S&T Clusters — in Bengaluru, Bhubaneshwar, Delhi, Hyderabad, Jodhpur, and Pune — are striving to solve local problems in a consortium mode. This initiative brings together academia, R&D institutions, industries, and local governments to tackle regional problems through S&T interventions. The clusters operate under a formal umbrella structure while retaining their internal autonomy, thus creating a shared ecosystem that fosters collaboration among stakeholders. In Figure 17, the S&T Cluster concept is explained:

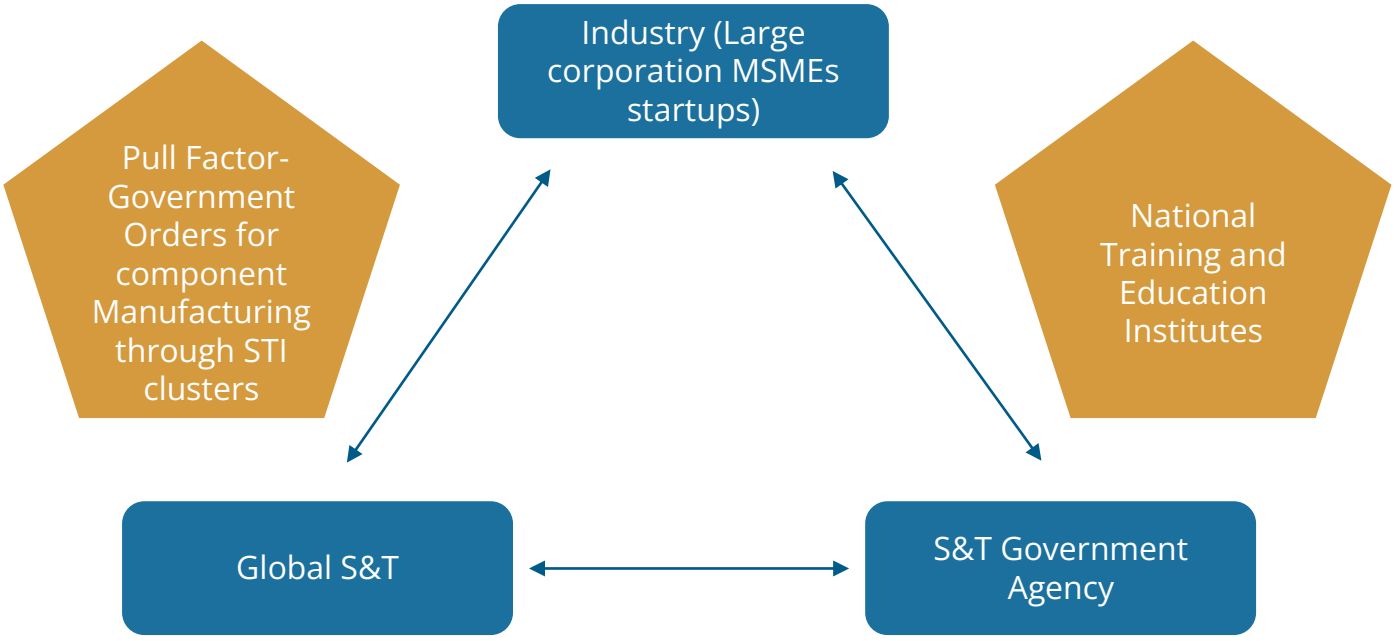

Figure 17: S&T clusters work as regional solution providers, while being nationally and globally competitive

A few of the milestones achieved by individual clusters are highlighted below:

3.1 Delhi S&T Cluster (Delhi Research Implementation and Innovation–DRIIV)

ONE DELHI App: Delhi Government's Transport Department and the Centre for Sustainable Mobility at Indraprastha Institute of Information Technology Delhi (IIIT Delhi) worked together on ONE DELHI App. Its features were further enhanced to cater to all the needs of public transport and electric vehicle (EV) users of Delhi. In early 2022, a new beta version of the ONE DELHI App was launched for Android and iOS users with the following key features: Live Bus Tracking, Contactless Ticketing, Journey Planner, EV Charging, Official Complaint and Feedback System, and Route Assignment.

The app has registered 5,00,000 downloads on Google Play Store, and around 2 lakh daily users can track over 7000 DTC and Cluster buses, and 50 depots, with real-time coordinates along with the actual waiting time in minutes to the bus stop. The algorithm and the adjoining software can now be replicated in any city as well.

End users: Citizens of Delhi NCR

Pilot Run of Air Pollution Control Technologies in the Delhi-NCR Region Under Project SAMEER (Solutions for Air-Pollution Mitigation Through Engagement, Engineering, and Research): From November 2022 to February 2023, several air pollution measurement and mitigation technologies—contributed by fifteen startups from across the country for free—were deployed at previously designated air pollution hotspots in Gurugram. The aim was to analyse the extent to which air quality could be improved through technological intervention. The results will help in determining whether the technologies could be scaled up to the national level as a solution to the increasing problem of air pollution in the country.

As a successful outcome of project SAMEER, corporates and Public Sector Undertakings have supported the adoption of technologies through sustainability projects. Under CSR, a Fast-Moving Consumer Goods conglomerate has offered financial support to project SAMEER for large-scale deployment of roof-mountable air filters on four-wheelers. Delhi Pollution Control Committee (DPCC) tied up with DRIIV to expand the scope and scale up hotspot monitoring to additional sites. The project timeline has been extended until December 2023 to include the winter months. The objective of the follow up study is to measure the reduction in PM2.5 levels due to the resolution of dust-causing issues in three cluster locations across Delhi. Cluster selection will be in one of the hotspots among the thirteen already identified by DPCC. The study will deploy low-cost sensors placed in these clusters to collect data over a period of six months and provide an analysis of changes pre, during, and post-intervention. Open Philanthropy has sanctioned a grant of Rs. 43 lakh to support this project.

End users: Citizens of Delhi NCR region

3.2 Pune S&T Cluster (Pune Knowledge Cluster–PKC)

One Million Galaxies—PKC's leading citizen science initiative involves analysing galaxy images from the Japanese telescope Subaru. Under this initiative, astronomy enthusiasts receive training from expert astronomers to identify features of the galaxy images and use an easy-to-use interface to mark them. After sensitising amateur astronomy groups and planetariums, a pilot platform was created, beta-tested by enthusiasts, and launched to the public on National Science Day, February 28, 2022. Over 1,000 astronomy enthusiasts from India and abroad have enrolled, identifying over 80,000 galaxy image features. The programme was presented at the State Level Amateur Astronomer's Meet and a multi-stakeholder roundtable on Citizen Science Policy and Practices in India.

End users: Educational institutions in Maharashtra

ConnecTree: An AI-enabled interactive platform developed by PKC, ConnecTree is publicly available for choosing, promoting, tracking, and maintaining sapling plantations by citizens, sponsors, and local government bodies. 200 saplings were brought under ConnecTree with a 70% survival rate. So far, over 500 saplings have been successfully mapped on the platform, and more than 3.5 lakh saplings planted by the Pimpri-Chinchwad Municipal Corporation will be mapped in the upcoming months.

End users: Citizens and local government bodies

3.3 Bhubaneswar S&T Cluster (Bhubaneswar City Knowledge Innovation Cluster–BCKIC)

Bayer Fellowship—MEDHA: Bayer Crop Science Limited in association with the Bhubaneswar City Knowledge Innovation Cluster (BCKIC) Foundation launched the Medha Fellowship with an aim to provide financial assistance to students from economically weaker sections/ Low Income Group for higher studies (Postgraduate and Doctoral studies) in the Life Sciences / Biotechnology / Pharma disciplines. Fellowship program was managed by BCKIC Foundation with extensive cross country reach out and student engagement, stringent selection criteria, multi-institutional interview panels for transparent evaluations and due diligence before the fellowship disbursal.

The Medha Fellowship attracted over 3200 applications from across the country. The fellowship was awarded to 100 postgraduates and 25 doctoral students. Special emphasis was given to women students and Divyang Jan category.

End users: Students across India

UK-India HealthTech Program: BCKIC Foundation and KIIT Technology Business Incubator jointly implemented the UK-India HealthTech Bootcamp with support from British High Commission India. The program focused on identifying the Indian innovators in health-space having promising technologies which can be adopted globally including by National Health Service (NHS) UK.

The program was conducted in association with Academic Health Science Network, Yorkshire, and Humber. The first phase of the program included the identification of 25 most promising innovators from across the country, selected through country-wide applications. The top 25 companies were invited for the 3-day bootcamp sessions focused on evidence generation, regulatory requirements, funding, and market connect along with working with NHS UK.

End users: Healthcare entrepreneurs and NHS UK

3.4 Jodhpur S&T Cluster (Jodhpur City Knowledge and Innovation Foundation–JCKIF)

Smart Traffic Management: JCKIF is actively collaborating with the police authorities in developing smart traffic management solutions for the city of Jodhpur, by using roadside cameras to detect traffic violations such as wrong lane detection and helmetless driving, and to perform traffic volume and speed variation analysis for traffic planning on roads and at roundabouts. In this regard, JCKIF has already completed and demonstrated Phase I of the project, and the next phase of development is underway.

End users: Jodhpur City Administration

Local Handicrafts and Handlooms: The COVID-19 pandemic severely affected the local handicrafts and handlooms industry, especially artisans from unorganised sectors. JCKIF and IIT Jodhpur have organised several need assessment workshops and interaction sessions, particularly with the artisans from the unorganised sectors. JCKIF has been playing a crucial role in preserving the culture of traditional arts & crafts by sensitising and creating awareness among the masses about local handicrafts and handlooms, thereby promoting their business. So far, JCKIF has organised three exhibitions which have attracted diverse audiences ranging from school children to faculty members, industrialists and local masses from Jodhpur and nearby areas. The total sales registered in these exhibitions were more than 15 Lakhs, which shows the impact JCKIF is creating in enhancing the lives of craftsmen. JCKIF has also developed Augmented/Virtual Reality (AR/VR) technology for these local artisans to promote their business using e-commerce to reach the unreached globally.

End users: Local artisans in the Thar Desert area

3.5 Hyderabad S&T Cluster (Research and Innovation Circle of Hyderabad–RICH)

Scholarship and Mentorship Programme for Women in STEM Education and Careers: Through the Women in STEM (Science, Technology, Engineering, and Mathematics) programme, 25 women students from across India pursuing various disciplines in STEM fields, have been selected and placed at top research institutes in Hyderabad like the Centre for Cellular & Molecular Biology (CCMB), Dr. Reddy's Institute of Life Sciences (DRILS), Dr. Reddy's Laboratories, and Bharat Biotech.

End users: Women in STEM

The Acceleration Initiative for Devices and Diagnostics (AID) Programme: RICH's AID programme addresses the medical devices sector by identifying and nurturing startups in this space for regional, national and global impact. The six-month AID programme provided structured support for clinical advice, regulatory compliance, go-to-market strategies, and access to funding and market access through workshops and mentoring. Over the last 3 cohorts, RICH supported 27 startups, onboarded over 35 mentors, organised more than 50 domain workshops, conducted over 65 one-on-one mentoring sessions and are connected with more than 20 hospital partners in the medical devices and diagnostics space.

End users: Hospitals and medical devices sector entrepreneurs

3.6 Bangalore S&T Cluster (Bengaluru Science and Technology Cluster–BeST)

The One Health Bengaluru City Consortium: In November 2022, Bengaluru's municipality, Bruhat Bengaluru Mahanagara Palike (BBMP) announced a One Health Cell for Bengaluru city. In collaboration with BBMP, BeST Cluster has launched One Health Bengaluru City Consortium to work towards the goal of integrating existing one health efforts, facilitating collaboration, and building a one health framework for the city. One Health is a multi-sectoral approach that takes into consideration human, animal, environmental health and the interconnectivity and interdependence of these three elements. The One Health Bengaluru City Consortium works across the verticals of disease ecology, environmental surveillance, human disease surveillance, veterinary disease surveillance, modelling and prediction, pathogen genomics, networking and communication, citizen science, outreach, and education.

Diseases, their causes, and cure to be focused by this consortium as directed by BBMP include Leptospirosis, Brucellosis, Anthrax, Rabies, Kyasanur Forest Disease, Q fever, Scrub typhus, and Dengue. A One Health Innovation event will be hosted later this year to crowdsource innovative solutions for challenges across the various verticals.

End users: Public policymakers, hospitals, and general public.

Theme 4

Indian Science, Technology, and Engineering Facilities Map (I-STEM)

2020

4. Indian Science, Technology, and Engineering Facilities Map (I-STEM)

The Indian Science, Technology, and Engineering Facilities Map (I-STEM) project is an initiative of the Office of PSA. I-STEM was set up at the Centre for Nano Science and Engineering (CeNSE), IISc Bengaluru for sharing laboratory facilities available at publicly funded R&D institutions.

I-STEM was launched and dedicated to the nation by the Honourable Prime Minister on 3rd January 2020, followed by Phase-II in August 2021.

I-STEM web portal was established to enable users in locating the specific facility they need for their R&D work and identifying the one that is either located closest to them or available at the earliest. The main objective of this portal is to provide support to researchers by facilitating sharing of costly R&D resources/equipment to optimize the usage of these resources established across the country. This saves public money and saves institutions from the financial burden of buying new costly equipment when it already exists in the country.

Enabling the sharing of resources across the country also helps the institutions from Tier 2 and Tier 3 towns and cities to provide their researchers access to state-of-the-art resources which exist in premier institutions, on sharing basis. This is being executed by an online national network that lists all scientific/technical research facilities procured with funds provided by agencies of the Government of India and installed in academic/R&D institutions. The government strongly recommends the listing of all such R&D resources on I-STEM web portal.

I-STEM web portal was designed with an IP-protected mechanism, that is, “Method and Process for Efficient Use of the Geographical Resources” which holds the database of publicly funded functioning R&D equipment and facilities in various public and private institutions in India.

Some of the milestones of I-STEM are highlighted below:

Milestones

Currently, over 27,000 analytical equipment/R&D facilities are listed by more than 2300 institutions in various parts of the country. More than 23000 registered users/researchers are linked to I-STEM.

I-STEM has the facility for users to book equipment with the help of the booking calendar. The payments on I-STEM portal are enabled through BillDesk, which is a leading Bharat Bill Payment Operating Unit in the Bharat Bill Payment System.

Through I-STEM, academic users in India will now be able to access the software COMSOL free of cost. I-STEM and the COMSOL group headquartered in Sweden have entered a collaborative arrangement for this. Software platforms like MATLAB and LabVIEW are now also available to users through similar arrangements.

Features of I-STEM:

The I-STEM web portal, developed entirely indigenously at IISc is fully functional, has been assessed rigorously for security and is certified by a government-approved agency, as shown in Figure 18.

The portal has a dashboard for the custodian institution to provide a live inventory of all public-funded equipment in-house, the functional status of the same, and the usage and sharing of the equipment. Every custodian and user have individual login and password.

It is built with a hierarchy of access – by the nodal office, Head of Institution, Head of the Department, facility-in-charge, and equipment operator/ technologist.

The facilities/equipment shared by the institutions carry a specific code.

Registered users can search and locate for the equipment/facility they need and correspond directly with the operator/technician to reserve it for use in a mutually convenient manner.

Each ‘sharing event’ is assigned a unique 10-digit Facility Booking Record (FBR), through which a user and the custodian/operator are aware of the status of a particular request for sharing a facility. The FBR is ‘closed’ only after the ‘sharing event’ is completed.

The portal has made provisions for users to upload project reports, publications, and patent filings for the benefit of other users.

The I-STEM user statistics is available at

For more information, scan:

Figure 18: I-STEM features

Theme 5:

Mental Health and Normalcy Augmentation System (MANAS)

2021

5. Mental Health and Normalcy Augmentation System (MANAS)

Considering the importance of positive mental health, the Office of PSA, in 2020, initiated Mental Health and Normalcy Augmentation System (MANAS), which is endorsed as a national programme by the PM-STIAC. MANAS, a well-being app, with the support of the Office of PSA, has been jointly developed by the National Institute of Mental Health and Neurosciences (NIMHANS) Bengaluru, Armed Forces Medical College (AFMC) Pune and Centre for Development of Advanced Computing (C-DAC) Bengaluru, as shown in Figure 19.

Milestones

A scalable digital platform, with appropriate data security certification testing, was successfully developed along with mental well-being MANAS App with scientifically evaluated contents as modules namely Timesmart, Good sleep, Deep connect, mindfulness, social connectedness, and emotion regulation.

C-DAC Bengaluru successfully developed MANAS App (an Android app V0.4.0, 0.8.0) for alpha and beta testing in Google Play Store for internal, user and group trials.

The App is now placed into the NIC cloud. C-DAC and National Informatics Centre (NIC) teams are collecting data and providing backend support. The MANAS App is being used by approximately 12,000 people in English and Hindi languages.

To spread awareness about mental well-being and MANAS APP, the Office of PSA with MoH&FW jointly organised MANAS Mitra webinar through state mental health departments in Jharkhand, Chhattisgarh, and Assam promoting mental well-being concept to the people. People shared their experiences during the Covid-19 period and discussed their mental health issues with experts. Yoga techniques were also demonstrated.

During a virtual meeting on March 6, 2023, the White House Office of National Drug Control Policy, Washington, D.C. expressed their appreciation for the mental well-being initiative. They acknowledged its potential to strengthen community resilience and recognised the positive impact it could have in promoting mental health within the community.

Expression of interest on May 2023 has been received from Head of the Department of Information Technology, Kannur University, Kerala to enhance the application MANAS App.

Implementing Agencies

- NIMHANS Bengaluru
- AFMC Pune
- C-DAC Bengaluru

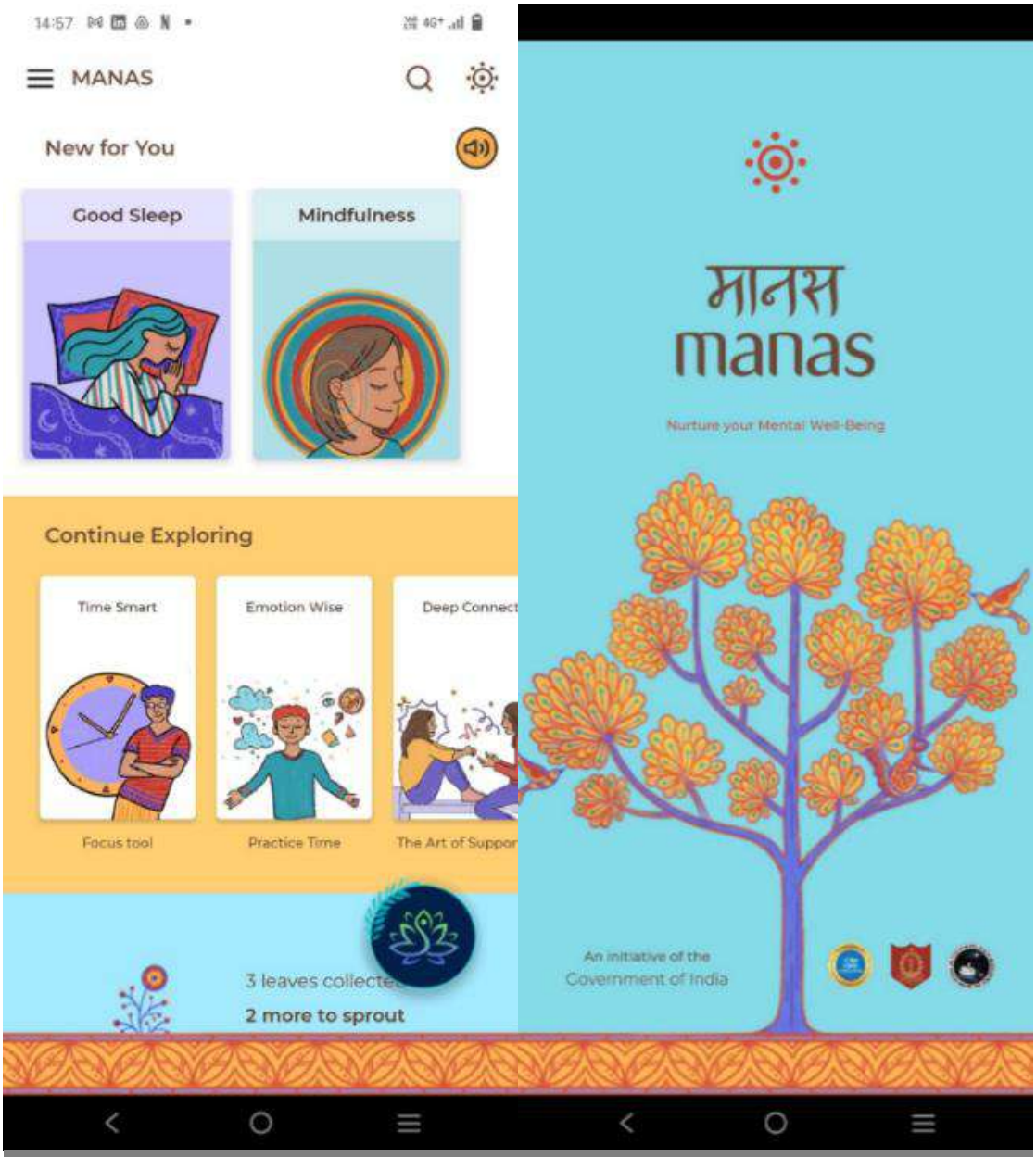

Figure 19: The MANAS App

Theme 6:

Mega Science

2021

6. Formulating Mega Science Vision–2035

India is a valued partner in several global Mega Science Projects (MSPs) and has plans to establish a few important MSPs in India too. The decision regarding which projects to undertake, or participate in, is taken through periodic national consultations, which have come to be known as Mega Science Vision (MSV) exercises. Currently, the MSV–2035 Exercise is being facilitated by the Office of PSA in six disciplines: Nuclear Physics, High Energy Physics, Astronomy & Astrophysics, Accelerator Science and Technology and Applications, Climate Research and Ecology and Environmental Science. Five leading nodal institutions and five nodal scientists have agreed to lead this exercise. A Working Group and a Drafting Group have been set up in each discipline. The outcome will be a Mega Science Vision–2035 Report in each of these disciplines.

Milestones

An advanced draft of the MSV-2035 Report on Nuclear Physics has been prepared after extensive consultations. Additional information is being compiled for the final report.

National and international consultations were completed for draft reports on Astronomy & Astrophysics and Accelerator Science and Technology and Applications. Similarly, national consultations have been completed for the report on Climate Research.

The remaining two reports are in progress. These are "Community Documents" summarising the dreams and aspirations of the national scientific community regarding MSPs in these disciplines, and their considered roadmaps for realising them.

Important steps were taken towards the establishment of a High Brilliance Synchrotron Radiation Source (HBSRS) in the country. The Office of PSA and Raja Ramanna Centre for Advanced Technology, DAE, Indore formulated a special note on the "Relevance of a National HBSRS for Applied and Industrial Research". A discussion meeting with representatives of Indian Industry and User Government Departments was organised at the Indian National Science Academy (INSA), New Delhi on 17th September 2022, as shown in Figure 20. A strong consensus emerged that having a national HBSRS is an urgent necessity for India's industrial competitiveness, especially in sectors such as drugs and pharmaceuticals, materials and manufacturing, and energy technologies. Further consultations were also undertaken by the Office of PSA and DAE in the governmental channels for this important project.

Collaborating Agencies

- Department of Atomic Energy
- Department of Science and Technology
- Department of Space
- Ministry of Earth Sciences
- Ministry of Environment, Forest, and Climate Change
- Department of Biotechnology

Figure 20: A discussion meeting among key stakeholders on HBRSS

Theme 7:

Rural Technologies Action Group (RuTAG)

2004

7. Rural Technology Action Group (RuTAG)

In 2004, an initiative, Rural Technology Action Group (RuTAG) was conceptualised by the Office of PSA, as a mechanism to provide a higher level of S&T intervention and support for Rural Technology, than hitherto achieved through other governmental programs and related institutional mechanisms. The appropriate technologies have been developed by the RuTAG centres established at seven IITs, i.e., in Madras (2004), Guwahati (2005), Kharagpur (2008), Delhi (2009), Roorkee (2009), Bombay (2010), and Kanpur (2013). These interventions are demand-driven and are catering to technology up-gradation, training, and demonstration.

A few successful technologies developed by the different RuTAG centres are given below:

IIT Madras: Electronic Jacquard Handloom (EJH)

The Electronic Jacquard Handloom (EJH) is a software-driven 192-hook technology that uses electricity to select hooks. This innovation transforms the production of fine mats from Korai grass. With the EJH, weavers can now create customised designs, and enhance their artistic capabilities significantly. The technology has boosted productivity by 300%, thus cutting down the time required to weave a full mat from 10 days to just 3 days. This impressive combination of traditional artisanship and modern technology ensures the preservation of weaving culture while meeting contemporary demands (Figure 21).

Figure 21: Electronic Jacquard Handloom with design software for fine korai grass designer mat weaving

IIT Bombay: The floating fish cages

The traditional fish cages made of jungle wood and sal wood are heavy, weak, and require frequent repairs. To address these challenges RuTAG IIT Bombay developed a better designed floating fish cage which has been widely adopted, benefiting tribals and fishermen in various regions, including Maharashtra and North-Eastern states.

The floating fish cages have improved the process of rearing fish in inland water bodies, such as lakes and ponds to enhance production. These improved cages provide a controlled and protective environment for growing fish from fry to fingerlings, thus, promoting efficient growth, as shown in Figure 22.

Figure 22: Floating fish cages for inland aquaculture

IIT Delhi: Treadle pump

The ergonomically designed Treadle pump is a human-powered water pump used primarily for irrigation purposes in areas with shallow water table (around 10m or less). Developed by RuTAG IIT Delhi, it features a user-friendly design, easy assembly, and adjustable pedals. It is environment friendly and saves electricity. It has a discharge rate of 3500-4000 litres per hour. With a lifespan of 10 to 15 years, it has proven beneficial for farmers with small land holdings in several states due to effortless water lifting with the ergonomically designed, that makes it a valuable irrigation tool (Figure 23).

Figure 23: Treadle pump under demonstration in Sarjapur, Bangalore

IIT Kharagpur: Integrated rice puffing machine

The integrated rice puffing (muri) machine is designed to expand rice grains, creating puffed rice, a popular food product in the eastern part of India. Its productivity is significantly higher, producing 40 kg/h of puffed rice compared to the traditional method of 4 kg/h. It incorporates a sand sieving mechanism for rapid sand separation. With the potential to impact the food industry, this technology offers better livelihood options for local artisans and spinners while empowering women Self Help Groups (SHGs) and NGOs. Around 50 units have been installed in various villages in West Bengal and the Northeastern states, contributing to their economic growth and prosperity (Figure 24).

Figure 24: Rice puffing (muri) technology developed by RuTAG, IIT Kharagpur

IIT Kanpur: The bael cutting machine

The bael cutting machine offers a safe and efficient solution for slicing bael fruit used in murraba preparation. Unlike the conventional manual method with hacksaws, this portable machine provides four neat and uniform slices in one pass. It has increased productivity fourfold, ensuring clean and uniform cuts for better returns. Users find it comfortable and highly effective, in cutting the bells into pieces. Collaborating with Panchal Pumps, Kanpur, this technology has proven valuable for food processors in Pratapgarh district of Uttar Pradesh and beyond, as shown in Figure 25.

Figure 25: Demonstration of bael cutting machine

IIT Roorkee: Modified Bageshwari wool charkha

This modified Bageshwari wool charkha, developed by RuTAG IIT Roorkee, improves traditional wool spinning in the Himalayas. It retains the foot-paddle operation while introducing an electric motor with speed control and a reciprocating mechanism for uniform bobbin filling. This cost-effective charkha enhances productivity, producing high-quality yarn from several types of wool. Its adoption by local artisans and NGOs has improved livelihoods and yarn quality, making spinning more efficient and rewarding. It produces smoother yarn production compared to the manual version, as shown in Figure 26.

Figure 26: Modified Bageshwari wool charkha developed by RuTAG IIT Roorkee

IIT Guwahati: Hank to Bobbin winding machine

The Hank to Bobbin winding machine for the weaving industry, is capable of winding twelve bobbins simultaneously, with an 8 kg daily winding capacity. This affordable and locally fabricated machine fulfils the demand of weavers in Assam's Silk village, reducing reliance on expensive machines. The technology's success has led to plans for dissemination across the Northeast, attracting interest from entrepreneurs to address the needs of weavers and textile producers, as depicted in Figure 27.

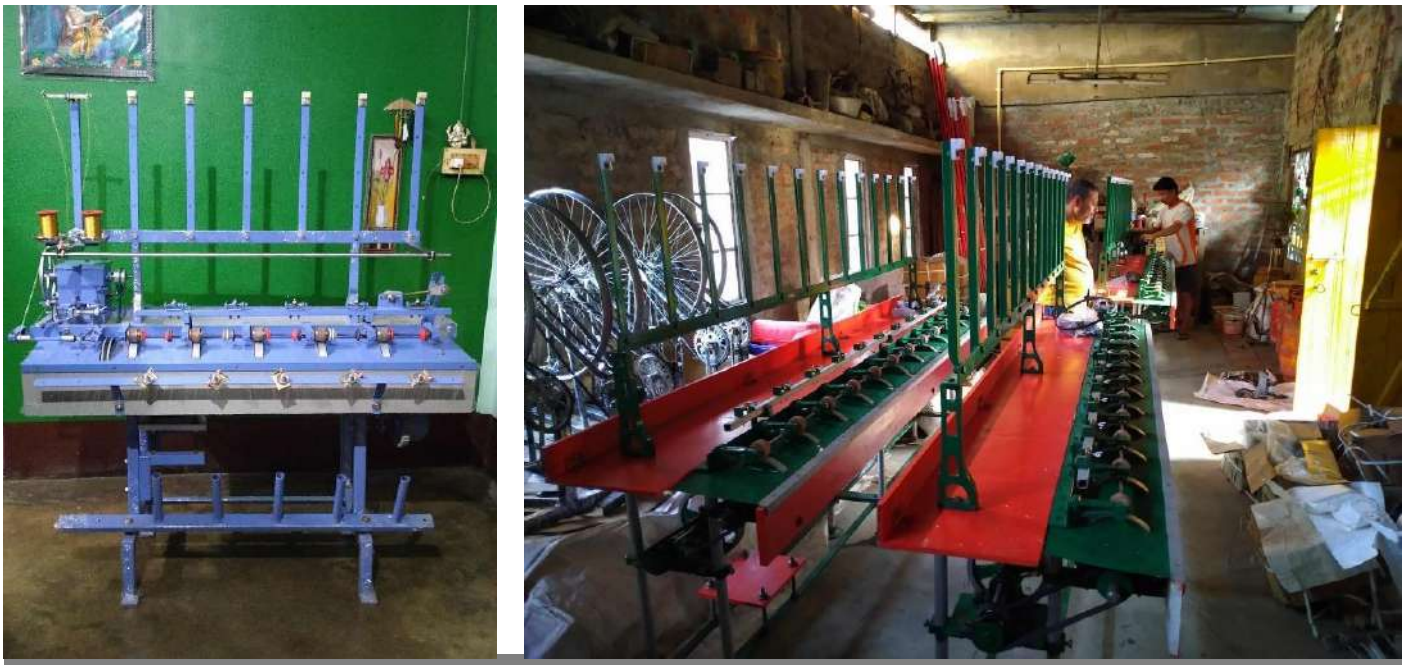

Figure 27: Hank to Bobbin yarn winding machine

This RuTAG 1.0 initiative has successfully developed and evaluated 59 rural technologies. With a vast outreach to approximately 752 NGOs, these innovations have effectively penetrated rural communities, yielding significant benefits. By reducing labour, enhancing production, and uplifting rural livelihoods, RuTAG's contributions have been widely embraced and accepted. Moreover, the collaborative nature of this initiative has fostered unity among stakeholders, instilling confidence in government efforts, and inspired IIT students to engage in rural innovations, making it an impactful initiative for rural development.

RuTAG 2.0

RuTAG 2.0 is being launched with a focus on commercialisation and broader dissemination of developed technologies as products, ensuring wider accessibility and socio-economic impact. The RuTAG 2.0 will lay emphasize on translating innovation into market-ready products reflecting its commitment to driving transformative changes in rural areas and empowering communities for sustainable development.

Theme 8:

Techno-Economics

2019

8. Techno-Economics

The Office of PSA plays a key role in integrating the techno-economic activities of stakeholders in the national R&D ecosystem. The major stakeholders in the national R&D ecosystem are Central Government, State Government, domestic industry, export industry and Academia. Towards this, the Office of PSA has taken the initiative to connect, collaborate and coordinate institutionally so as to boost the national R&D ecosystem in the most efficient and optimal manner. The key initiatives of the Office of PSA relating to the Central Government R&D Budget, State Government R&D Budget, initiatives towards R&D Tax Incentives, initiatives towards Boosting Foreign Direct Investment into R&D, Promoting R&D Exports and Evaluation of Innovation Excellence Indicators of Public-Funded R&D labs under techno-economics are as follows:

2019

8.1 Central Government R&D Budget

The Office of PSA and the Economic Advisory Council to the Prime Minister (EAC-PM) jointly prepared a report titled "R&D Expenditure Ecosystem – Current Status and Way Forward" in 2019. This report contained 14 recommendations for revamping the national R&D Ecosystem. Recommendation 12 of this report inter-alia related to the creation of a centralised repository of data on R&D projects, grants, and related activities in the Office of PSA.

The initiative of the Office of PSA

Accordingly, the Office of PSA took up the matter with the Department of Economic Affairs, Ministry of Finance to introduce a separate appendix in the Union Budget Circular in order to capture R&D Expenditure incurred/projected by different Ministries/Departments in the Government of India. Ministry of Finance took due cognizance of this request and introduced a new Appendix LV in the Union Budget Circular 2021-22. The purpose of this new appendix was to capture the Budget Allocated by Ministries/Departments for R&D Umbrella Schemes/Schemes/Sub-Schemes/ Components and for R&D organisations within their administrative control.

Milestones

With the introduction of Appendix LV in the Union Budget circular 2021-22, R&D allocation/expenditure data of central government departments could be captured. This enabled the Office of PSA to develop Research and Innovation capacity in line ministries for better delivery of departmental programs and services. The latest consolidated data for FY 2022-23 and 2023-24 has been compiled and a consolidated R&D Budget of the central government has been prepared.

Collaborating Agency

- Department of Economic Affairs, Ministry of Finance

2021

8.2 State Government R&D Budget

The state sector is an important component of Gross Domestic Expenditure on R&D (GERD). It is an integral stakeholder in the R&D ecosystem. The objective of the initiative of R&D Budgeting by States is to impress on the State Government the need to include a mechanism of capturing the overall R&D spent, department wise in their respective States/UTs which is not being practised today by a majority of States/UTs.

The advantage of preparing a comprehensive State R&D Budget is that it would enable each State Government to fix its R&D priorities in respect of subjects reserved in the State list like health, nutrition, forest, agriculture, education etc. at the time of preparation of the State budget. This will enable the Government to quantify resources being devoted to R&D and its expected outcome. A correct and accurate assessment of R&D resources being devoted by States will impact GERD in a big way.

The initiative of the Office of PSA

Towards this, the Office of PSA has engaged with State Governments to introduce a separate R&D Budget in respective State Budgets. The governments of Goa, Odisha, and Kerala are leading this initiative.

Milestones

States incur expenditure towards R&D, with the major items of expenditure including medical, agriculture, science, technology, and ecology. This was revealed in a study by the Reserve Bank of India (RBI) initiated at the behest of the Office of PSA. Pursuant to this study, the Office of PSA engaged with State Governments for introducing a separate R&D Budget in their respective State Budgets. Nodal officers were nominated by 19 States to undertake this exercise in their respective States. The governments of Odisha, Goa, and Kerala are leading this initiative. Kerala is the first state to bring out a separate R&D Budget for FY 2023-24 (Figure 28). Odisha, on the other hand, is the first State Government to bring out a separate statement titled "Statement on Allocation for Research & Development, Training and Capacity Development" in their State Budget for FY 2022–23. Goa has introduced a dedicated chapter on Research and Innovation in their State Economic Survey 2022-23 (Figure 29).

Collaborating Agencies

State Governments/UTs

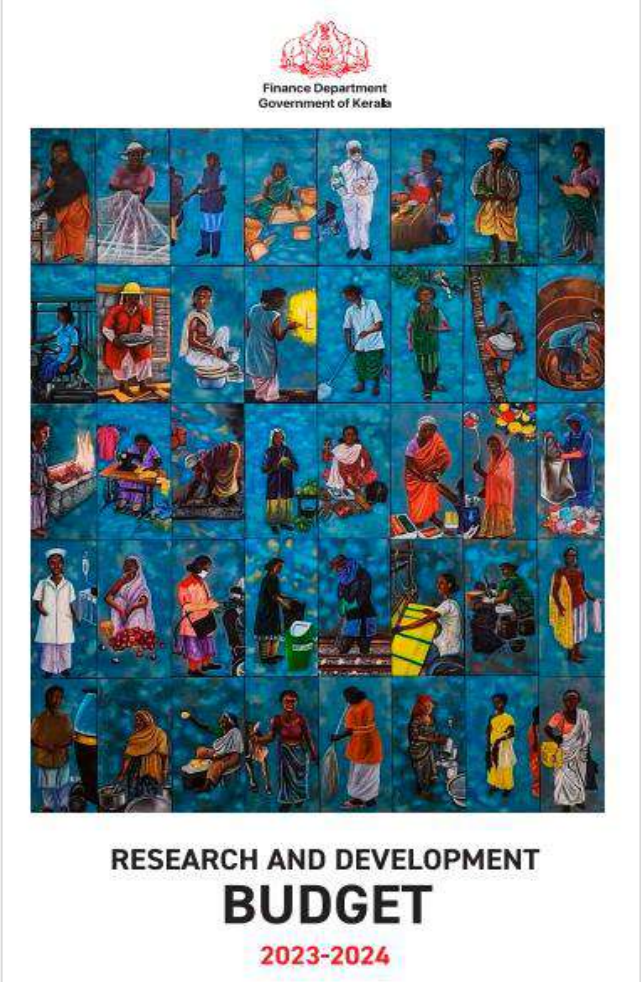

Figure 28: Research and Development Budget (2023–24), Government of Kerala

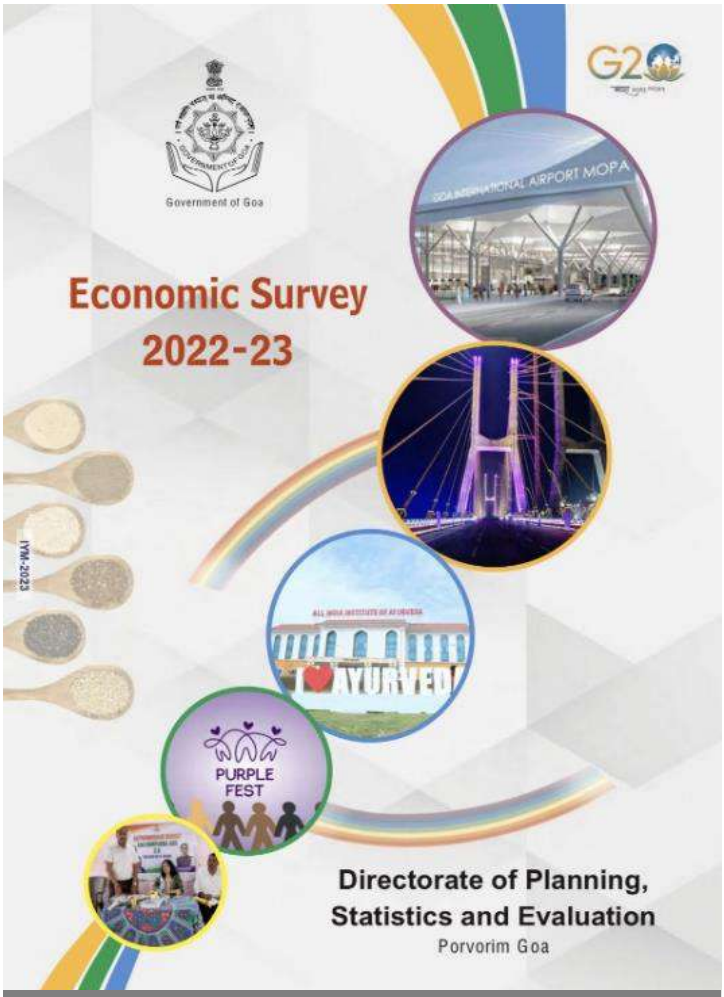

Figure 29: State Economic Survey 2022–23, Government of Goa

For more information, scan:

2022

8.3 R&D Tax Incentives

The Government of India has continuously supported R&D activities and seeks to provide an environment that offers incentives for undertaking R&D investment. As per Economic Survey 2020-21, India has had a generous R&D tax incentive framework that provides tax and non-tax incentives in five categories, namely: (i) Income tax deduction, (ii) State Industrial Policies, (iii) Foreign Trade Policy, (iv) Customs duty exemption and (v) GST exemptions. However, the changes in the GST rates announced in July 2022, by the Department of Revenue, Ministry of Finance adversely impacted the R&D Budget of many stakeholder scientific departments.

The initiative of the Office of PSA

Consequently, the Office of PSA after due consultations with NITI Aayog and stakeholder scientific departments/ministries (CSIR, DBT, DST, ICAR, Indian Council of Medical Research (ICMR), Ministry of Earth Sciences and MeitY) had taken up the matter of tax incentives for R&D activities with the Ministry of Finance in view of recent changes in GST rates.

Milestones

The Office of PSA prepared a study paper titled "Note on R&D Tax Incentives in India - Recent Changes in GST Rates, its estimated impact and Way Forward" in consultation with stakeholder scientific ministries, and the same was shared with the Ministry of Finance for suitable action. The Ministry of Finance has agreed in principle to the recommendation of the office of PSA for compensating the scientific departments.

Collaborating Agencies

- Ministry of Finance
- Scientific Ministries

2020

8.4 Boosting Foreign Direct Investment into R&D

FDI is a key instrument for integrating the Indian economy into the global economy. It supplements domestic capital for R&D investment. Its role and relevance in strengthening the R&D ecosystem were discussed in the report titled R&D Expenditure Ecosystem prepared jointly by the Office of PSA and the EAC-PM in 2019.

The initiative of the Office of PSA

The Office of PSA prepared a note on FDI into R&D–status and way forward (Figure 30), which inter-alia recommended that in order to boost the national R&D and innovation ecosystem, outreach programmes may be conducted.

Milestones

Accordingly, the Office of PSA in collaboration with FICCI organised the first National Seminar on FDI into R&D on 25th August 2022 (Figure 31) with the objective to provide a platform to various stakeholders such as government functionaries, representatives from states and countries, academia, think tanks and industry leaders to deliberate on the various challenges faced by India in attracting FDI in R&D in various sectors.

This seminar was attended by representatives from the Government of Germany, the Department of Promotion of Industry and Internal Trade, the Government of Tamil Nadu, the Government of Telangana, the Government of Odisha, industry and academia to discuss electronics, mining, medical devices, pharmaceuticals, telecom/ IT, electric vehicles and battery/ fuel cells sectors which have potential to attract FDI.

The key takeaways from the seminar were that FDI should not just be in megacities, it should go beyond Tier 1 cities. There is a need to include more R&D in newer technologies especially quantum technologies to tap tremendous business values in areas such as quantum communication and quantum computing. An ecosystem where public R&D, the private sector, academia, venture capitalists and startups can collaborate is the need of the hour. This will enable India to emerge as a global R&D hub.

Collaborating Agencies

- DPIIT
- FICCI

Figure 30: Note on FDI into R&D–Current Status and Way Forward

Figure 31: National Seminar on FDI into R &D–Making India and R&D Hub @2047

For more information, scan:

For more information, scan:

2020

8.5 Promoting R&D Exports

R&D as an activity is measurable and has economic value. It contributes to national exports. This has a direct effect on the national R&D Ecosystem.

The initiative of the Office of PSA

The Office of PSA took due cognizance of the R&D services exports sector and has engaged with the RBI and the Department of Commerce to prepare a database of R&D Services Exports so as to study this sector and produce detailed roadmaps for stakeholder scientific departments/ministries in the GoI and other ecosystem stakeholders. The office of PSA had also taken up the matter with the Department of Commerce for including R&D Exports in the Foreign Trade Policy.

Milestones

The Office of PSA with support from RBI created a database of the R&D exporters in the country. This is the first of its kind exercise in the country. The analysis of this data has revealed that around 2.2 lakh transactions amounting Rs. 37,000 crores were reported by authorised dealer (AD) banks during 2021-22 for research and development services (under other business services of Balance of Payments Manual, Version 6 of International Monetary Fund (BPM6)). Of the total, large transactions (about 4000 in number) were identified (that accounted for 2% in terms of volume but 81 per cent in terms of value).

This analysis will enable the Government of India to make informed decisions and policy interventions for integrating the national R&D Ecosystem with the Global economy.

Collaborating Agencies

- RBI
- Department of Commerce

2019

8.6 Evaluation of Innovation Excellence Indicators of Public-Funded R&D Organisations

The Office of PSA at the behest of the PMO initiated an exercise for capturing and evaluating the innovation indicators of publicly funded R&D organisations to comprehend and highlight the contribution made by these institutions qualitatively and quantitatively. This exercise was based on the initial framework developed by NITI Aayog. The objective was to assess the absolute and relative strengths and weaknesses of these labs and provide the labs with an opportunity to reassess their mandate and re-evaluate their research output in alignment with contemporary national needs and missions.

Milestones

The study was completed in March 2022 and a report titled "Evaluation of Innovation Excellence Indicators – A Report on Publicly Funded Organisations" was prepared and released in the public domain (Figure 32). This report is the first of its kind, and a unique exercise to assess innovation indicators of centrally funded R&D organisations. By compiling data on R&D and innovation-related inputs, systems, processes, outcomes, and impact into an exhaustive list of 62 indicators, this report provides an excellent overview of India's R&D and innovation landscape of publicly funded organisations. The report covers 193 labs out of the 606 R&D organisations which were the original scope of work of this exercise.

The Office of PSA convened a sensitisation meeting under the Chairmanship of the Principal Scientific Adviser to the Government of India on 14th July 2022 with the stakeholder ministries/departments to disseminate the findings of the report. Round II of the study is presently under process.

Collaborating Agencies

- NITI Aayog
- Confederation of Indian Industry (CII)
- Ministries/Departments in GoI

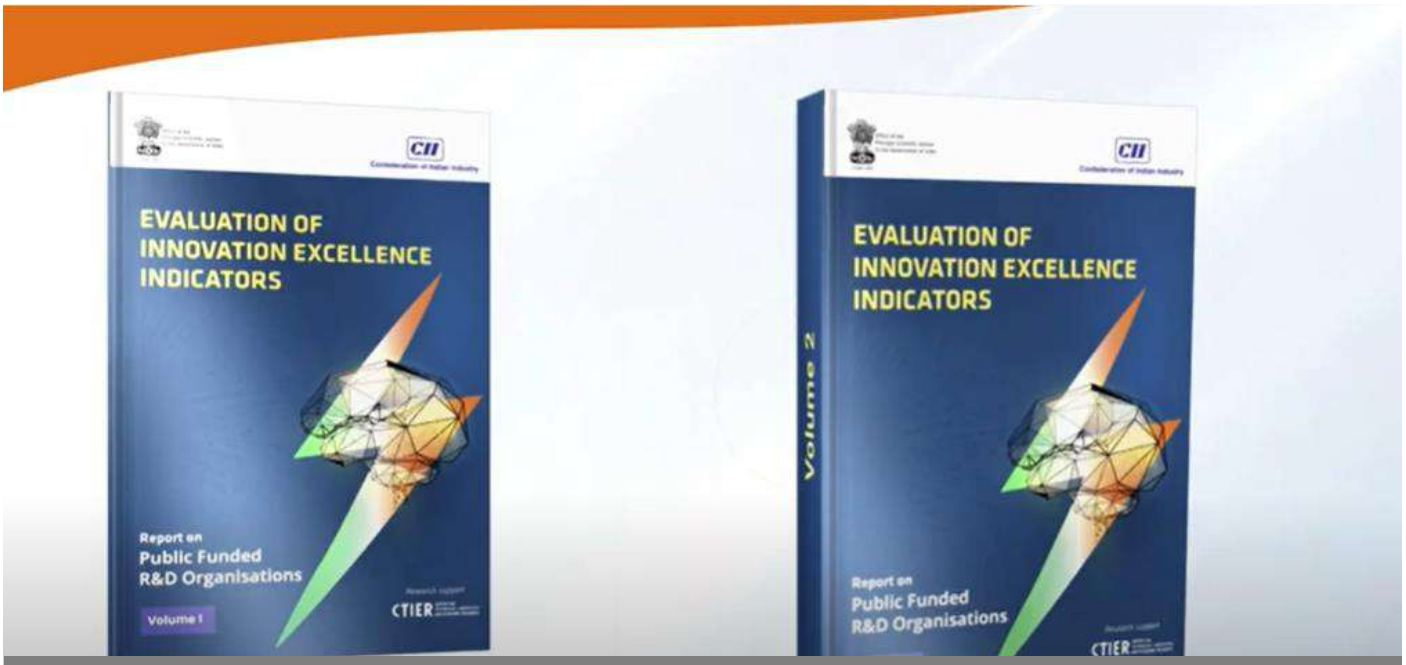

Figure 32: Report on Evaluation of Innovation Excellence Indicators of Public Funded R&D Organisations

For more information, scan:

Theme 9:

Science and Technology Capacity Building

9.1 Capacity Building of Scientists in the Government R&D ecosystem

Science Technology Innovation and Capacity Building (STI-CB) Cell was set up at the Office of PSA in collaboration with the Capacity Building Commission (CBC) to ensure the effective rollout of capacity building and training programs for scientists in government departments, funding agencies, and R&D laboratories (Figure 33). The cell works with all S&T departments to develop and launch upskilling and future training modules at both individual and institutional levels. The cell is working towards capacity-building interventions through a structured induction program for junior scientists (Sc B to Sc D) and a S&T Leadership program for senior-level scientists (Sc E to Sc G).

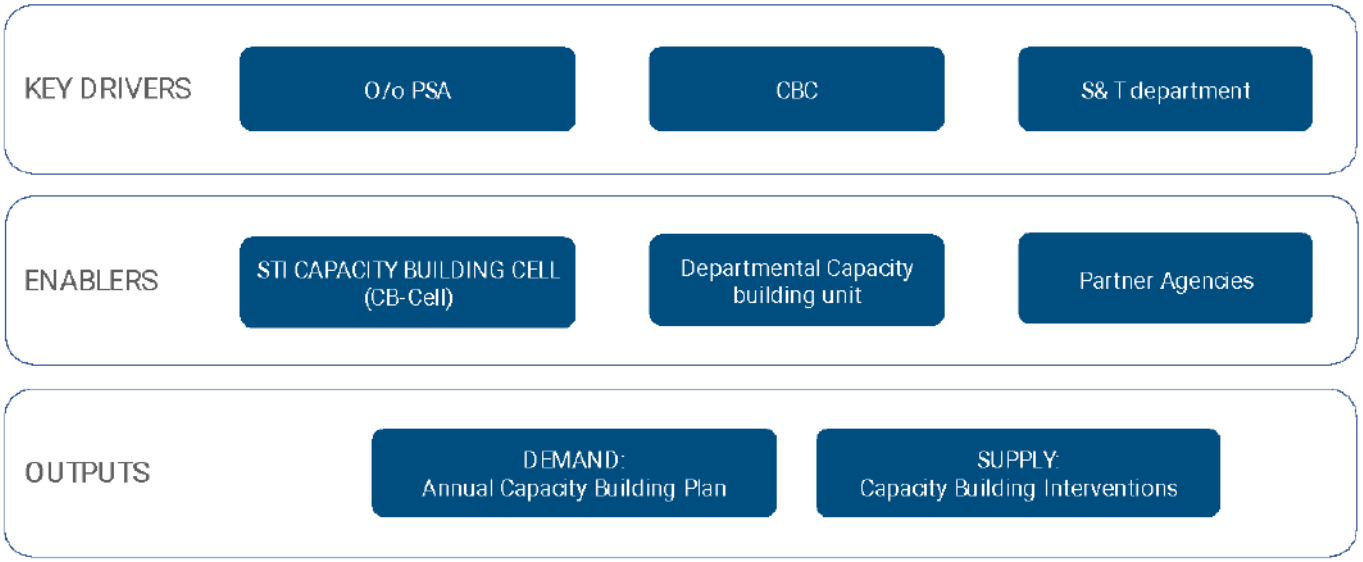

Figure 33: Capacity Building Structure in S&T Departments

Milestones

The STI-CB Cell, along with CBC, initiated the Competency Need Analysis for six departments (ISRO, MoES, DBT, DST, DAE, and CSIR) in December 2022 and has curated an Annual Capacity Building Plan (ACBP) with training need assessment and a plan of action for implementation for scientists at all levels. The ACBP document brings out all the necessary training & non-training interventions in a calendarised structure for the scientific and non-scientific staff at headquarters and individual labs/centres.

In this direction, STI-CB Cell coordinated a science leadership program at ISRO, Bengaluru in September 2022 and another in February 2023 at ASCI, Hyderabad. Also, a Science Communication workshop with Vigyan Prasar, FAST, and Cactus Communications was held in May 2023 (Figure 34).

Figure 34: images from science leadership session at ISRO, Bengaluru

Dr. Jitendra Singh, Honourable Union Minister of State (Independent Charge) for Science and Technology and Minister of State for Prime Minister's Office; Personnel, Public Grievances, and Pensions; Department of Atomic Energy & Department of Space launched the Annual Capacity Building Plans of five departments namely, ISRO, DBT, DST, CSIR/ DSIR, and DAE on 17th August 2023.

The event was also used to announce the following training interventions curated with different partner agencies:

1. Science Leadership Program for senior scientists [Scientist E and above] and lab leaders' programs by Administrative Staff College of India, Hyderabad.

2. Scientist Inductions Program for junior scientists [Scientist B, C & D] by IIM Vishakhapatnam.
3. IPR workshops by Controller General of Patents, Design and Trademarks across different locations; Science communications workshops by Foundation for Advancing Science and Technology (FAST), and Cactus communications for scientists, and training on data-based decision-making, basics of blockchain and AI, etc by partner agencies.
4. Digital modules like Procurement in Science departments, Financial Management, Code of Conduct by CSIR, and Design Thinking module by IIT Delhi were made live on Integrated Government Online Training (IGoT) for scientists.
5. The STI-CB Cell is developing many other training modules like emerging technology in policymaking, the history of contemporary science in India, STI policy, etc catering to specific functional competencies to be hosted on the IGoT platform for rapid online training of Government of India scientists. The cell is also coordinating with other resource institutions like Arun Jaitley National Institute of Financial Management, National Institute of Advanced Studies, FAST, and Centre for Technology, Innovation, and Economic Research to curate and deliver need-specific training programs for different departments.

9.2 Establishing Process-Based Identification and Mentoring Practices for Potentially Gifted Children in Science and Mathematics

The Office of PSA has supported four synergy projects on "Identification of Gifted children in Maths and Science (in the age group of 3 -15 years)" during the period 2010-19. These projects were intended to develop tools for the identification of Gifted Children in the demographic diversity of the country and were successfully implemented by (a) the University of Delhi, (b) the National Institute of Advanced Studies, Bangalore, (c) Agastaya International Foundation, Bangalore.

Milestones

The simple and easily adoptable methodology for identification of the gifted children developed and field tested, which could be followed in all districts/states in India. Overall, the work was carried out to develop following tools /methods to identify gifted children (age group: 3-15 year), training modules for teachers and parents, mentoring workshops etc.

- Identification Tools for 07- 09 years has been developed.
- Activity Tool kit for Cognitively Advanced learners in Early Childhood - Pre-Primary (3-7yrs) More than 16 block Mentoring sessions have been conducted since 2012 of maximum duration of 21 days and minimum duration of 3 days (Figure 35).
- Mentoring modules have been developed which can be carried out as online course, offline course or face to face interaction.
- Digital version of identification process has been developed.
- Professional Development Course in Education of Gifted Students (Certificate & Diploma Courses in Education of Gifted Students) for teachers, school administrators, educators and counsellors.
- In-service professional development program for teachers and school counsellor.
- Special lectures organised by NCERT to sensitize school counsellors to understand needs of gifted students.
- Gifted Resource Lab at Cluster Innovation Centre to develop, analyse, and design resources.

The review meeting chaired by the PSA was held on 23rd September 2022. Appreciating the initiative, the Committee felt that it should be adopted by Ministry of Education and executed pan-India benefitting the students.

Recently in June 2023, consultative meeting for discussion and finalisation of draft implementation guidelines of Pradhan Mantri Innovative Learning Programme (PMILP)- 'Dhruv' held under chairmanship of Secretary, Department of School Education & Literacy (DoSE&L). The developed tools are included in the draft of PMILP-Dhruv and would be submitted for the approval.

Figure 35: Cognitive ability kit for Cognitively Advanced Learners

Theme 10:

Important Initiatives

Initiatives of Government of India in Science and Technology which are led by the Office of PSA

2022

10.1 One Nation One Subscription

The One Nation One Subscription (ONOS) initiative is aimed at providing access to scholarly research content to all individuals in the country. ONOS intends to acquire national licenses for e-journal/database subscriptions from most of the prominent STEM and social sciences publishers and database providers by combining multiple institutional and consortia-based subscriptions. Concessions on Article Processing Charges for open-access publications is also envisioned as part of ONOS. Implementation of ONOS, which is expected to benefit all academic and R&D institutions including universities, colleges, and research organisations in the country, will be done in a phased manner.

Milestones

Approval of the Committee of Secretaries (CoS) for the One Nation One Subscription initiative was obtained on 2nd June 2022. Subsequently, a Core Committee to oversee the implementation of ONOS was constituted under the Chairmanship of the PSA.

Planning and Execution Committee (PEC) and the Cost Negotiation Committee (CNC) for ONOS were constituted in August 2022. The PEC is mandated to prepare the suitable plan, strategy, and guidelines for effective implementation of ONOS based on the guiding principles laid out by the Core Committee to oversee the implementation of ONOS. The CNC is tasked with carrying out negotiations with prominent STEM, social sciences and humanities publishers for national licenses of electronic journals as per the licensing model and cost estimated by the Planning and Execution Committee (PEC) for ONOS in a timely manner.

INFLIBNET Centre, Gandhinagar, an Inter-University Centre under UGC was designated as the executing agency for ONOS by the Core Committee.

Based on the recommendation of the PEC for ONOS, the Core Committee approved a list of 70 publishers whose resources will be considered under the first Phase of ONOS which will bring all government/ government-funded academic and R&D institutions under the central subscription.

The CNC for ONOS held the first round of negotiations with selected publishers who had submitted quotations for ONOS from 14th–16th December 2022.

The target date to commence implementation of ONOS is 1st January 2024.

ONOS initiative was also presented at the 16th Berlin Open Access Conference held during 5th–7th June 2023 in Berlin.

Collaborating Agencies

- Department of Higher Education
- Department of Science & Technology
- INFLIBNET Centre, Gandhinagar

2022

10.2 Consultative Group on e-Mobility (CGeM)

Long-distance heavy trucks contribute the largest, at about 35%-40% of all road emissions, despite their very low relative inventory on the roads. It is a priority for the country to focus on converting this sector into a Zero-Emission Trucking (ZET) sector with a judicious combination of Battery Electric Trucks and Fuel Cell Electric Trucks along with good greening of the national grid. ZET being a performance-sensitive commercial sector needs a field research-based action plan for its countrywide effective deployment.

Accordingly, a Consultative Group on e-Mobility (CGeM) was constituted on 12th August 2022 under the leadership of Prof. Ajay Kumar Sood, PSA, for preparing the R&D roadmap in surface transportation and e-Mobility with a two-tier structure, consisting of an Advisory Committee and a Working Committee, as shown in Figure 36. In this regard, 'CGeM' with experts from the industry, academia, and other techno-commercial entities identified the urgent actions required for the ZET. After detailed consultations, a document titled Technical Roadmap for Deployment of Zero-Emission Trucking in India has been prepared.

The R&D roadmap aims to achieve commercial and operational success and acceptance in the industry and field in the e-mobility surface transport domain. It is envisaged that the document shall highlight a clear way forward with indicative implementation strategies by keeping a futuristic vision and Indian requirements at the centre.

Figure 36: Discussion with the Union Minister of Road Transport and Highways on Zero-Emission Trucking

The roadmap was presented to the Honourable Minister of Road Transport and Highways, and it was well received. As a follow-up to the meeting, the subcommittee in CGeM is conducting a study regarding the "technology assessment" pertaining to ZET for Delhi-Jaipur Corridor. The study will result in the selection of the most suitable charging technology for the Delhi-Jaipur Corridor. In addition to this, the roadmap has gained a lot of interest from concerned ministries/departments/organisations.

In addition, the CGeM is working towards the preparation of the R&D roadmap in the Surface Transportation and e-Mobility.

Milestones

Technical Roadmap for Deployment of Zero-Emission Trucking in India has been prepared and went live on March 6, 2023. The roadmap can be accessed by scanning the QR code.

Regarding the preparation of the R&D Roadmap in the Surface Transportation and e-Mobility:

- 45 priority items have been identified in the domain of battery chemistry, charging infrastructure, Fuel cells, advanced materials and others and these items have been thematically categorised and assigned to multiple subgroups.
- A PMU has been set up in Automotive Research Association of India to provide all logistical as well as secretariat support.

2022

10.3 National Initiative of Science, Technology, and Innovation Statistics (NISTIS)

Science, Technology, and Innovation (STI) Statistics refers to the measurement and monitoring of the scientific ecosystem and its impact. The STI Statistics include data collection, analysis, and dissemination of the data and indicators. STI indicators help in gaining a detailed understanding of the STI ecosystem and its socio-economic impact.

The National Initiative on Science, Technology, and Innovation Statistics (NISTIS) has been launched as a one-stop coordinated effort to bring together various efforts to build a robust STI Statistics ecosystem. India's STI Statistics ecosystem is highly fragmented and faces challenges: accessibility, availability, reliability, and international comparability of data and indicators.

A National Advisory Committee (NAC) has been constituted to provide overall direction and guidance on the deliverables of the NISTIS. The NAC is chaired by the PSA and co-chaired by the Secretary of DST. The composition of NAC includes high-level representatives from the Key ministries/departments and agencies, including IISc Bangalore, NITI Aayog, Department of Higher Education (DHE), Ministry of Statistics and Programme Implementation (MoSPI), DPIIT, Department of Expenditure (DoE) and MeitY among others (Figure 37).

Figure 37: First meeting of the National Advisory Committee (NAC)

In the first meeting of the NAC, held on 4th August 2022 with the constituent members, it was recommended that a Centre for Science, Technology, and Innovation Statistics (CSTIS) be established as a one-stop coordinated mechanism for a robust STI Statistics system. A Detailed Project Report (DPR) for the proposed CSTIS is being prepared by the PMU anchored at IISc Bangalore. The DPR will include the conceptual, functional, and operational framework, administrative as well as governance aspects of the proposed centre.

The DPR is being shaped with inputs from key national and international stakeholders. The NAC will finalise and approve the DPR to be implemented as the CSTIS.

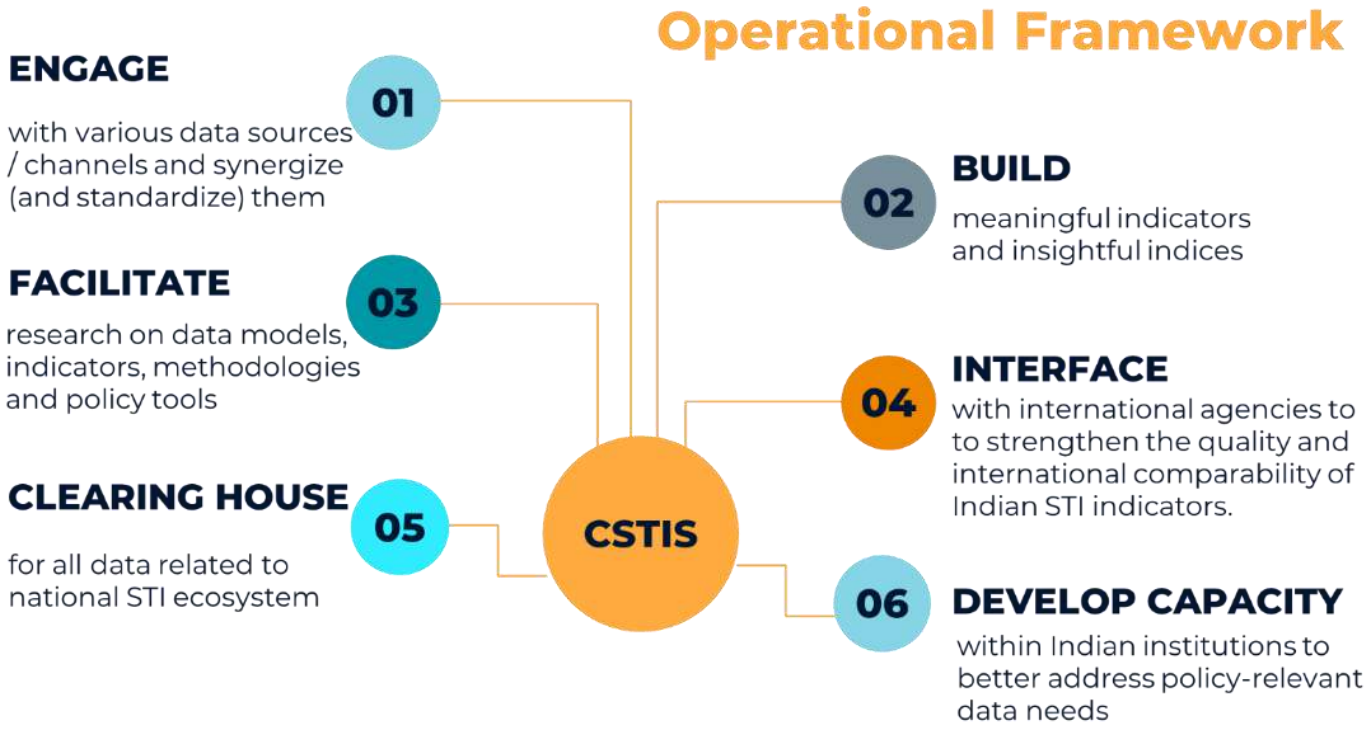

Figure 38: Operational framework of the proposed CSTIS

Key Objectives

The centre would perform six primary activities as given in Figure 38.

- **Engage** with key data sources to collate and synergise STI-related data points and indicators. The key data sources include national agencies such as DPIIT, DST, etc., and international agencies such as OECD, UNESCO Institute for Statistics, WIPO, etc.
- **Build** meaningful, contextually relevant indicators and indices. This is essential to produce insightful indicators on a regular frequency for policy and programme planning.

- **Facilitate** in-house research activities to build new data models, indicators, and indices relevant for STI Statistics. This will help in developing research outputs as well as policy insights.
- **Interface** with international agencies to strengthen quality and comparability of Indian STI indicators.
- Function as a **clearing house** for any STI-related data and indicators to avoid ambiguity among the data sources.
- **Develop capacity** with institutions and organisations to respond to policy-relevant data needs. It is important to develop this internal capacity to ensure the effectiveness of the STI Statistics system.

The proposed CSTIS aims to improve the collection, interpretation, analysis, and applicability of STI indicators. At a functional level, this will help the stakeholders gain a better understanding of our STI ecosystem at multiple levels of granularity.

These efforts may result in the following outcomes:

- **Evidence-based budgeting**: The STI indicators and insights will assist in ensuring that the allocation of financial resources related to STI, are based on evidence-informed understanding.
- **Identifying leverage points for effective interventions**: A better STI Statistics system would help in understanding the gaps that exist in the Science & Technology ecosystem and addressing them with targeted intervention.
- **Pathways for new research areas**: As a result of data analytics and in-house research, new research areas could be evolved within the STI policy realm and in various sectors.
- **Value-additions to International STI Committees/Forums**: Improved understanding of the National STI ecosystem will augment the proposals and stances taken by India in the International STI Committees and Forums.

Collaborating Stakeholders

Including the members of the NAC and representatives from key agencies who would advise on the implementation of this initiative, the CSTIS would be associated with multiple national and international stakeholders. The stakeholders could play any of the roles from advisors to data providers to data users. A non-exhaustive list of stakeholders is captured below:

Key National Stakeholders list

Office of the Principal Scientific Adviser
Department of Science and Technology
Indian Institute of Science, Bangalore
Department of Higher Education
Department of Promotion of Industry and Internal Trade (DPIIT)
Ministry of Statistics and Programme Implementation (MoSPI)

NITI Aayog
Ministry of Electronics and Information Technology (MeitY)
Department of Expenditure
Department of Biotechnology (DBT)
Ministry of Earth Sciences (MoES)
Department of Atomic Energy (DAE)
Defence Research and Development Organisation (DRDO)
Indian Space Research Organisation (ISRO)
Council of Scientific & Industrial Research (CSIR)
Indian Council of Agricultural Research (ICAR)
Indian Council of Medical Research (ICMR)
Industry Associations like CII, NASSCOM

Table 2: Key Stakeholders

Key National Stakeholders list

World Intellectual Property organisation (WIPO)
World Bank
UNESCO Institute for Statistics
Organisation for Economic Co-operation and Development (OECD)
United Nations Conference on Trade and Development (UNCTAD)
United States Patent and Trademark Office (USPTO)

Table 3: International Key Stakeholders

2021

10.4 Establishment of Dholera Drone Hub

Despite having a huge domestic demand for drones, India still imports key drone components like motors, propellers, batteries, engines, etc. Further, India also has a critical dependency on imports for large strategic drones used by the Indian defence forces and intelligence agencies.

Most companies working on drone technology in India are startups or MSMEs and are scattered across the country. To achieve leap-frog growth in core research and undertake large-scale competitive manufacturing of drones, there is a need to create a dedicated ecosystem with infrastructure support, common test facilities and a dedicated industrial manufacturing cluster.

It is the vision of the Honourable Prime Minister to establish an all-encompassing Drone Hub in India. During his visit to the USA in 2021, he had met five CEOs of USA companies. In that interaction, it emerged that a dedicated zone to create a drone ecosystem should be developed. Thereafter, the task of preparation of a concept paper on the drone manufacturing / industrial zone and working with the Government of Gujarat to check out the feasibility of such a zone in the Dholera Special Investment Region (Dholera SIR) was entrusted to the Office of PSA.

Accordingly, a brief concept note for creating an integrated drone research, manufacturing and testing hub (called the Dholera Drone Hub) was prepared after obtaining inputs from the relevant stakeholders and the DFI (Drone Federation of India, a not-for-profit private body) and was submitted to the PMO on 3rd January 2022.

Milestones

The concept of the proposed DDH was presented to the Hon'ble Chief Minister of Gujarat in a meeting in February 2022. Hon'ble Chief Minister in that meeting suggested that the Gujarat government can allocate land for the same.

Further, DFI signed a knowledge transfer MoU with Fukushima Robot Test Field, Japan which is a fully operational testing field for unmanned ground, water, and aerial vehicles in Japan.

Important Initiatives
Dholera Drone Hub

The Dholera Industrial City Development Ltd has also shown interest in partnering with DFI for creation of the said Hub.

It was therefore recommended to set up an integrated Drone Research, Innovation, Testing and large-scale manufacturing facility known as Dholera Drone Hub within Dholera SIR, Gujarat.

As the next step, a DPR highlighting the land use, 3D models of the facility, equipment setup and other requirements need to be worked out which will require engaging with consultants, architects and other technical experts. The Office of the PSA entrusted this task to DFI.

The First Draft of DPR submitted by DFI is currently under review.

2022

10.5 Empowering Young Scientists of India

One of the mandates of Office of PSA is to empower the country's STI ecosystem to position India in the global arena. Young scientists have a significant role to play in nation-building and fulfilling the vision of Atmanirbhar Bharat. As a result, fostering and empowering the next generation of young scientists and researchers (less than or equal to 45 years of age) is critical to achieving excellence in scientific and technological leadership in research and development. This involves the creation of policy guidelines for empowering young scientists, which can then be translated into funding for appropriate programmes.

A strong research ecosystem is imperative for inter-institutional and multi-disciplinary effective collaboration among researchers from government organisations/ universities and institutes of national importance. Identification of concrete models for young scientists to create new knowledge and at the same time translate research into tangible products is important. Building seamless collaboration between young scientists and technologists within the ecosystem consisting of academia, national labs, private enterprises, industry/startups, government agencies, and diaspora is critical to achieve this.

As a part of the wider consultation, following activities were undertaken by the Office of PSA:

Two online surveys were conducted, over a period of one month (October 2022 and March 2023) to obtain feedback from young researchers (less than or equal to 45 years of age) by filling a questionnaire across India. Around 2000 researchers have participated in the survey.

International Webinar on inputs to policy on Empowering Young Scientists was organised on 9th January 2023, to collate inputs on a new policy document. Speakers from various parts of the world participated and gave their inputs. The salient points which emerged from the webinar include recommendations for funding support for early career researchers; freedom to take up research in their area of interest; skill development - both hard and soft skills; involvement in decision-making; easing of administrative procedures for undertaking international collaborations; rewards and recognition of early career scientists and spreading awareness about opportunities for career growth to retain and encourage young researchers; spreading awareness on opportunities for collaboration and funding by investing in the networking of young scientists; good mentorship programmes and incentives for mentors; education on research ethics, research paper publications and supporting patent filing.

Two-day National Brainstorming Session was organised at IIT-BHU on 24th and 25th January 2023, depicted in Figure 39. The discussions were held in 7 sessions corresponding to 7 major topics concerning research and education, viz., 1) Ease of Doing Research/ Facilitating Research; 2) Opportunities for Interdisciplinary and Multidisciplinary Research 3) Research Ethics 4) Challenges at Workplace and Family Support 5) Grievance Redressal and Incentivising Research 6) Performance Criteria and Promotion Policy; 7) Career Growth Opportunities and Capacity Building. The participants cutting across various scientific sectors shared their concerns and aspirations about their research and academic pursuits and suggested solutions for addressing the concerns raised, especially for young scientists.

Figure 39: Two-day National Brainstorming Sessions on Empowering Young Scientists (EYS) of India at IIT-BHU.

The conclusions and recommendations will serve as inputs for a policy document being prepared by the Office of PSA to empower young scientists in India.

2021

10.6 Empowered Committee for Animal Health

Set up under the aegis of the Office of PSA, the Empowered Committee for Animal Health (ECAH) is chaired by the PSA and vice-chaired by the Secretary, DAHD. This Committee brings together various animal health experts to collaborate on achieving the completion of its goals. The members represented on the committee include experts from Central Drug Standard Control organisation (CDSCO), DBT, ICAR, ICMR, Indian Veterinary Research Institute (IVRI), Veterinary Council of India, Ministry of Ayush and prominent academics from notable veterinary institutes and industry.

ECAH is focused on creating resilient, farmer-centric animal health systems in India and bring forth changes to ensure the long-term success of India's livestock sector by:

- Acting as a think tank to provide inputs on animal health programmes of national importance.
- Streamlining and improving the process of regulatory approval to protect public, animal health, and the environment by examining the safety, efficacy, and quality of veterinary products.
- Overseeing and supporting programmes/initiatives to drive uptake of innovative practices in the Indian animal health sector.
- Assessing the threat of and offering guidance on emerging animal diseases that have epidemic/pandemic potential.

Milestones

Streamlined approval process has been defined for timely processing of applications on animal health products with participation from various government bodies and private sector.

Online portal has been created for applications requiring No Objection Certificate from DAHD, and this portal is linked to the Sugam portal from CDSCO for seamless integration.

Major policy change was approved to enable import of pathogen strains to facilitate vaccine development for priority animal diseases.

Guidelines for conducting field trials on animals to facilitate R&D has been created for the first time.

2023

10.7 Policy Analytics and Insights Unit (OPSA-PAIU) Established

The Office of PSA Policy Analytics and Insights Unit (OPSA-PAIU) was established by the Office of PSA to the Government of India to support its initiatives and missions by providing data-driven policy analysis and insights. It is housed at IISc Bangalore.

An induction meeting of the OPSA-PAIU was held with the PSA Prof. Ajay Kumar Sood, Scientific Secretary Dr. Parvinder Maini, and Adviser Dr. Preeti Banzal on 5th June 2023, as depicted in Figure 40.

Figure 40: Induction meeting of the OPSA-PAIU with PSA, Scientific Secretary, and Adviser.

Activities of OPSA-PAIU

The unit provides in-house capacity to supplement evidence-informed and outcome-driven science advice. To deliver the objectives of various initiatives, the unit undertakes activities, including:

- Data-driven policy research and analysis support for initiatives and various policy matters.
- Policy scouting and mapping, policy communication, technology assessment, technology strategy, technology foresight, and forecasting exercises.
- Workshops, training programs, and other capacity-building activities to build in-house capacity in S&T policy research and analytics.
- Coordinating and supporting inter-ministerial, inter-departmental, and international collaboration.
- Engage with national and international partners and stakeholders to share best practices, exchange knowledge, and collaborate on science, technology, and innovation policy initiatives.
- Policy advice for international science, tech and innovation projects and initiatives.

Key Initiatives Of PAIU

The unit is currently responsible for timely deliverables of the following key initiatives of the Office of PSA:

I. **G20 Chief Science Advisers' Roundtable (G20-CSAR):** The unit is providing knowledge, management, coordination, and outreach support for the G20-CSAR initiative. The tasks include coordination of the G20-CSAR meetings and bilateral discussions, policy analysis support, supporting planning of events, outreach, communication, coordinating side events and post-event partnerships, and drafting the Policy Communique and G20-CSAR Non-Paper.

II. **Mapping S&T advice mechanisms and policy initiatives of key partner countries:** The role of the unit is to conduct scanning and scouting exercises and provide coordination support for mapping the S&T advice mechanisms and policy initiatives of the key partner countries. Here are some of the key deliverables under this initiative.
a. Interactive Dashboard for S&T engagements with the UK: The policy unit is coordinating the development of an interactive dashboard to list India's science, tech, and innovation-related engagements with the UK.
b. Science advice mapping platform: Scouting and mapping science advice mechanisms, institutions, and individuals across the world and making this information available on a dynamic platform.
c. Policy scouting exercise to build synergies with other countries: A long-term policy scouting and analysis exercise to build S&T policy synergies with partner countries.

III. **National Deep Tech Startup Policy**: OPSA-PAIU is coordinating the consultation and drafting process of the National Deep Tech Startup Policy. The deliverables include coordinating and consolidating inputs from working groups and expert members, consulting with other subject matter experts and thought leaders, drafting the Zeroth version of the policy document, and facilitating post-draft consultations and revisions.

IV. **Initiative on STI Statistics–indicators; data for policy**: The unit is working towards enhancing in-house capacity for providing data-driven S&T policy insights. The unit is also facilitating participation in OECD-Committee for Scientific and Technology Policy (OECD-CSTP) and its working groups to ensure in-house adoption of Oslo and Frascati manuals. As part of this initiative, the unit is providing drafting and revision support for the DPR on establishing the Centre for STI Statistics at IISc Bangalore.

V. **Policy Support to the other initiatives**: OPSA-PAIU is providing knowledge and management support to the following initiatives and activities of the Office of PSA as and when necessary and advised:

a. Indo-US Initiative on Critical and Emerging Technologies (iCET).
b. Indo-European Union Technology and Trade Council (Indo-EU TTC).
c. Mapping STI-related initiatives and engagements across ministries and departments of the government.
d. Research support to the various missions and initiatives of the PM-STIAC.
e. Any other S&T-related policy instrument that requires support from the Office of PSA on assessment, vetting, and analysis.

Theme 11:

International Engagements

2023

11.1 G20-Chief Science Advisers' Roundtable (G20-CSAR)

G20-CSAR is an initiative incepted under the Sherpa Track of India's G20 Presidency led by the Office of PSA.

G20-CSAR was conceived with the idea of providing a platform for Chief Scientific Advisers' and the equivalent of G20 and invited countries to come on a common platform to discuss and devise frameworks to address some of the pressing policy challenges through inclusive global science advice. This collaborative and inclusive approach not only enhances the quality of science advice but also reinforces the role of science in addressing pressing global challenges.

The Chief Science Advisers (or their equivalents) are embedded within the highest level of governance in any national context. They have a prominent role in shaping policy choices by providing evidence-driven science advice. G20-CSAR provides an institutional mechanism to discuss some of the long pending as well as anticipated issues underpinning scientific research, technology development, and deployment.

Milestones

The G20-CSAR planning meeting, held in January 2023, brought together delegations from G20 member countries and invited nations to discuss a broad set of agendas. The primary aim was to reach a consensus on four priority agendas that have a crosscutting nature and significant impact on various aspects of the science and technology ecosystem. These four priority agendas will be further deliberated in the upcoming meetings. The inputs and discussions from this meeting will be consolidated into a policy communiqué during the final meeting scheduled for August 2023.

The first meeting held in Ramnagar, Uttarakhand, in March 2023 witnessed discussions under the broad themes of opportunities in Opportunities in One Health for better disease prevention, control and pandemic preparedness; Synergizing global efforts to expand the access to scholarly scientific knowledge; Diversity, Equity, Inclusion, and Accessibility in Science & Technology (S&T), and an Institutional mechanism for inclusive, continuous, and action-oriented global science advice, as depicted in Figure 41.

The event witnessed delegates experiencing the rich culture of Uttarakhand during the state dinner and an excursion to Jim Corbett National Park, as seen in Figure 42.

Figure 41: PSA, Scientific Secretary at the 1st meeting of G20-CSAR in Ramnagar, Uttarakhand

Figure 42: Glimpses of the 1st G20-CSAR meeting at Ramnagar, Uttarakhand

The second and final meeting of G20-CSAR under India's Presidency will be held at Gandhinagar, Gujarat, in August 2023. The final meeting also will lead to a draft policy communiqué which will be inclusive and a result of deliberations by all countries in the two meetings.

2023

11.2 Quantum

11.2.1 The Indo-US Quantum Coordination Mechanism under US-India Initiative on Critical and Emerging Technologies (iCET)

India and the US, in 2022, launched the US-India Initiative on Critical and Emerging Technologies (iCET), spearheaded by the National Security Councils of the two nations. The inaugural meeting of the iCET was held in Washington DC on 31st January 2023, led by the National Security Advisors of the two countries. In this meeting, it was decided to establish a joint Indo-US Quantum Coordination Mechanism with participation from industry, academia, and government to facilitate research and industry collaboration. This is being led by Prof. Ajay Kumar Sood, PSA, on the Indian side, and by Dr. Charles Tahan, Director, National Quantum Coordination Office (NQCO) in the White House, on the US side. The activities on the US side are being organised by the Quantum Economic Development Consortium (QED-C) and, on the Indian side, by the office of PSA.

Both sides identified a group of experts from government, industry as well as academia to help give shape to the Indo-US Quantum Coordination Mechanism. This was followed by the first (online) US-India Dialogue on Quantum Information Science and Technology (QIST) on 3rd May 2023. Both sides presented the government perspectives, academic and industrial landscapes in the two countries; and discussed potential pathways for collaboration, including testing and certification, as well as workforce capacity building and training. It was agreed that some focused Indo-US workshops should be organised to further refine ideas of mutual interest for academic and industrial collaboration. Efforts are being made to organize more such workshops.

Vision of Indo-US Quantum Coordination Mechanism

The establishment of the joint Indo-US Quantum Coordination Mechanism was welcomed by President Biden and Prime Minister Modi in their Joint Statement on 22nd June 2023. Among the items identified in the Joint Statement for follow-up are (i) India's participation in the Quantum Economic Development Consortium; (ii) India's participation in the Quantum Entanglement Exchange; and (iii) the development of an Indo-US Quantum Cooperation Agreement.

The Office of PSA has closely coordinated with QED-C, NQCO-White House, National Security Council Secretariat (NSCS), and DST to take this initiative forward. India is already among 38 identified nations, from where entities can apply for QED-C membership. This information, and the membership process, has already been conveyed to many academic and R&D institutions in the country. The SN Bose National Centre for Basic Sciences, Kolkata, under DST, has applied for QED-C membership and the same is under review.

Regarding India's participation in the Quantum Entanglement Exchange (QEE) (it will be the 14th country in the group), DST is developing a webpage listing multilateral exchange opportunities available in India where researchers from the other 13 countries can apply. It is expected to be linked to the main entanglementexchange.org website soon.

2021

11.2.2 Quad Centre of Excellence on Quantum Information Sciences (Quad CoE-QIS)

Quad, as a group of nations (Australia, India, Japan, and the US), was established at the time of the 2004 Indian Ocean Tsunami. It has now grown into a leading regional partnership. In the 1st Quad Summit on 24 September 2021 in Washington DC, these four nations established cooperation on Critical and Emerging Technologies (CET).

A leader-level working group was formed to promote cooperation on CET among the Quad nations. During the 2nd Quad Summit on 23rd May 2022 at Tokyo, the formation of a Quad Investors Network (QuIN) was envisaged, as "an independent consortium of investors that seeks to advance access to capital for critical and emerging technologies within and across the Quad."

QuIN was launched during the third Quad Summit on 20th May 2023 at Hiroshima, Japan "to facilitate investments in strategic technologies, including clean energy, semiconductors, critical minerals, and quantum". An international Advisory Board for QuIN has also been formed. Five expert working groups on artificial intelligence, semiconductors, clean energy and critical minerals, mobile networks, and quantum information sciences have also been established.

The Working Group on Quantum Information Sciences has come to be known as the "Quad Centre of Excellence on Quantum Information Sciences (Quad CoE-QIS)". The Chief Scientist of Australia Dr. Cathey Foley and PSA Prof. Ajay Kumar Sood have been appointed as the first co-chairs of Quad CoE-QIS. It is envisaged that it will consist of five expert members from government, academia, and industry from each of the four nations. India has nominated its five members to this expert group.

The first (launch) meeting of the Quad CoE-QIS was held in Melbourne on 9th June 2023 where the two co-chairs were present in person. Country Presentations were made to summarize the national status and future roadmaps of quantum technology-related activities in each of the four nations.

During the meeting, the following recommendations emerged:

(a) Having 4 co-chairs of the Quad CoE-QIS, one from each nation.

(b) The formation of four Task Forces on Computing, Communications, Sensors, and Ecosystem & Workforce Development, one to be led by each country. The Task Forces would chart the relative strengths and best practices. These task forces will rely on experts in industry, academia, and research and development, determine funding sources, engage in knowledge mapping, and work to facilitate coordination on supply chains.

Nominations for co-chairs from Japan and the US and nominations for CoE members from Australia, Japan, and the US are being made. The four Task Forces are also being set up.

2022

11.2.3 Quad STEM Fellowships

The Quad STEM Fellowships were announced at the Quad Leaders' Summit in September 2021. The Fellowship will provide one hundred fellowships–25 from each Quad country–for graduate or doctoral studies in STEM fields in leading US universities.

PSA serves the International Advisory Board, which provides inputs on key design decisions related to the Fellowship's founding and to support the accomplishment of the mission. The Board plays an integral role in advising on ways to identify and support cohort and connect them to opportunities that enable them to have a lasting positive impact on society.

Eligibility

Candidates must demonstrate academic excellence in any STEM field and an aptitude and interest in public policy. This means a first-class honours degree at the undergraduate level.

The Fellowship includes:

- Personal Award that will cover tuition and other expenses for a master's or doctoral degree in a STEM field in a U.S. accredited institution, and expenses for research and travel.
- Prior to commencement of the academic programme, Fellows will be flown to a location for an immersion and orientation programme.
- Virtual Programming comprising lectures and discussions with leading STEM scholars, CEOs and government leaders.
- Annual Quad Fellows Summit on the sidelines of Quad Leaders' Summits. This will include an interactive session with Quad Leaders.
- Alumni network to connect between cohorts.
- Mentorship opportunities
- Competitions for funding opportunities. Corporate partners will sponsor this.

Milestones

The First cohort of Fellows was launched in June/July 2022.

2022

11.3 Transfer of Rural Technologies

Transfer of RuTAG Technologies to various African-Asian Rural Development organisation (AARDO) member countries with AARDO functioning as the Technology Transfer Intermediary.

The Office of PSA received a request from the AARDO to adopt and transfer select technologies under RuTAG program to African-Asian countries. Four AARDO member countries namely, Ghana, Namibia, Sudan, and Zambia have identified some of the technologies developed by RuTAG. In this regard, the Office of PSA, has extended its support in procuring the identified technologies by AARDO member countries.

A committee constituted by the Office of PSA, with AARDO as the technology transfer intermediary, developed the Transfer of Technology (ToT) Docket with hand-holding measures to assist technology receiving institutions in member countries. The ToT process will include training, local manufacturing, technical support, and impact studies for successful technology implementation in the selected countries.

Handing over of the RuTAG technologies to AARDO member countries

On 28th September 2022, a ceremony was held in New Delhi, India to hand over affordable technologies developed by RuTAG and other institutions supported by the Office of PSA to AARDO member countries like Ghana, Namibia, Zambia, and Sudan. The technologies were: (i) Ground water level measuring device & treadle pump (developed by IIT Delhi) related to farm irrigation, (ii) Cold press oil expeller for groundnut & sesame (developed by IIT Kanpur), (iii) Soil organic carbon detection kit (developed by Bhabha Atomic Research Centre) and (iv) Water purifying reactor device (developed by Taraltec Solutions Pvt. Ltd.) to eliminate water borne diseases.

This event, a joint initiative of AARDO and the Office of PSA was attended by the Ambassadors/High Commissioners, representatives from Ministry of External Affairs (MEA), MoRD, Government of India and a few representatives of IITs. Besides, senior officials of AARDO's nodal Ministries from Republic of Ghana, Republic of Namibia, Republic of the Sudan and Republic of Zambia attended the event online. Excellencies and senior diplomats from Embassies/High Commissions in New Delhi were handed over the earmarked technological devices for onward transmission to their respective capitals.

Dr. Parvinder Maini, Scientific Secretary, Office of PSA, along with Mr. Piyush Singh, Under Secretary, MEA, presented these technologies to representatives from AARDO member countries, as depicted in Figure 43.

Figure 43: Dr. Parvinder Maini, Scientific Secretary, Office of PSA, handing over the earmarked RuTAG technological devices to AARDO member countries

2022

11.4 India-European Union Trade and Technology Council (India-EU TTC)

India-EU-TTC is a strategic coordination and engagement on trade and technology between India and Europe. It was formally announced on 25 April 2022 after the bilateral cooperation meeting between the Hon'ble Prime Minister of India, Shri Narendra Modi and the President of the European Commission Ursula von der Leyen. Later, on February 6th, 2023, India-EU strategic engagement platform was established to promote strategic engagement between the two countries.

Within the framework of the TTC, the following three working groups have been set up:

i) Working Group (WG1) on Strategic Technologies, Digital Governance and Digital Connectivity, chaired by Secretary Ministry of Electronics and Information Technology

ii) Working Group (WG2) on Green & Clean Energy Technologies, chaired by the Principal Scientific Adviser to the Government of India

iii) Working Group (WG3) on Trade, Investment & Resilient Value Chains, chaired by Secretary, Department of Commerce

The Working Group 2 on Green & Clean Energy Technologies is chaired by Prof. Ajay Kumar Sood, PSA to GoI. A concept paper on the activities to be taken up under Working Group 2 was finalised after several rounds of discussions and meetings with the EU counterparts including the Indian stakeholder ministries/departments. The concept paper was discussed along with a work plan during the First ministerial meeting of the India- EU TTC held in Brussels, Belgium on 16th May 2023 (Figure 44).

Figure 44: Ministerial Meeting of India-EU TTC WG 2 held on 16th May 2023 in Brussels, Belgium

The Work Plan endorsed on 16th May 2023 consisted of three main Actions viz., (i) Action 1 focuses on wastewater treatment, marine plastic litter, and waste to energy. It will also focus on co-developing technologies regarding the conversion of waste (eg. biomass) to green hydrogen and various waste-to-energy strategies/technologies; (ii) Action 2 focuses on E-mobility, battery performance, and sharing of knowledge on circularity aspects of batteries. Emphasis is on the development and deployment of charging infrastructure and battery raw material recovery, with the aim of an increase in battery circularity to facilitate emergent EV market opportunities. In this context, the modalities for setting up of the virtual joint centre of excellence for training and R&D for testing of EV batteries and allied products will also be considered; and (iii) Action 3 on Standards. The Bureau of Indian Standards and European Union will exchange best practices on how to valorise research investment by connecting science to international standards. Standards on specific technologies will be addressed under the different thematic actions.

A few of the outcomes expected from the India-EU TTC WG 2 include implementation of joint wastewater treatment projects and their market uptake, work on wastewater to energy and waste to green hydrogen, gap analysis to tackle marine and plastic litter pollution, knowledge sharing on circularity aspects of batteries for recovery of raw materials. In addition, the development of standards to ensure interoperability, renewable and green hydrogen will be a key takeaway. These efforts will help India and Europe to stimulate innovation by strengthening the role of startups and building skills and capacity building.

To take this discussion forward and concretize the outcome, a Workshop on 'Green and Clean Energy Technologies' is planned in the first week of October 2023 with participation of key stakeholders from either side.

Theme 12:

Synergy Projects

The Office of PSA plays a catalytic role in supporting the execution of synergy projects which are R&D projects of interdisciplinary nature involving multiple institutions. These projects are funded by the Office of PSA in the form of grants-in-aid to the Government institutions which involved in the implementation. The Office also facilitates a thorough review mechanism to ensure the timely execution of these projects.

2016

12.1 Multi-Centric Clinical Trials of The Indigenous Total Knee Prosthesis 2.4 and Pilot Production of TKP 2.4

In 2016, the project was sanctioned to the Non-Ferrous Materials Technology Development Centre (NFTDC), Hyderabad with joint funding by NFTDC and the Office of PSA, initially for a period of 4 years. Later, the project extension was accorded till July 2022.

The project aimed at demonstrating the safety and functional efficacy of limb sparing surgery and reconstruction with distal femur prosthesis implanted in patients with distal femur tumours. The objective of this project is to ensure end-to-end technology development of medical devices, along with its armamentarium and a complex test bed with validation of detailed risk analysis in empirical, long-duration tests.

Milestones

The knee prosthetic implant is designed to restore all functional requirements together with a long service life of 10+ years. This state-of-art medical device is biomechanically closest to the natural knee, with the implant axis coinciding with the anatomical axis and joint line. Furthermore, the implant features high precision nano-finish and lowest wear rate. Notably, a specialised Knee Simulator & Testing Machine was also designed and fabricated (Figure 45).

In the second phase of the project, clinical trials of the device, armamentarium and Knee Testing Machine were conducted at AIIMS New Delhi, TMC Mumbai, and Hinduja Hospital Mumbai and at two more centres in east and south of India. This implant is the first indigenous medical device cleared (on 22nd June 2018) under Medical Device Rules, which came into effect in January 2018, for Multi-Centric Clinical Trials. Despite pandemic-induced disruptions, the clinical trial has proceeded at the above three centres and nearly 30 implantation surgeries have been successfully completed as of November 2022.

Implementing Agency

a) NFTDC, Hyderabad

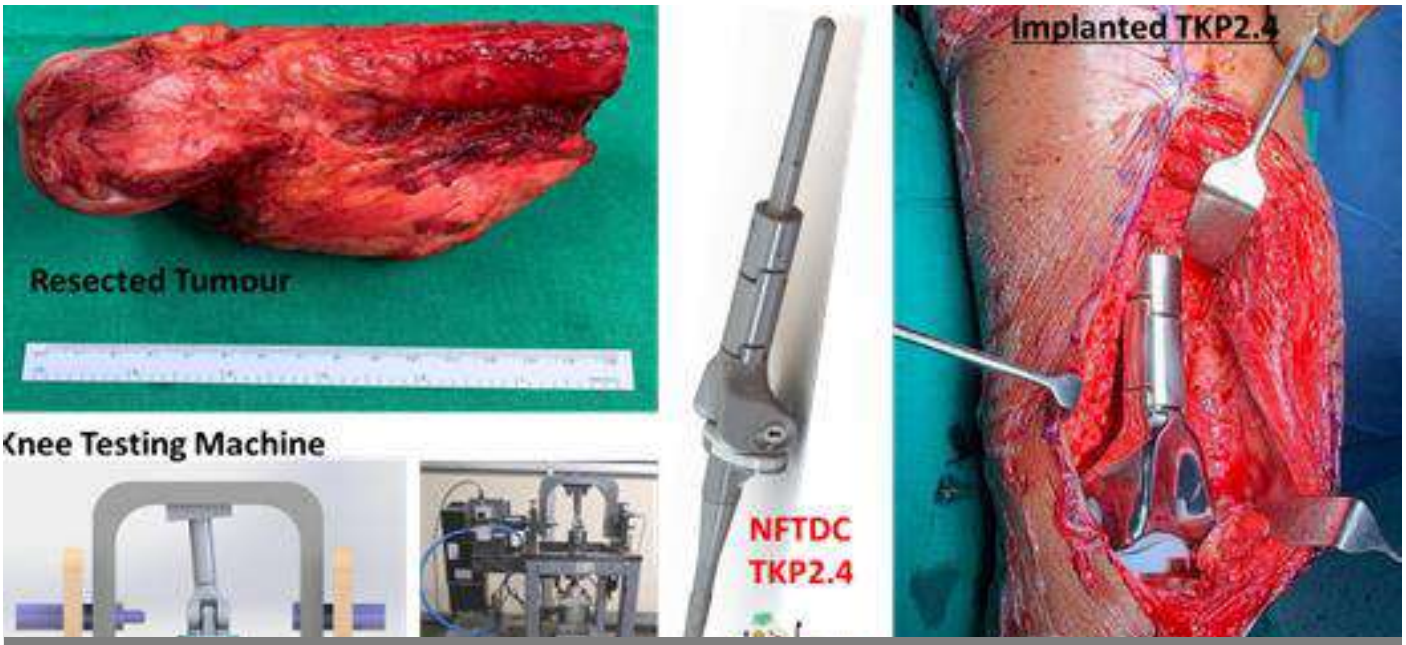

Figure 45: Indigenous Total-knee Prosthesis (Tkp 2.4) For Limb Salvage Reconstructive Surgery

2017

12.2 Indigenous Development and deployment of Explosive Detectors based on Raman Back-Scattering Principle

This project was sanctioned in October 2017 and is being implemented by Instrument Research Development Establishment (IRDE), DRDO.

As part of the project, IRDE has indigenously developed a Handheld Explosive Identification System called PREEMPTOR Mk-II based on Raman back scattering principle.

Background

Laser Science and Technology Centre (LASTEC), DRDO which has now been merged into IRDE, had developed an earlier prototype PREEMPTOR MK-I system which was also based on the principle of Raman back scattering. It was taken under extensive evaluations/ demonstrations with different law enforcing agencies like Special Protection Group (SPG), CISF, Cabinet Secretariat, Intelligence Bureau (IB), Central Reserve Police Force (CRPF), Bureau of Civil Aviation Security (BCAS), BSF, Ministry of Home Affairs (MHA), Gujarat Police, Meghalaya Police, Delhi Police, Maharashtra Police, Tamil Nadu Police, Northern Army Command, Udhampur and Uttarakhand Police.

After successful demonstrations/ trials conducted on PREEMPTOR Mk-I, a meeting was organised by the Office of PSA on 9th May 2016 to bring the users and developers in the field of explosive detection at the same platform. In this meeting, which was chaired by the National Security Adviser, IRDE, erstwhile LASTEC, demonstrated handheld explosive identification system, PREEMPTOR Mk-I.

In the subsequent meeting chaired by the then PSA on 15th November 2016, LASTEC was directed to get the PREEMPTOR Mk-I system evaluated independently by High Energy Materials Research Lab (HEMRL), DRDO, Pune and Institute of IED Management, CRPF, Pune. The system was successfully evaluated at both agencies and LASTEC submitted the reports of these evaluations to the Office of PSA well within the scheduled time. Consequently, the Office of PSA sanctioned a project to LASTEC on the indigenous development of 22 explosive detectors based on Raman back-scattering principle, and PREEMPTOR Mk-II explosive detector was developed with funding support from the Office of PSA (Figure 46).

Synergy Projects
Explosive Detectors based on Raman Back-Scattering Principle

Milestones

In March 2022, 22 PREEMPTOR Mk-II systems were demonstrated to the PRMC for the project constituted by the Office of PSA.

During the inspection visit, it was suggested by the PRMC to fix a pipe in front of the trans-receiver and implementing glass cuvette/ vial-based sample chamber at the other end of pipe. This was to ensure the operator's safety by concealing the laser beam.

In addition to it, PRMC suggested preparing a computer-based Training Programme and to provide with the systems.

In the last PRMC meeting held in September 2022, the developed CBTP video of PREEMPTOR Mk-II was displayed, and one unit was demonstrated with pipe-assembly & vial sampling. After approval of PRMC, this pipe-mechanism has been successfully implemented in all 22 units.

The rectification/ upgradation work in all 22 units of PREEMPTOR Mk-II has been completed and all 22 units are ready for field deployment.

Implementing Agencies

a) IRDE, DRDO, Dehradun

b) M/s Ananth Technologies Ltd., Hyderabad (Industrial partner)

Figure 46: Preemptor MK-II, RBS technique based explosive detector developed by IRDE, DRDO

2017

12.3 Indigenous Development and Deployment of Explosive Detectors based on Ion Mobility Spectrometry technique

This project was sanctioned in November 2017 and is being implemented by Electronics Corporation of India Limited (ECIL), Hyderabad.

As part of the project, ECIL has developed an explosive detector called the Trace detector which is based on Ion Mobility Spectrometry (IMS) technique for the detection of various types of explosives traces (at the order of nanograms) in particle mode (Figure 47). Table-Top Trace Detector TD 5612 is indigenously developed system with state-of-the-art technology. IMS Spectrum provides footprint of explosive samples based on differential migration of ions. Time taken by the ions of different explosives to reach the collector plate differs. Hence, the basis of detection is drift time of ions in high electric field. Identification of explosives is done by comparing the drift time with the available data in the device library. Trace Detector is capable of detection of all the listed explosives in device library.

Milestones

The Trace Detector was evaluated at Institute of IED Management, CRPF, Pune & HEMRL, DRDO, Pune for Sample testing.

Subsequently, 12 units of Trace Detector were handed over to 12 law enforcing agencies (SPG, National Security Guard (NSG), CRPF, BCAS, IB, CISF, SSB, Delhi Police, ITBP, Cabinet Secretariat & Special Frontier Force (SFF)) through the Office of PSA for field trials on 19th May 2019.

Synergy Projects

Explosive Detectors based on Ion Mobility Spectrometry technique

Based on the feedback received from the above agencies, 12 units were taken back from field and the following improvements were carried out to address the issues raised by the user agencies and additional suggestions from the Project Review and Monitoring Committee (PRMC) for the project constituted by the Office of PSA:

- Redesigning of unit resulting in reduction of size by 40% and weight by 30%.
- Production of new 12 units of Trace Detectors with improved performance after implementing the suggestions from user agencies and PRMC.
- Software support for additional explosives in the detector library is provided.
- Testing of detectors for accuracy, false alarm, warm-up time, and clearing time of Trace Detectors.
- EMI / EMC tests were repeated at NABL-certified laboratory as per IEC standards and the recommendation of PRMC.
- Endurance test was performed on Trace Detector as per the Office of PSA recommendation.
- Knowledge Management document was prepared for capturing the experiences and evolution of the project.
- Professional Training video development has been taken up for the training of Trace Detector to end users.
- Upgraded version of Trace Detectors (12 Nos.) are ready for field deployment.

Implementing Agency

- ECIL, Hyderabad

Collaborating Agencies

- IGCAR, Kalpakkam
- RRCAT, Indore

Figure 47: Trace Detector, an IMS technique based explosive detector developed by ECIL

2018

12.4 Epilepsy Research Project

With the support of the Office of PSA, an epilepsy research project was jointly implemented by the All-India Institute of Medical Sciences (AIIMS), New Delhi; IIT Delhi; Delhi University, and National Institute of Advanced Studies (NIAS), Bangalore during 2018–2023.

The project has four sub-projects which are aimed at developing a portable device for rapid detection of epilepsy; to gain a better understanding about the resistance to Anti-Epileptic Drugs (AEDs) in some patients; and finding a lead, if not a product, in the direction of finding new drug targets for AEDs.

Milestones

Sub-project 1: Development and Demonstration of a Portable Device for Rapid Detection of Epileptiform Discharges

The agency has developed a mobile app and EEG device with dry electrodes which would help for the diagnosis of epilepsy especially in rural settings, where there is an acute shortage of trained manpower (Figure 48).

The mobile app (Android and iOS) developed through the project would help physicians to cater to patients at remote locations. The functionality of the app has been demonstrated. The APP is bidirectional nature, allowing communication from patient to doctor and vice versa. It facilitates video capture of seizure episode along with addition of medication, lifestyle changes, reminders etc.

In a randomised controlled trial carried out on 20 patients with the developed EEG device with dry electrode, accuracy of 83-86% was observed.

The cost of the dry electrode of each headset would be around Rs 5,000/- versus USD 750,000 for commercially available machines in US e.g., Zito.

Implementing Agencies

- IIT Delhi
- AIIMS, New Delhi

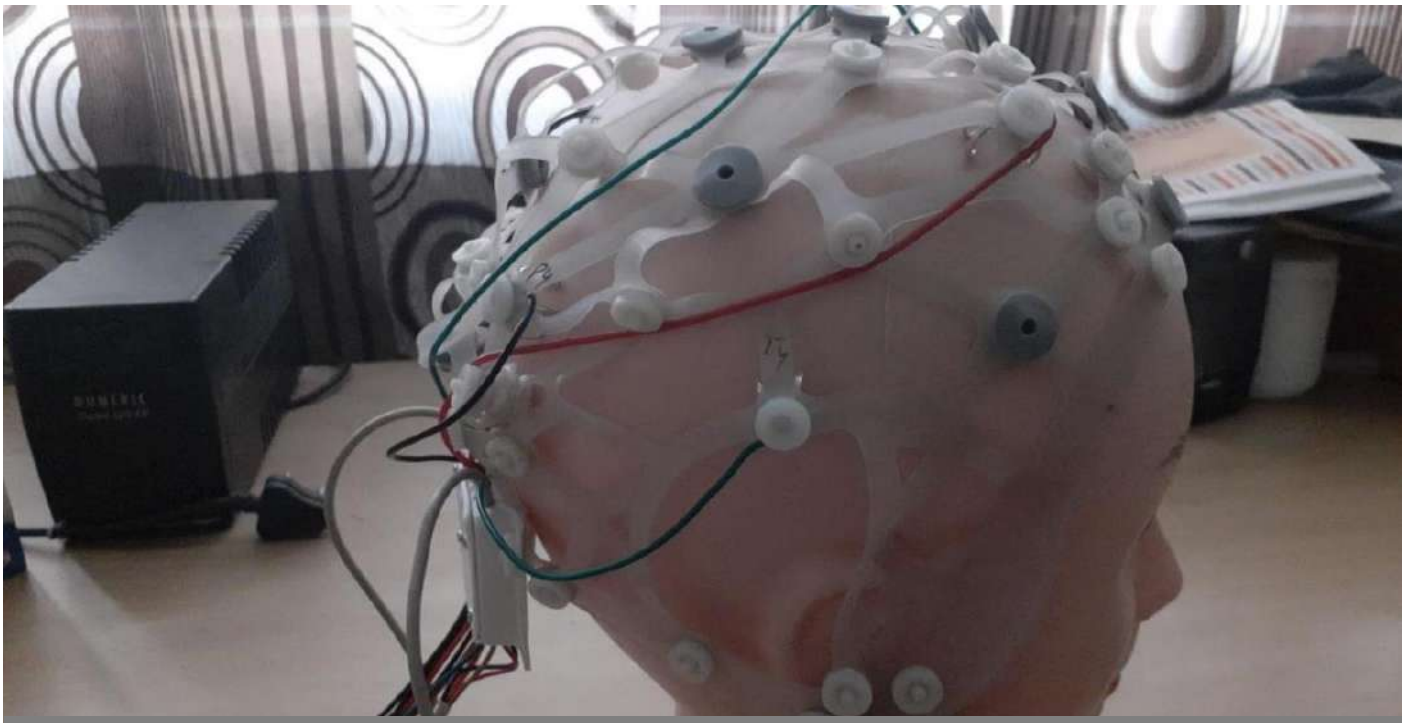

Figure 48: EEG Device with dry electrodes for diagnosis of Epilepsy

Sub project-2: Investigation of the Role of Dysfunctional Benzodiazepine Binding Site on GABAA Receptor in Benzodiazepine-resistance Associated with Drug-resistant Epilepsy (DRE)

Many patients with DRE are resistant to benzodiazepine class of drugs. The primary objective of this project is to identify the molecular and cellular markers responsible for benzodiazepine-resistance in patients with DRE.

Through this project and based on findings at cellular and molecular level on resected brain samples obtained from patients with DRE, it has been shown that increased expression of α4-containing GABAA receptors could be associated with benzodiazepine resistance. Novel variants identified α-subunits of GABAA receptors may also lead to possible loss of benzodiazepine binding sites in patients with DRE. α4-containing GABAA receptors which could be potential therapeutic targets for DRE pathologies.

Implementing Agency

- AIIMS, New Delhi

Sub-project 3: Mass Spectrometry-based Lipidomic Analysis Reveals Altered Lipid Profiles in Brain Tissues resected from Focal Cortical Dysplasia (FCD)

The objective of project was to generate mass spectral lipid database for resected brain tissues with varying level of abnormalities based on specific grading using ECoG, MRI, SPECT/PET and MEG data from FCD patients. Lipid mass spectral analysis was carried out for various FCD types and subtypes (type I & II).

Focal cortical dysplasia (FCD) is a common pathology responsible for drug-resistant epilepsy (DRE). Failure to precisely localize the epileptogenic zones (EZs) is a major reason for poor surgical outcome in FCD Lipid mass spectral profiles of 11 FCD and 15 autopsy samples were successfully generated. This preliminary study shows association of altered TAG synthesis/ metabolism with FCD pathology. Thus, it is proposed that increased TAG levels could serve as potential biomarker of FCD and the lipid mass spectra, if validated on a greater number of FCD patients, can aid in real-time identification of resection margins akin to intelligent knife (iKnife) approach.

Implementing Agency

- Delhi University

Sub-project 4: Epilepsy research – (i) Molecular Modelling to Understand Resistance to Anti-epileptic Drugs. (ii) Identification of Novel Drug Targets, using Tools of Data Science.

Levetiracetam inhibition of the enzyme calpain-1 is one of the modes of action of the Levetiracetam drug. Studies on the chemical binding of levetiracetam to calpain-1 were carried out based on the crystal structure of calpain-1 protein and using computational technique and two derivatives of levetiracetam with better properties have been designed.

Through mapping of RNA-seq data, identified 3'-UTR region of GABRA1 gene as a target to develop newer miRNA-based (miR1275 and miR6769) drugs for drug-refractory MTLE. The two miRNAs have already been synthesised. Three-dimensional structural models of 17 missense mutant proteins have been built.

Epilepsy Research Project

CDAC-Bangalore has carried out the following tasks for the project: a) built machine learning models for identifying potential druggable proteins b) developed epilepsy database, and c) developed computational platform or a web interface Target Research in Anti-epileptic drugs using Data Science tools (TREADS), to access the data as well as methods developed in-house. TREADS has been released in public domain for the benefit of the epilepsy research community.

Implementing Agency

- NIAS Bangalore

Collaborating Agency

- C-DAC Bangalore

2018

12.5 Potash from Incineration Boiler Ash

This project was sanctioned in January 2018 and is being implemented by Vasantdada Sugar Institute (VSI), Pune. It is aimed at developing an efficient (~90 %) potash recovery method from incineration boiler ash.

A pilot scale potash recovery plant designed by VSI has been installed with the support (~Rs. 50 Lakhs) from KS Kale SSKL Karmaveer Shankarrao Kale Sahakari Sakhar Karkahana Kolpewadi, Ahmednagar, Maharashtra, and it is operational with 90% potash recovery. The technology was presented in the recent meeting of VSI Governing Council (GC) on 19th June 2023 and the commercial plant of this technology would be installed at KS Kale SSKL. If adopted by many industries, this technology has a potential to significantly reduce potash import.

Milestones

It is a green technology which is capable of recovering around 90% of potash from Incineration Boiler Ash. It has been successfully developed at lab scale and validated at pilot scale.

RoI is less than 3 years at any scale.

Implementing Agencies

- Vasantdada Sugar Institute (VSI), Pune
- Karmaveer Shankarrao Kale Sahakari Sakhar Karkahana, Kolpewadi, Ahmednagar, Maharashtra (Supported the pilot plant of the technology)

2019

12.6 Indigenous Development of Integrated Threat Management Appliance (ITMA-2)

The project was sanctioned in March 2019 and is being implemented by Society for Electronic Transaction & Security (SETS) and ECIL.

ITMA perimeter gateway solution is a powerful solution aimed at real-time protection of network infrastructures with small to medium business networks. ITMA gateway ensures security from Internal and External threats such as unauthorised connections, intrusions, backdoor invaders, spam emails, and virus attacks. ITMA is equipped with various threat detection and prevention capabilities with impressive IMIX throughput.

Milestones

All software modules were deployed and tested by the SETS team by 31st December 2022.

Unit level testing of all three variants of ITMA has been completed. Performance and testing of the appliance are underway. 3rd party certification for ITMA is being done.

ITMA software has been deployed across seven agencies including SETS, C-DAC Hyderabad, BHAVINI Kalpakkam, and Cyber Defence Agency New Delhi.

Implementing Agencies

- Society for Electronic Transaction & Security (SETS).
- ECIL

2019

12.7 Physical Unclonable Function (PUF)-based Application Specific IC (ASIC) by Technology-Circuit-System Co-Development for Strategic Applications

The project was sanctioned in March 2019 and was implemented by IIT Bombay in collaboration with IIT Delhi, SETS Chennai and SCL Mohali.

Although software security has received much attention, hardware security is the ultimate safeguard. However, in high-volume production, each computer chip is identical. To overcome this, IIT Bombay proposed a novel approach to spontaneously generate chip identity. The approach, inspired by the adage that "lightning never strikes at the same place twice", harnesses the unpredictability of electrical breakdown within nanoscale capacitors in the chip. The capacitors are open before a breakdown, and after a breakdown become short, defining binary states "0/1", respectively. This generates a random binary string of open/short capacitors with guaranteed randomness.

Milestones

- OTP (One Time Programmable) technology was demonstrated as a process of recording with 25 A SiO_2 for sub-3.3V programming.
- Integration with n-MOS transistors to form a 1T-1OTP bitcell.
- Formation of bitcell arrays of various sizes e.g., 4×4, 7×8, and 14×4.
- Previously, a differential pair design for unbiased randomness was demonstrated. It consists of 2 1T-1 OTP bit cells connected in parallel. This design shows an inter-hamming distance peak at 50%, which matches the ideal PUF condition.

The project ended in Mar 2023, but the team is carrying on system-level translation: Tape out is complete and awaiting Chip Fab out with the following blocks:

– Crypto Blocks (SHA-3 and AES).
– 8 kbyte array with peripherals.
– Kill Switch with a small micro-controller.
– A small Error Correction Block.

Implementing Agencies

- IIT Bombay
- IIT Delhi
- SETS Chennai
- SCL Mohali

2020

12.8 Computational and Experimental Platform for High-Resolution Terapixel Imaging of ex-vivo Human Brains

The project was sanctioned in February 2020 and is being implemented by IIT Madras.

The goal of the IITM-HBP (Human Brain Processing Pipeline) is to establish an integrated histology-imaging-compute pipeline at IIT Madras to acquire petabyte-sized image data volumes from post-mortem brains of deceased from natural causes and various pathologies. The project explicitly takes an experimental biomedical engineering approach to develop cutting-edge tools and technologies for the transformation of fixed brain tissue into a digitised 3D neuronal map at micrometre resolution that involves a complex series of processes (Figure 49).

Milestones

- The integrated pipeline consisting of histology, technology development, imaging, and computation is fully operational for generating cell resolution data volumes for human brains.
- The histology pipeline has optimised Immunohistochemistry protocol for classifying cell types in the human central nervous system, for Rabies, parvalbumin, calretinin, calbindin, GAD65/67, NeuN and GFAP markers.
- Large format autostainer and automated cover slipper instruments were custom designed & developed, verified on 1300+ slides and subsequently deployed in the lab to accelerate human brain tissue processing. A large format slide digitiser capable of handling adult human tissue sections was indigenously developed.
- Central storage system has been scaled to 6PB. High-capacity compute nodes have been integrated consisting of high memory node, GPU nodes, high CPU nodes, and development workstation. Data flow and pre-processing are fully automated.

Algorithms developed for 3D reconstruction of serial sagittal sections at 64um resolution, and Cell detection on whole sections at native resolution using deep learning models with sliding window inference.

Till date, the brain centre has acquired 100 human brains and processed over 35 of them using the indigenously developed histology pipeline.

Implementing Agencies

- IIT Madras
- Clinical Collaborators:
  i. CMC Vellore
  ii. Saveetha Medical College and Hospital
  iii. NIMHANS Bengaluru
  iv. AIIMS Delhi
  v. Mediscan Systems

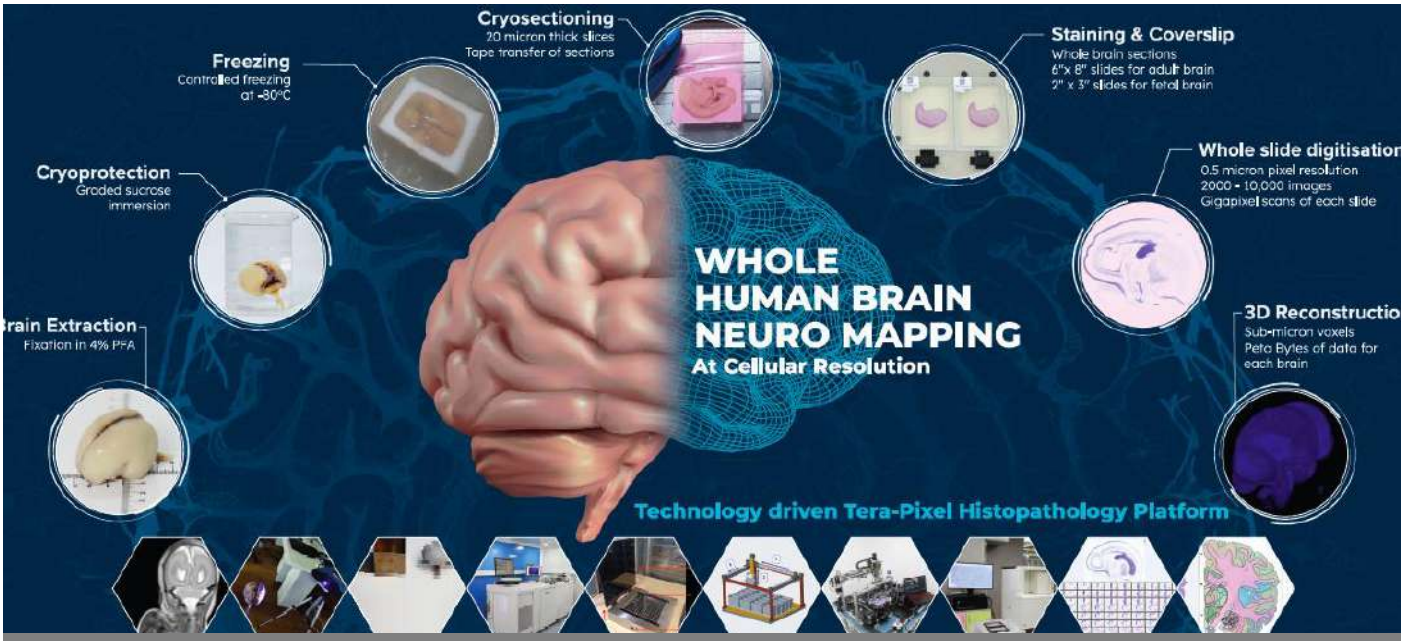

Figure 49: Depiction of the Terapixel ex-vivo human brain processing pipeline developed by IIT Madras

2020

12.9 Bacteria-Mediated 3D Printing of Green Bricks

The project was sanctioned in April 2020 and is being implemented by the Indian Institute of Science, Bangalore. The project aims to build a bacteria-mediated 3D printer for making bricks. The bricks will be eco-friendly and contribute to important applications such as the development of cost-effective habitats. The operative principle will be the use of bio cementation-capable microbes.

Biocementation is a natural process wherein bacteria can produce calcium carbonate and secrete binders which can bind loose particles together. Carbon sequestration is a natural outcome. The project proposal centres around a proof-of-principle objective to build a laboratory prototype for a 3D printer using this principle of biocementation (Figure 50).

Milestones

A 3-axis 3D printer for depositing slurry-based materials was designed and developed. The printer is presently housed at the PI's lab in the Indian Institute of Science, Bangalore (Figure 51).

A dedicated customised setup was designed to enable CO2 sequestration via direct purging from the cylinder. Three sets of experiments have been performed.

A potential spin-off has been planned for the Gaganyaan Mission.

Implementing Agency

- Indian Institute of Science, Bangalore

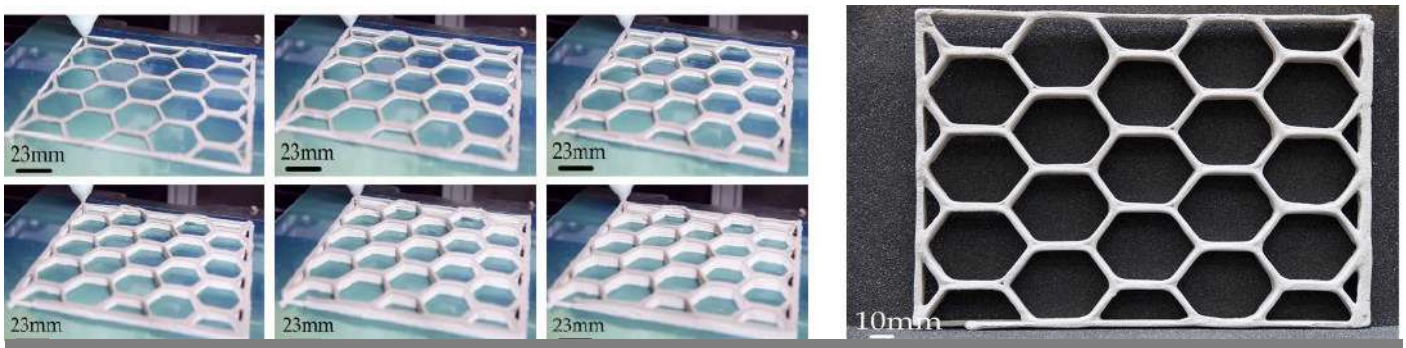

Figure 50: Honeycomb mechanical structure, 3-D printing using bacteria

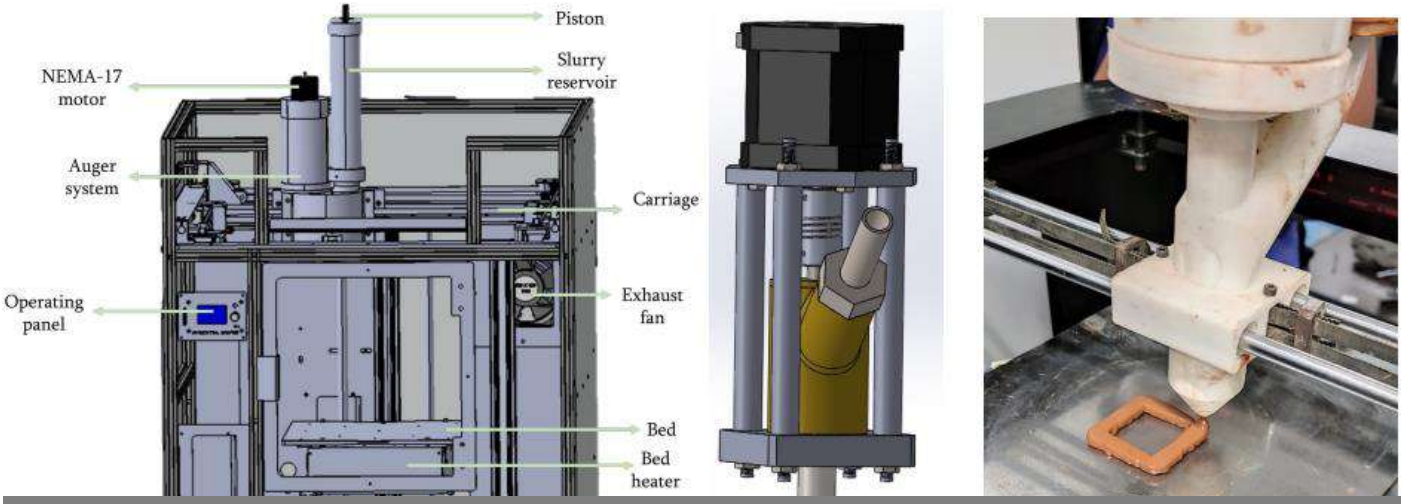

Figure 51: Bacteria-Mediated 3-D Printing of Green Bricks

2020

12.10 Experimental Investigations to Characterise the Entangled States of Light in the presence of Background Noise

The project was sanctioned in October 2020 and is being implemented by the IISc, Bangalore.

The project aims to generate and characterise entangled states of light from optical and microwave regimes. It will experimentally demonstrate the detection of an object on the signal beam path and study the effect of environment/noise on the signal beam and its impact on correlations. It will experimentally investigate and benchmark measurement procedures to quantify the signal-to-noise ratio effect and obtain the noise threshold for quantum illumination (Figure 52). A new protocol will be developed to use hyper-entangled photon states to enhance detection in quantum illumination experiments and test its practical feasibility. The project will optimise the protocol and resources to drive the technology out of the laboratory.

Milestones

- Four theory papers and three experimental papers were published, and one patent application was made.
- Lumped Josephson Parametric Amplifiers were designed and fabricated.
- Practically, quantum illumination was realised using path-entangled single photons.
- Noise resilience was demonstrated in path-polarisation hyperentangled probe states.

The following was achieved: (i) Controlling multi-path interference to induce change in the frequency of photons (ii) Harnessing Brillouin Interaction in rare-earth Aluminosilicate glass microwaves for optoelectromechanic quantum transduction.

Implementing Agency

- Indian Institute of Science, Bangalore

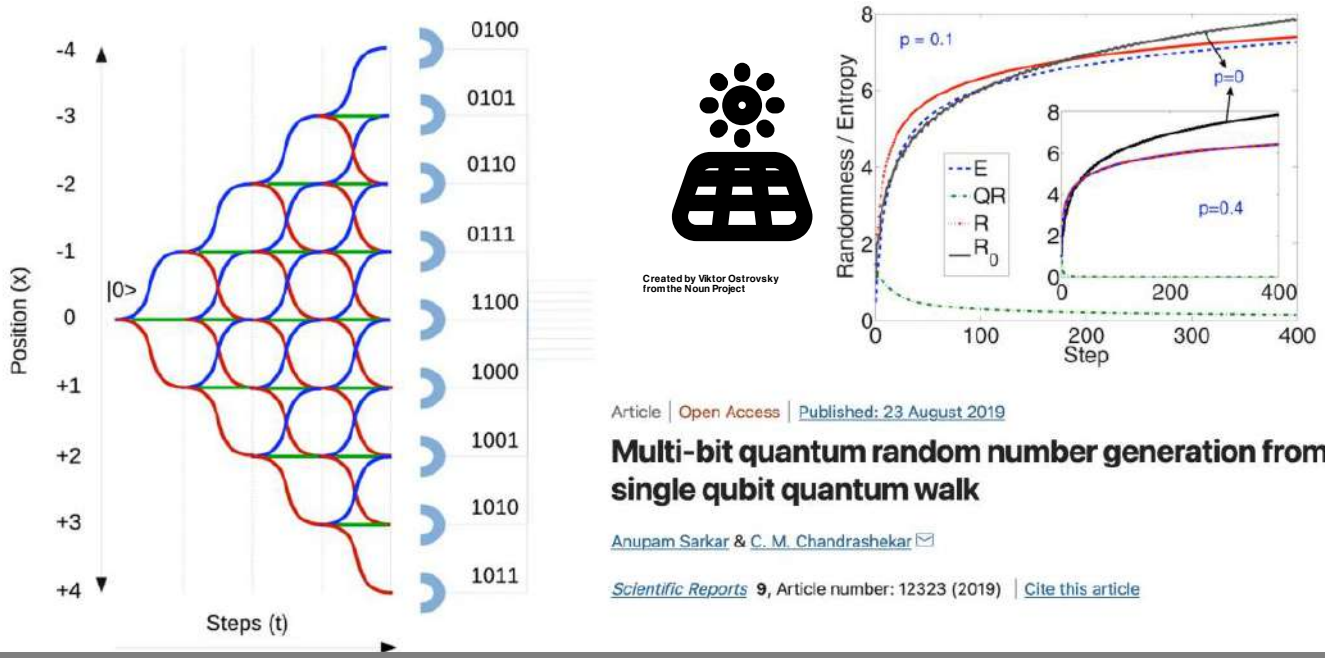

Figure 52: Quantum Random Number Generator

2020

12.11 Indigenous Development and Manufacturing of Seamless Tubes of ASTM B983 for High Temperature/Pressure applications

The project was sanctioned in October 2020 and is being implemented by Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam (Lead agency), NTPC Limited, Bharat Heavy Electricals Ltd. (BHEL) and Mishra Dhatu Nigam Limited (MIDHANI).

This project aims to indigenously develop and manufacture seamless tubes of Ni-based superalloy ASTM B983 (ASME CODE CASE: 2702) with India-specific composition for high temperature/pressure (-720 °C/310 bar and beyond) applications, such as Advanced Ultra Super Critical Power Plant and Super Critical Water Reactors. The main objectives of the project are:

- Development of India-specific specifications for Ni-based superalloy ASTM B983.
- Indigenous development and manufacturing of Ni-based superalloy ASTM B983 seamless tubes.
- Development of optimum process sheet for tube-making process, starting from melting stage through final tube-making/heat treatment stage, followed by a demonstration of the process sheet by repeat manufacturing.

Milestones

Literature survey, preparation of basis documents, technical specifications for the billets and tubes, and vendor identification were completed.

The procurement process for experimental billets to establish the process for indigenous alloy manufacture is in progress.

IGCAR is entering into a Memorandum of Understanding with M/s. MIDHANI, to manufacture the billets needed for the project.

Implementing Agencies

- IGCAR, Kalpakkam (Lead agency)
- NTPC Limited
- BHEL
- MIDHANI

2021

12.12 Synchronising Energy Transitions towards Possible Net-Zero (NZ) for India: Affordable and Clean Energy for All

The project was sanctioned in November 2021 and is jointly funded by the Office of PSA and the Nuclear Power Corporation of India Ltd. (NPCIL). The project is being implemented by IIM Ahmedabad.

This project aims to conduct a comprehensive study with rigorous methods for minimising the cost of power at the consumer end and to work out an optimum mix for all sources of power, aiming at net zero-emission to be realised by a definite year.

Milestones

The first draft report has been submitted by the project team on 1st May 2023. The report is currently under review by the Project Review and Monitoring Committee (PRMC) constituted by the Office of PSA. The final report is expected to be completed by August 2023.

Key findings of the study are:

Clean, affordable electricity can be achieved in Net-zero pathways, especially with a focus on nuclear power no NZ scenario is possible without substantial nuclear power generation in 2070.

Widespread electrification of end-use sectors, especially transport and residential, and eventually green hydrogen production will lead to a rapid increase in electricity demand after 2050 but not a corresponding increase in the carbon footprints of the power sector.

If India plans to phase down coal in the next three decades, it will need to build adequate infrastructure for alternative sources such as nuclear power, in addition to flexible grid infrastructure and storage to support the integration of Renewable energy.

Implementing Agency

- IIM Ahmedabad

Theme 13:

Events

2023

13.1 Workshop on Environmental Surveillance for One Health

A workshop on 'Environmental Surveillance for One Health' was organised on 9th February 2023 by the Office of PSA in collaboration with ARTPark at IISc Bengaluru (Figure 53). The workshop aimed to develop a shared understanding of the current state of research, policy, and implementation of environmental surveillance across sectors. It brought together distinguished leaders from 16 organisations in national and state administrative, research, and technological spheres. The workshop also created a network of practitioners willing to help articulate key questions, identify priorities, and enable meaningful collaborations.

Milestones

The workshop gained a shared understanding of environmental surveillance, created a network of practitioners and created a plan for integrating environmental surveillance into national and state disease programs. Dr Parvinder Maini, Scientific Secretary at the Office of PSA, chaired the workshop and emphasised the importance of the One Health Mission and the need for a coordinated approach among stakeholders.

Participants agreed on the significance of environmental surveillance for monitoring priority diseases like Polio and COVID-19 and discussed how this could be expanded to cover diseases of both human and animal sectors as well as AMR. Key priorities included developing standardised diagnostic tools, utilising data science for decision-making, creating policies for secure data sharing, and fostering collaborative research.

Recommendations to enhance environmental surveillance discussed during the workshop were to formalise priority diseases, establish mechanisms for sharing samples and protocols, create infrastructure for data-sharing, set up collaboration mechanisms, undertake pilot projects, and develop a template for environmental surveillance frameworks.

Participants of the workshop arrived at a few common next steps, including developing a framework for cross-compartmental diseases, identifying bottlenecks for pilot studies, outlining agency roles, creating data pipelines, and establishing a technical forum for ongoing discussions on research methodologies.

The workshop concluded with participants ideating an environmental surveillance framework for avian influenza, a disease impacting wildlife, livestock, and human health. The broad framework was created, with specific implementation details depending on disease dynamics and surveillance context. Participants agreed on the need for such forum and having regular workshops to discuss the progress.

Figure 53: Workshop on Environmental Surveillance for One Health organised by Office of PSA and ArtPark

2022

13.2 National Workshop and Consultative Meeting on Quantum Technologies

An online National Workshop and Consultative Meeting on Quantum Technologies was held on December 13th, 2022, to discuss Quantum Computing, both from the Hardware and the Software perspective; Quantum Communication; Quantum Sensing; and Quantum Materials & Devices.

The day-long workshop was conducted by DST and Chaired by Prof. Ajay Kumar Sood, PSA. The workshop was attended by 165 participants from all over the country working in quantum technologies.

In his opening remarks, Prof. Sood stated that the purpose of the collaborative meeting is to sharpen our focus on various applications of quantum technologies, finding specific products/solutions that both countries can co-develop, solve IP-related issues for such collaborations, engage with US universities, labs, programmes, etc. for possible collaborations. He said that it is important to know what India can gain and what could be shared in such bilateral partnership in quantum technologies.

Prof. Sood suggested that discussions be organised in the four broad verticals of quantum technologies i.e. 1) Quantum Computing 2) Quantum Communication 3) Quantum Sensing 4) Quantum Materials & Devices. He also suggested the formation of four sub-teams and the submission of a crisp technical document to highlight the focus areas by the end of December 2022. Prof. Sood further suggested individual members to discuss the four verticals in about 10-15 minutes - starting with Quantum Computing.

The knowledge gained in the workshop is being used to define the contours of the Indo-US iCET programme on Quantum.

2022

13.3 Brainstorming workshop on National Air Quality Resource Framework of India (NARFI)

The brainstorming workshop on National Air Quality Resource Framework of India (NARFI) was held on 22nd June 2022 at India International Centre, New Delhi to kick start an ambitious National Mission on air quality framework by the National Institute of Advanced Studies (NIAS), Bangalore with the support from the Office of PSA. The inaugural function was graced by Prof. Ajay Kumar Sood, PSA; Dr. Shailesh Nayak, Director, NIAS and Former Secretary, MoES; Dr. Parvinder Maini, Scientific Secretary, Office of PSA; Dr Randeep Guleria, Director AIIMS, New Delhi; Prof. Gufran Beig and Dr. M. Mohanty the Project Coordinators of NARFI. The workshop was also attended by delegates from government and non-government agencies, scientists, industry, and startups (Figure 54).

During the workshop, it was unequivocally recommended that India needs an integrated air quality resource. The short-term basic training modules tailored for different groups such as active ground-level staff in government establishments, implementers, media, and policymakers, would be an integral part of the framework. All this can help to enrich communication and enhance general awareness, leading to self-mitigation.

The NARFI will evolve around the following five modules:

1. **Emission Inventory, Air Shed, and Mitigation**
2. **Impacts on Human Health and Agriculture**
3. **Integrated Monitoring, Forecasting, and Advisory Framework**
4. **Outreach, Social Dimension, Transition Strategym and Policy**
5. **Solutions, Public-Industry Partnership, Stubble Burning, & New Technologies**

Figure 54: PSA Prof. Ajay Kumar Sood graces inaugural session of brainstorming workshop on NARFI

2022

13.4 Post Budget Webinar on Technology Enabled Development

The Post Budget Webinar on Technology Enabled Development was organised by the Office of PSA on 2nd March 2022 virtually in association with Department of Science & Technology, Department of Telecommunication, the Department of Scientific and Industrial Research, and the Ministry of Electronics and Information Technology as the lead ministries, with participation from other scientific ministries and departments. The webinar was inaugurated by the Honourable Prime Minister Shri Narendra Modi (Figure 55).

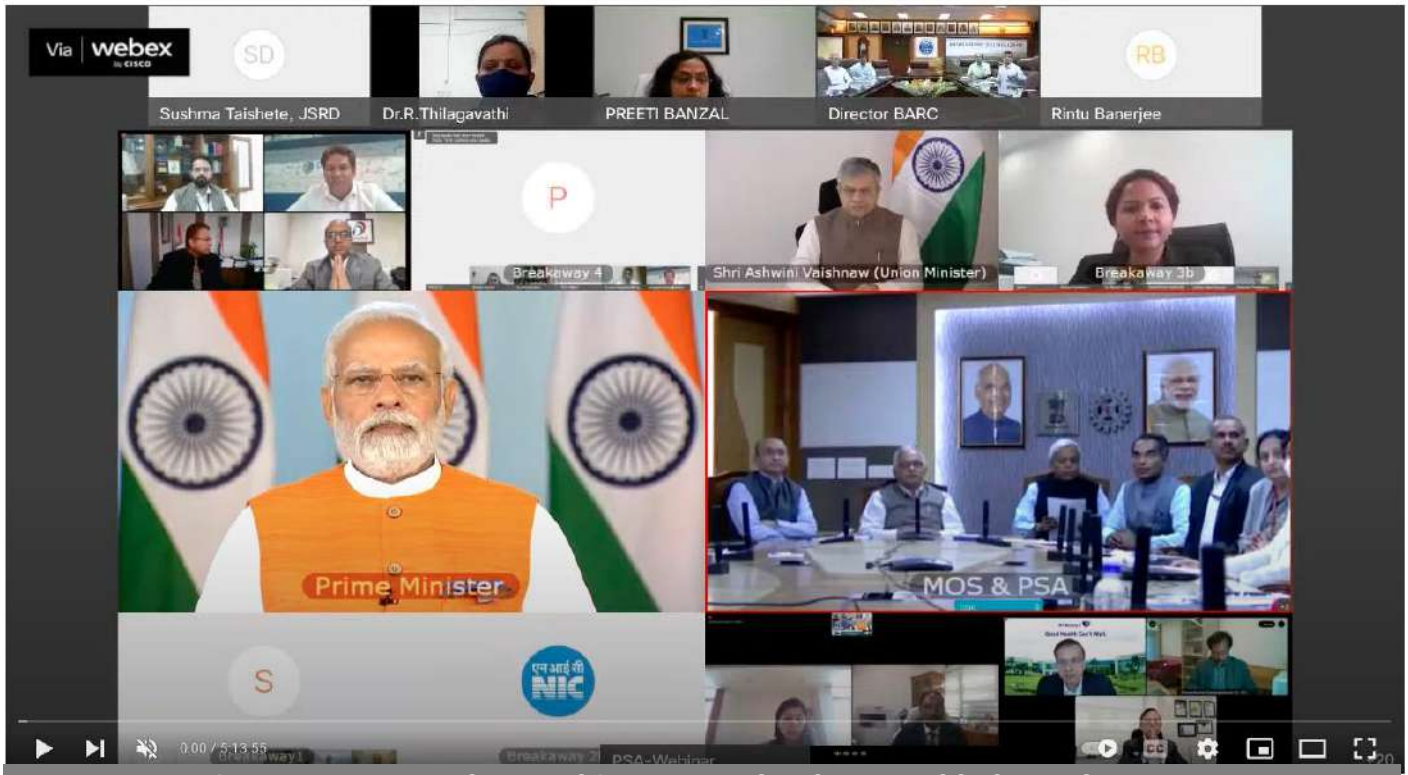

Figure 55: Post Budget Webinar on Technology-enabled Development

Post Budget Webinar on Technology Enabled Development

In the 1st plenary session, the address by Honourable Prime Minister was followed by six parallel Breakaway sessions conducted by each of the four lead departments as mentioned above. In the 2nd Plenary session, which was held after the breakaway sessions, the Secretaries of the four lead departments/ ministries provided a summary of the recommendations and suggestions which emerged from the breakaway sessions for incorporation in the design and implementation of the government programs.

The Hon'ble Ministers Shri Ashwini Vaishnaw, Minister of Railways, Communications, Electronics & Information Technology, Shri Rajeev Chandrasekhar, Minister of State for Skill Development and Entrepreneurship, and Electronics and Information Technology; and Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology and Minister of State for Prime Minister's Office; Personnel, Public Grievances and Pensions; Department of Atomic Energy & Department of Space, Government of India, also addressed the 2nd plenary session and provided their valuable insights for enhancing the roadmaps developed as outcomes of the webinar.

The entire webinar can be found on YouTube.

To watch webinar, scan:

2022

13.5 Vigyan Sarvatra Pujyate (Science & Technology is Revered All Over)

Under the Azadi ka Amrit Mahotsav, the Office of PSA and Ministry of Culture, Government of India organised week-long celebrations during 22nd–28th February 2022, glorifying the achievements of Science & Technology under the title Vigyan Sarvatra Pujyate.

The event was inaugurated on 22nd February 2022 by Shri G. Kishan Reddy, Honourable Union Minister of Tourism, Culture and Development of North Eastern Region of India, and Dr. Jitendra Singh, Honourable Union Minister of State (Independent Charge) Science & Technology; Minister of State PMO, Personnel, Public Grievances, Pensions, Department of Atomic Energy & Department of Space.

Vigyan Sarvatra Pujyate programme was coordinated by the Office of PSA along with the DST, DBT, CSIR, MoES, ISRO, DAE, ICMR, DRDO, All India Council for Technical Education, and Indira Gandhi National Open University. Vigyan Prasar under DST participated as the implementing agency (Figure 56).

Milestones

The event was organised at 75 locations in major Indian Languages: Kashmiri, Dogri, Punjabi, Gujarati, Marathi, Kannada, Malayalam, Tamil, Telugu, Odiya, Bengali, Assamese, Nepali, Maithili, Manipuri, Hindi, English, Urdu, and Sanskrit.

Some important highlights of the mega event are as follows:

Unified Portal for the VSP Festivities and events

The Portal was created as a one-stop information place, especially for VSP events.

Expert Lectures at 75 Locations

Under the theme of Annals of History of Science, one lecture every day at 75 locations was conducted in hybrid mode.

Expositions of Indian S&T

'Milestones of Modern S&T', critical discoveries, innovations, or inventions that made a mark in the global science or India's development story had been highlighted.

Competitions: Poster Making, Essay Competition, Story Telling

Several competitions, including quiz shows, essay, poster, and poetry contests, were held to promote scientific temper, particularly among youths, and different science activities were organised at all 75 locations.

Short Films

On 23rd February 2022, 75 films were released on 75 Scientists in 75 cities based on the theme Annals of History of Science.

Popular Science Books

75 books were released on 28th February 2022.

Radio Talks

75 radio talks were broadcast through All India Radio in different languages.

Science Lit Fest. – 75 (Story Telling, Theatre, Poetry Recital, Feature Film Screening)

The science literature festival brought together science writers, communicators, artists, poets, dramatists, street play artists, hands-on science demonstrators, journalists, students, and teachers. The literature festival has been aimed to communicate science through theatre, poems, various folk forms, and cultural events, including a puppet show and shadow play. It was organized at 75 locations.

Mega Exposition

As a feather in the cap, a science & technology mega expo was held in New Delhi's Jawaharlal Nehru stadium to showcase the S&T prowess of India.

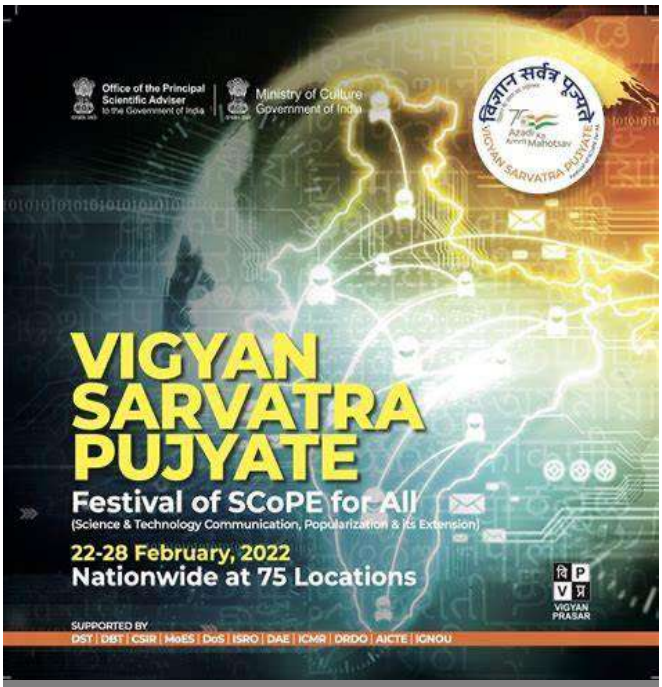

Figure 56: Vigyan Sarvatra Pujyate Festival organised nationwise at 75 locations

The grand valedictory function was ended on **28th February 2022** coincided with the National Science Day. Honourable Union Minister Dr. Jitendra Singh; Prof. K. Vijay Raghavan, Former PSA to GoI; Dr. S Chandrasekhar, Former Secretary, Department of Science and Technology; Dr. Parvinder Maini, Scientific Secretary, Office of PSA; Dr. Balram Bhargava, Former Secretary, Department of Health Research, Dr. Shekhar C Mande, Secretary, Department of Scientific and Industrial Research; Dr Rajesh S Gokhale, Secretary, Department of Biotechnology; and Dr. M Ravichandran, Secretary, Ministry of Earth Sciences were present for the ceremony.

The entire event, including the main inaugural and valedictory functions at Delhi, was live-streamed from across all 75 places.

Theme 14:

Outreach

2022

14.1 Manthan

Manthan is a digital platform for promoting collaboration between various stakeholders and the scientific research and development ecosystem to help meet India's national targets and Sustainable Development Goals (SDGs) through sharing Industry or philanthropic challenges or opportunities for partnerships on emerging technologies, other scientific interventions, as well as those with a social impact. Manthan, derived from a Sanskrit word, means "churning of ideas," and it encapsulates the platform's core philosophy. The platform was launched on August 15, 2022, with the aim of scaling Science & Technology-based social impact & Industry research/innovations in India. This initiative is led by the Office of PSA.

Manthan benefits a wide-range of stakeholders, including industry, embassies/ other governments, coalitions/consortiums, philanthropists, multilaterals, public sector units and co-operatives, MSME Sector, Government—State and central line ministries, entrepreneurial support organisations, research institutes, incubators and their startups, Startups and SMEs S&T clusters, and CoEs.

Around Rs 2600 crores worth of opportunities were posted on the platform for researchers and innovators' ecosystem. The platform won the 'Dun & Bradstreet Business Excellence Award' for the Best Tech initiative of the year 2022. The platform was co-funded by Industry i.e. Shri Lakshmi Narayan, Former CEO and VC, Cognizant, Amazon Web Services (for computing space), and ACT (Action Covid Taskforce) Grants along with the Office of PSA which is funding the development, commissioning, and maintenance of the platform.

Pillars of Manthan

1. Opportunity creation that includes a call for early-stage innovation, market-ready innovation, implementation projects, CoEs, Fellowships, etc.
2. Submitting proposals for collaboration, R&D, and proposals submission against opportunities.
3. Innovation Exhibition—showcasing innovations like a virtual expo; partners can organise an exhibition.
4. Conference/Meeting Facility—providing a space for collaboration using virtual meeting rooms for organising webinars, conferences, stakeholder consultations, etc.

Stakeholders of Manthan

Demand Side:

The platform can be used by Industry, NGO, global foundations, philanthropic organisations, central line ministries and state governments, MSME, Multilateral organisations, PSU & Cooperatives, and Foreign Governments/Embassies. They can post their opportunities, challenges, or problem statements.

Supply Side:

The platform can also be used by Academic and Research Institutes, Incubators & Startups, SME, Science & Technology Clusters, Student Innovators, and Individual Users (Grassroot innovators).

Key Features of Manthan

Integration with other platforms: Manthan aggregates and consolidates rolling opportunities from both industry and government sources, establishing itself as a one-stop hub for researchers to seize a vast array of opportunities.

Rating System: Credentials based tagging of proposals allow the demand side to review the proposals uploaded on the platform under the Sustainable Development Goals and Emerging Technologies.

Peer Review: The platform has a complete process of peer reviewing of proposals submitted by way of selecting the reviewers from Subject Matter Experts section of each Sustainable Development Goals and Emerging Technologies. In addition, one could also nominate their own colleague as peer reviewers on the platform.

Segmentation: Each SDG or Emerging Technology has its own mirror image of opportunities, Industry R&D proposals, CoEs, and Fellowships that require support. It also includes SMEs of that thematic area. There are different segments of international partnerships, central and state government, women in STEM, School Innovations and linkages to rolling challenges of other Industries.

Access to thematic journal papers: It allows industry, researchers, and professionals to stay updated with the latest scientific research and findings. This is provided through integration to a pro bono journal aggregator platform of a startup.

Outreach of STI opportunities to lesser-known institutes: Reaching the unreached (both ways by demand through proposals uploaded and supply side through opportunities posted) within the reputed circle.

Access to Market Research Reports: For startups, not to duplicate efforts KPMG has provided pro bono reports for them to study the same and ensure they work in niche technologies.

Section Owners: Section owner is an organisation that is passionate about a certain thematic area. They will need to energise that area by engaging with industries, startups, academia and bringing them to that section. Quantum, for instance, is owned by Quantum Ecosystems and Technology Council of India, a group of Industries running Quantum initiatives, Cyber Security by Karnataka Digital Economy Mission, Telangana State Emerging Technology Department leads the AI, ML, NLP section of Emerging Technology while Climate Action and No Poverty SDGs are owned by Climate Collective and the Nudge Institute respectively. This is over and above engagements through the Office of PSA, Government of India.

Showcase of Proposals: Researchers and Innovators can showcase proposals that need support as per the Sustainable Development Goals or Emerging Technologies.

Manthan has supported 36 Institutes, 5 Clusters, 11 Centres of Excellence, 300 Research Fellowships, and 70 Women in Stem Internships

Number of Central Line Ministries Research Problems (STAS G): 15 Number of states seeking R&D/Innovative solutions: 17

Total no. of users: 31,346, Demand side: 1,397, Supply side: 29,949

Total Opportunities (By Funding)	Total Number of Opportunities	Total Number of Opportunity Providers
2,690.20 Cr (148 opportunities did not disclose their funding budgets)	254	175

Some of the initiatives under Manthan platform are highlighted below:

14.1.1 NETFLIX series of Azadi ki Amrit Kahaniyan on stories of Inspirational Innovators

In April 2022, through an initiative called **Azadi Ki Amrit Kahaniyan**, Netflix and the Ministry of Information and Broadcasting (MIB) partnered to produce 25 short, inspirational videos. This is a part of India's initiative to celebrate **Azadi Ka Amrit Mahotsav**. The first set of 7 videos was on India's **Women Change makers**, and was narrated by renowned actress, Ms. Neena Gupta. The next 7 videos were on India's freedom fighters of 1857, India's first war of independence. These animated videos were narrated by accomplished actor, Mr. Manoj Bajpayee.

In continuation of this partnership to inspire people across the country with impactful videos, The Ministry of Information and Broadcasting and Netflix has collaborated with the Office of PSA and Manthan.com to create 10 impactful short-films on "**India's Innovators for Social Impact**" -- under the program Azadi Ki Amrit Kahaniyan (Figure 57).

Figure 57: Collaboration of Manthan and Ministry of I&B to create short films on Azadi ki Amrit Kahaniyan

The vision is to create powerful videos on people across the country who have come up with unique innovations for social impact and change.

Netflix and the Ministry of Information & Broadcasting, Government of India have selected 3 innovations on Waste to Value, Covid testing kits & EdTech, nominated by the Office of PSA through 'Manthan' platform in its 1st Phase roll out which is proposed to be launched at the 54th International Film Festival of India on 28th November 2023 in Goa.

14.1.2 DD Kisan Series on Market Ready Innovations for Agriculture technologies funded by IFFCO

Indian Farmers Fertiliser Cooperative (IFFCO) partnered with the Office of PSA and Doordarshan to telecast episodes of Innovations from Academia and Startups of Agriculture Technologies.

The Office of PSA, through its digital initiative, Manthan, sourced innovations evaluated by Kisanmitr advisory committee. DD Kisan has created 16 episodes that were telecasted and aired (Figure 58).

Figure 58: DD Kisan series on market ready innovations for Agriculture Technologies

Here is the link to view the episodes:

Nine more episodes are under production currently for which 18 innovations have been shortlisted out of more than 60 innovations received through Manthan platform. Doordarshan team is in the process of reaching out to those innovators for seeking more details and to take them forward.

14.1.3 Manthan Showcased at various platforms

14.1.3.1 Showcasing Manthan at Airports in India with Airport Authority of India & GMR

Since 1st March 2023, the Manthan platform has been showcased across more than 100 airports across the country under the Airports Authority of India and three GMR airports in Delhi, Hyderabad & Goa (Figure 59).

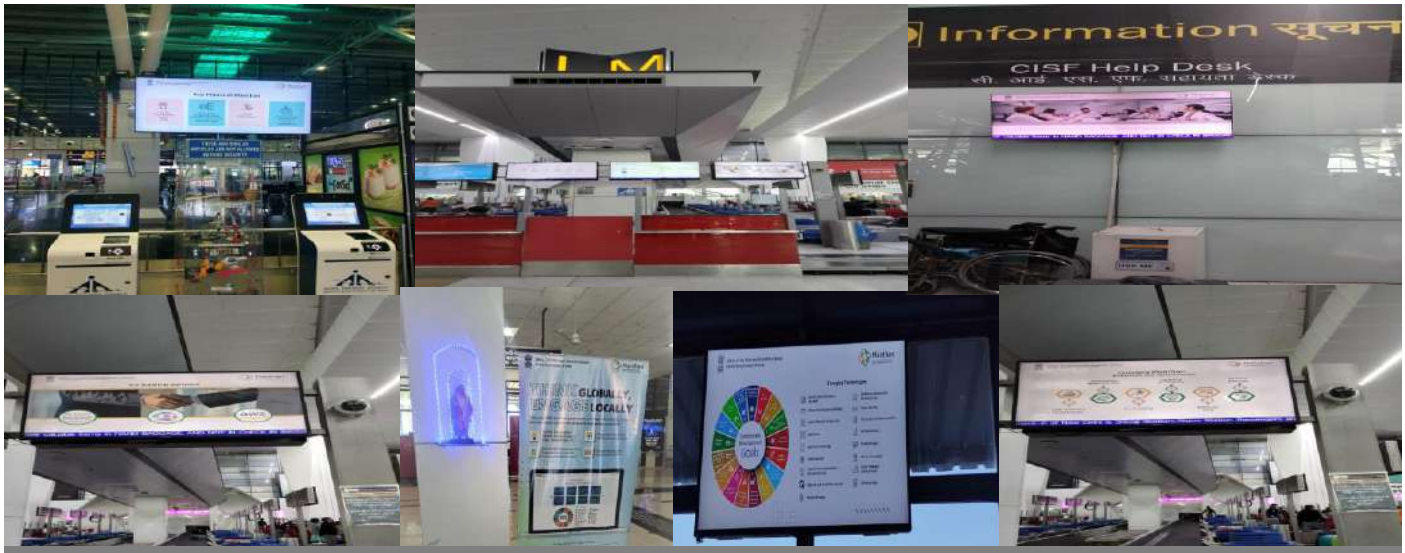

Figure 59: Manthan showcased at over 100 airports

14.1.3.2 MyGov India featured Manthan on their platform

MyGov India is a citizen engagement platform launched by the Government of India on 26th July 2014 to promote the active participation of Indian citizens in their country's governance and development. It is aimed at creating a common platform for Indian citizens to "crowdsource governance ideas from citizens".

The Office of PSA partnered with MyGov India and launched multiple engagement campaigns with objective to:

- Raise awareness of the importance of research and innovation for socio–economic development.
- Promote an understanding amongst youth, startups, incubators, institutes, and industries about the need for promoting Sustainable Development Goals and their role in bringing social transformation.
- Learn about India's newest platform on research and development and to leverage multiple innovations and technologies.
- Enable multistakeholder collaborations to change the landscape of science and technology.

The following work have been featured at MyGov India portal:

Manthan Short Video Contest:

Design a Poster for Manthan:

Compose a Jingle for Manthan

Share your inputs on the Role of Manthan in empowering women entrepreneurs and startups to scale up innovation for a larger social Impact:

Manthan Portal for Ideas & Implementation through Science, Technology and Innovation:

2023

14.2 Amazon Prime Reality Show (Bootcamp) on Grass Root Innovators

It's not enough to have a great idea to create a successful startup. It takes a special kind of entrepreneur – an entrepreneur who has the vision, the grit and the entrepreneurial skills required to build a Unicorn. **Amazon Prime** collaborated with the Office of PSA to design the **Prime Video web-series focused on showcasing Indian startups and entrepreneurs**. Prof. Ajay Kumar Sood, PSA, graced the launch of the initiative of the Amazon Prime Web Series 'Mission Start-अब' on July 12, 2023, in Delhi (Figure 60).

Figure 60: PSA Prof. Ajay Kumar Sood at the launch of the initiative of Amazon Prime reality web series 'Mission START-अब'

The bootcamp is an entertaining reality series in which 4 leading investors are searching for those special entrepreneurs who have it in them to potentially build India's next Unicorn. They pick **10 early-stage founders** with great ideas and put them through an unforgiving & intense grind. The grind is designed to simulate situations that draw out entrepreneurial skills and attributes in these founders – ranging from their ability to communicate their vision & product to exploring the dynamics between the founding team. From the founders' ability to market their product most innovatively to their ability to attract the best talent to their startups.

2023

14.3 She Is – Water Sheroes with Consulate General of Canada & Red Dot Foundation

Red Dot Foundation, in collaboration with the Office of PSA & the Consulate General of Canada in Mumbai, launched a book 'She Is - Water Sheroes', written by ElsaMarie D'silva and Supreet K Singh, in partnership with Prof. Irena Creed, on 23rd March 2023 (Figure 61).

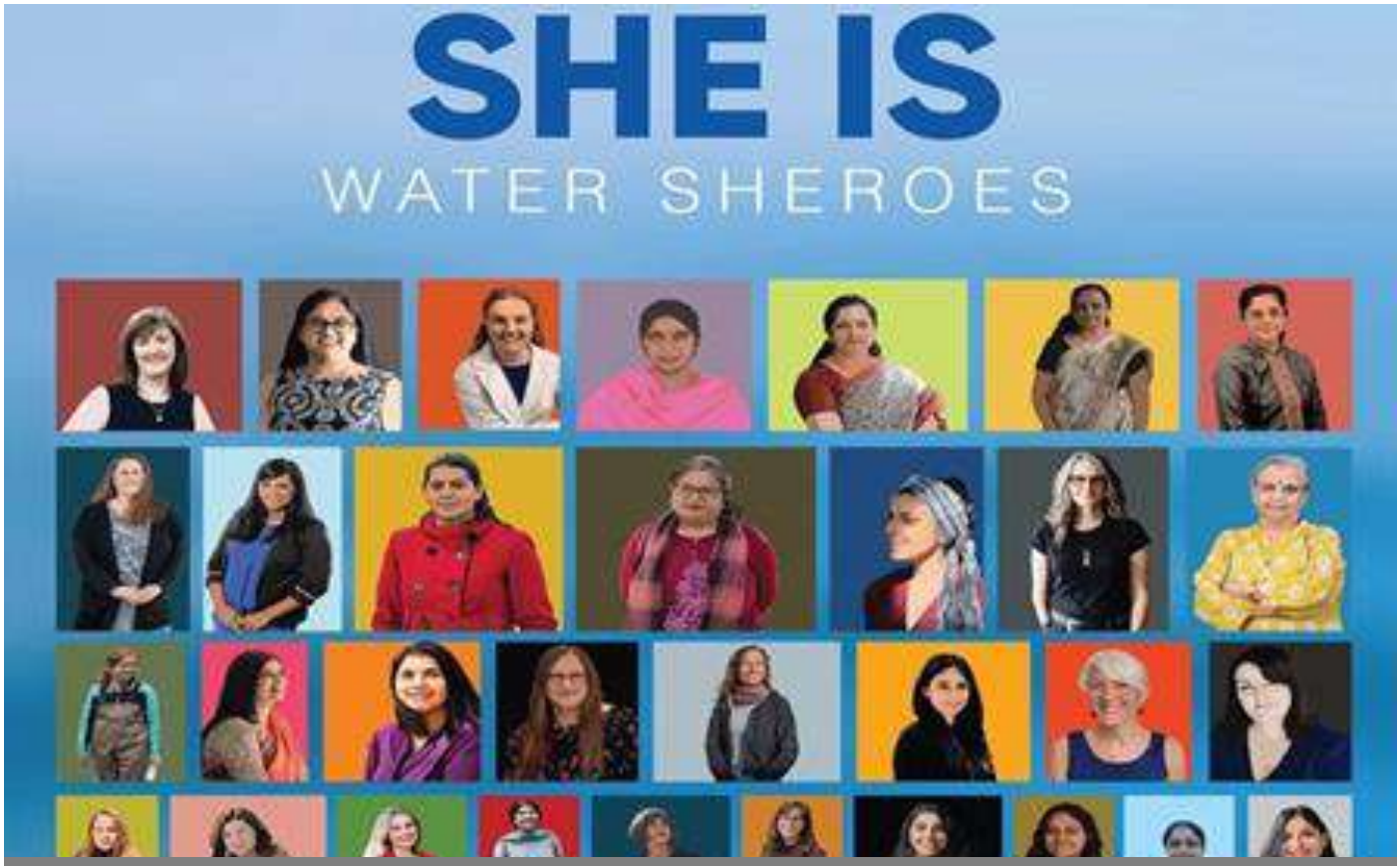

Figure 61: Office of PSA, Red Dot Foundation & Consulate General Of Canada at book launch of 'She Is- Water Sheroes'

Third in the series, She Is – Water Sheroes, makes visible the accomplishments of Indian and Canadian women in the field of water. They represent scientists, researchers, community organisers, entrepreneurs, and youth leaders. Their work is collaborative, often community driven and has a social impact that is sustainable. As we are in the decade of action to achieve the United Nations mandated Sustainable Development Goals, it is critical that each of us understands our role in ensuring that water as a resource is available both in quality and quantity. Women scientists have contributed a lot to climate change, especially on water-related issues and women leaders are often left out of public view because of patriarchy.

Through the She Is book series, Elsa Marie D'Silva, and Supreet K. Singh have been amplifying the stories of women leaders, capturing their unique journeys and their valuable professional contributions. These have proved to be instrumental in providing visibility amongst youth as role models and motivators for young girls to challenge gender stereotypes.

Red Dot Foundation has focused on this topic in this book, in line with the "She Leads Here“ campaign of Canada.

2022

14.4 75 Women in STEAM: She Is: Stories of Women Advancing the Sustainable Development Goals in India

In celebration of India's 75th year of Independence, to honour 75 Indian women, and one woman who has made India her home, in STEAM (fields of Science, Technology, Engineering, Arts, and Mathematics). This book, published in collaboration with British High Commission, FICCI Ladies Organisation (FLO), UN Women, Red Dot Foundation, celebrates gender, leadership, and sustainable development in the fields of STEAM. PSA Prof. Ajay Kumar Sood attended the launch of the book at British High Commissioner's Residence in Delhi on 12th September 2022 (Figure 62).

Figure 62: Launch with PSA Prof. Ajay Kumar Sood at British High Commissioner's Residence in Delhi

It seeks to make women in the fields of STEAM more visible, celebrate their significant contributions, and acknowledge their journeys which are often fraught with challenges that are gendered.

The She Is Women in STEAM book is important because it is time we foster an inclusive workforce, and the book will push the agenda of gender diversity in the Women in STEM space. The book reflects on the collective experiences of the 76 notable women in STEM and harnesses inclusivity in every chapter. Therefore, this book is an inspiring tool to encourage diversity and rich perspectives needed to drive innovation at the workplace.

2021

14.5 Establishment of the Cosmology Education and Research Training Centre (COSMOS-I)

In India, there is an increasing requirement to communicate science to the public and to provide science education to young school and college students. Planetariums are the best centres to provide the above opportunities. There are about 40 planetariums in the entire country that cater to only a very small fraction of the society and many are old with outdated technology. It was therefore planned to build a hi-tech planetarium in the campus of Mysore University, with seed funding from the Honourable Finance Minister, Ms. Nirmala Sitharaman's Members of Parliament Local Area Development Scheme Fund.

COSMOS is expected to create access to students of about 250 colleges and the University of Mysore, comprising about 1.25 Lakh students in the region. The planetarium will have a research and education hub, connecting the other institutions, planetariums, and telescopes in the country. Institutions that are part of the mega-science projects will be involved in providing hands-on experience. Exposure and training to use data from the space missions of ISRO will be an integral part of the education program. The proposed hi-tech light-emitting diode (LED) dome is not only capable of creating stunning visuals of the universe but also to project real-time as well as archival data from our telescopes as well as space missions. The Planetarium will also provide awareness regarding mega-science projects to the public.

The proposed Planetarium can accommodate approximately 130-150 people and is designed to highlight the History of Indian Astronomy and have a mini data research centre, where the students visiting the Planetarium can be educated on the possibilities and potential of studying the stars and Galaxies. Scientific Advisory Board (SAB) chaired by PSA to GoI with members from Scientific Ministries and institutions is guiding the Project Management Unit (PMU) for the establishment of the Cosmology Education and Research Training Centre (COSMOS-I). Eight meetings of SAB were held covering issues on design, timeline, etc.

Collaborating Agencies

- PMU: Indian Institute of Astrophysics (IIA), Bangalore
- Equipment: M/s Konika Minolta, Japan
- Architecture: M/s. Kothari & Associates, Kolkata
- Funding agencies
- Members of Parliament Local Area Development Scheme Fund
- Department of Science and Technology
- Department of Atomic Energy

2021

14.6 JLF Be Inspired Series for Researchers and Innovators to showcase Noble Technologies

Be Inspired is a forum aimed to expand the reach and impact of scientific communication and bring to the forefront the many sectors of Emerging Technologies through a global lens. Launched in July 2021 by Teamwork Arts, producer of the iconic Jaipur Literature Festival, Be Inspired is a partnership with the Office of PSA & the United Nations India Office. Every call to action needs a compelling story; this is a forum where domain experts and innovators are fuelled by the creative arts to enhance our understanding of the tremendous range of human endeavour unfolding around us.

Since July 2021, they have produced more than 25 sessions and have hosted the first on-ground 'Festival of Ideas' at Dubai Expo 2020 in February 2022.

The first on-ground forum in India was held on April 15, 2023, at the India International Centre, New Delhi, with an exciting programme spanning across the domains of healthcare, education, artificial intelligence, space travel and ocean biodiversity. It was well attended with a robust audience comprising diplomats, policymakers, entrepreneurs, corporates, media, and students and was inaugurated by Prof. Ajay Kumar Sood, PSA (Figure 63).

Figure 63: PSA Prof. Ajay Kumar Sood launches first on-ground be-inspired forum in Delhi

2021

14.7 Swacchta Saarthi Fellowship

The Swachhta Saarthi Fellowship is a programme initiated in July 2021 by the Office of PSA to the Government of India, under its Waste to Wealth Mission. The programme aims at recognising and rewarding young students from schools and colleges, community level participation by citizens, Self Help Groups, and sanitation workers for their efforts in sensitizing the communities towards waste management and offering innovative solutions for the conversion of waste to wealth.

The fellowship inspires young citizens and community workers to participate in this programme and showcase their innovation through creating value from the waste around them, and ultimately form a wide network of waste warriors on the ground as Swachhta Saarthis.

The Fellowship is awarded across three different categories as below:

Category A	Category B	Category C
Includes school students from 9th to 12th standard engaged in waste management community	Includes college students (Undergraduates, Postgraduates, and research students) engaged in waste management community work	Includes (i) citizens working in the community and through Self Help Groups and (ii) municipal or sanitary workers working beyond the specification of their job requirements/descriptions

The Swachhta Saarthi Fellows (SSFs) selected under the three categories are supported with monthly fellowships of ₹500/-, ₹1,000/- and ₹2,000/- respectively for a period of one year.

SSF Cohort 1

A total of 1,062 applications were received from across the country (from Jammu & Kashmir, Ladakh, Tamil Nadu, Mizoram, Gujarat, the Andaman & Nicobar Islands) for the 2021 Cohort. Out of the 1,062 applications, 379 SSFs were selected from 27 States and 6 Union Territories, based on their proposed ideas and action plans to tackle the challenge of waste management scientifically and sustainably, as shown in Figure 64. An 8-member expert committee, nominated by the Office of PSA, evaluated a total of 3800 reports submitted by the fellows and provided critical feedback on the portal to each fellow for improvements within their specific projects going forward, over a course of 12 months. Based on the evaluations and feedback on the individual project reports, the respective monthly fellowship amount was disbursed to the fellows across India.

Figure 64: 379 SSFs were selected from 27 States and 6 Union Territories were selected under SSF Cohort 1

Work by Fellows: The SSF programme has demonstrated that citizens, young and old, have a great deal of interest and enthusiasm for working toward waste management. Numerous fellows have developed new ideas into products, prototypes, and technological innovations. Many of these fellows are eager to take their ideas further towards building their own startups. The fellows have demonstrated their entrepreneurial acumen by involving community workers, especially underprivileged people, and generating employment for them.

The SSFs have been successful in encouraging their peers and the community to manage their waste by raising awareness through a variety of sensitisation campaigns. The award of the fellowship encouraged the fellows to conduct their proposed activities quite actively as torchbearers of this programme. The most admirable feature of the programme is the fellows' dedication to transforming "Waste to Wealth" through their modest but honest activities.

From time to time, fellows have been recognised for their waste-to-wealth initiatives. Many of their activities have also been publicised in the form of pamphlets, posters, and videos on social media platforms and via print media. The programme has reported a significant impact on the community/environment (homes, schools, villages, communities, industries) through increased community involvement which has led to positive behavioural changes of citizens towards effective waste management, a decrease in waste production, and cleanliness.

The fellowship has produced several products and prototypes that the fellows can now develop further for commercialisation and scaling up by utilising the platform and networking opportunities provided under the fellowship.

The most significant accomplishment of this programme is the instillation of a culture of waste management among the fellows.

Swacchta Saarthi Samaroh 2022

**Figure 65: Swacchta Saarthi Samaroh 2022:
Celebrating 379 Outstanding Fellows from across the country**

To celebrate the work done by the fellows in the first year of this fellowship, the Waste to Wealth Mission hosted a two-day event, the 'Swachhta Saarthi Samaroh', on 30th September and 1st October 2022, at IIT Delhi (Figure 65). The event was inaugurated by Dr. Parvinder Maini, Scientific Secretary, Office of PSA and saw participation of SSFs from 27 States and 6 UTs under the 2021 Cohort (Figure 66). It was attended by eminent dignitaries from academic institutions, industries, national R&D labs, startups, etc.

Figure 66: Inauguration of the Swachhta Saarthi Samaroh held at IIT Delhi

This two-day event gave the SSFs under the Waste to Wealth Mission an opportunity to showcase their work and the impact made within their community with their peers to a large audience. In the first batch of the fellowship, the Mission selected 379 fellows but over the fellowship period, 344 fellows were able to continue based on their ideas and action plans to tackle the enormous challenge of waste management scientifically and sustainably.

As ambassadors of change, these 344 fellows conducted over 2700 sensitisation programmes, including workshops, cleanliness drives, technology interventions, development of prototypes, audio-video demonstrations, one-on-one discussions, and creation of innovative radio jingles, and sensitised over 3.1 lakh citizens.

During the event, the fellows showcased their work done over the past year in the form of posters, prototypes, papers, presentations, and products in the event exhibition. The fellows displayed their work across 8 waste categories, and a total of over 100 posters and over 60 prototypes were displayed at the exhibition venue. 110 fellows from all 3 categories were felicitated for their excellent work in waste management space. 20 fellows were also felicitated under Wellbeing Out of Waste (WOW) program by I.T.C. Limited, with a fellowship amount of ₹5001 each for their efforts and the impactful work (Figure 67). I.T.C also provided an opportunity for all the fellows to join the WOW programme within their operating states.

Figure 67: 20 fellows were felicitated under (WOW) Program by I.T.C. Limited, with a fellowship amount of ₹5,001 each.

SSF Cohort 2

The applications for the 2022 Cohort were open between 4th February–4th May 2022. A total of 1290 applications were received from across the country from 28 states and 5 UTs for Cohort 2. Out of the 1290 applications, 71 SSFs were selected from 20 States and 3 Union Territories, based on their proposed ideas and action plans to tackle the challenge of waste management scientifically and sustainably. The fellowship has commenced from July 01, 2023.

2021

14.8 Tech Dome at Nav Bharat Udyan

The Tech Dome is a visionary initiative planned as part of the Nav Bharat Udyan, set to be developed on the eastern side of the Central Vista along the Yamuna bank. This ambitious project aims at showcasing innovative ideas and advancements in the field of science and technology.

The objective of the Tech Dome is to demonstrate the technology prowess and how it is closely linked to current human way of living and how it is going to influence our future lives. The Tech Dome will come up in an area of about 0.90 acres and will have two components: (i) a dome of 12 metres above the ground with 360 degrees projection, with a 12-metre radius and 460 sq. metre area and (ii) a peripheral structure surrounding the dome with an area of 1500 sq. metre that will showcase different technologies utilising different display technologies, including virtual reality, augmented reality, 3D screens, etc. The Office of PSA and MoHUA are working together with various science departments, National Council of Science Museums (NCSM), and Central Building Research Institute (CBRI) on structural design of the Tech Dome. The PSA chairs the committee with members from science ministries and MoHUA.

The Office of PSA has coordinated the efforts with government departments and agencies with specific tasks as below:

The structural design of the Tech Dome is being finalised by CBRI of CSIR with inputs from National Institute of Design, Ahmedabad. The dome structure will capture elements of Indian architecture, including the Sanchi-Stupa and that of traditional other buildings such as Havelis.

The NCSM is working to finalise:

- Supply, installation, testing, and commissioning of Dome Theatre
- Supply, installation, testing, and commissioning of 3D film and large format Dome, and;
- Select vendor for technology development, content creation, and structural design work of museum, which will be done jointly with the C-DAC.

A committee chaired by the PSA along with Secretary, MoHUA; and Secretary, DST, and other senior officials as members is closely reviewing and guiding the project. The project is a concerted effort with all scientific departments, academia, and select technology industries actively partnering in the development initiative.

Theme 15:

Taskforces and Committees Chaired by PSA

15. Taskforces and Committees Chaired by PSA

Sl. No	Subject	In capacity as
1	Empowered Technology Group	Chairperson
2	Prime Minister's Science, Technology, & Innovation Advisory Council	Chairperson
3	Empowered Committee for Animal Health for policy inputs on veterinary vaccines/biological/drugs	Chairperson
4	CORE Committee of Secretaries on ONOS	Chairperson
5	One Health Steering Committee	Chairperson
6	Task Force on Nutra Sector	Chairperson
7	Planning Committee of Space Applications Management System and the ten standing Committees to address the requirements of satellites & associated ground segment and its optimal utilization	Chairperson
8	Apex Committee on SETS	Chairperson
9	Research and Technology Advisory Committee for examining the need and advising science and innovations in the field of Animal Husbandry and Dairying	Chairperson
10	Geospatial Data Promotion and Development Committee	Chairperson
11	National Green Hydrogen Mission – Constitution of an Advisory Group	Chairperson
12	Technical Committee for examination and use of innovations and technologies in drinking water and sanitation sector	Chairperson
13	Deep Ocean Council under Deep Ocean Mission	Chairperson
14	Gati Shakti	Chairperson
15	Advisory Committee for S&T Capacity Building	Chairperson
16	Committee to deliberate on difficulties in accessing virus/clinical material for research from ICMR-National Institute of Virology, Pune	Chairperson
17	National Technology Led & Deep Tech Startup Policy Consortium	Chairperson

Taskforces and Committees Chaired by PSA

Sl. No	Subject	In capacity as
18	Constitution of Committee for devising format for Indian Science Congress – 2024	Chairperson
19	National Advisory Committee for the National Initiative on Science, Technology, and Innovation Statistics	Chairperson
20	Oversight and Policy Guidance Committee to facilitate life sciences-based research	Chairperson
21	Mission Technology Research Council, National Quantum Mission	Chairperson
22	Committee on Tech Dome	Chairperson
23	Indo-US Quantum Coordination Mechanism under Indo-US Initiative on Critical and Emerging Technologies	Co-Chair
24	Quad Investors Network Centre of Excellence on Quantum Information Sciences	Co-Chair
25	Committee on Technical Textiles on Research, Development & Innovation	Co-Chair
26	Scientific Advisory Board for the establishment of COSMOS-1	Co-Chair
27	Apex Committee for VAIBHAV Research Programme	Co-Chair
28	ACT Acceleration Facilitation Council of World Health Organization	Co-Chair
29	Task Force for focused research on Corona Vaccine and other S&T issues	Co-Chair
30	Mission Governing Board, National Quantum Mission	Member
31	National Technical Textile Mission- Mission Steering Group	Member
32	Advisory Committee for India Semiconductor Mission	Member
33	Mission Steering Group – National Digital Health Mission	Member
34	National Committee for examining the techno-commercial feasibility of installing small scale nuclear power plants	Member
35	Mission Steering Committee under Deep Ocean Mission	Member
36	Space Commission	Member

Sl. No	Subject	In capacity as
37	Review Committee for Space reforms and Gaganyan Space Mission – 2022	Member
38	Mission Steering Group for Ayushman Bharat Digital Mission	Member
39	Apex Council – Bharat 6G Mission	Member
40	Advisory Committee for the development of a policy framework for the effective implementation of the Carbon Capture, Utilisation, and Storage initiatives in India	Member
41	Mission Governing Board for National Mission on Interdisciplinary Cyber-Physical Systems	Member
42	National Green Hydrogen Mission – Constitution of an Empowered Group	Member

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