

Brief Statement of Activities 2018



सत्यमेव जयते

Government of India
Department of Science & Technology
Ministry of Science & Technology
New Delhi

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Contents

Overview	iv
1. S&T Institutional and Human Capacity Building Programme	1
2. Research & Development	14
3. Innovation, Technology Development and Deployment	23
4. Autonomous Institutions	39
5. Science and Engineering Research Board	54
6. Technology Development board	56
7. Strengthening Survey and Mapping Capability	57
8. Administration and Finance	60

OVERVIEW

Department of Science and Technology (DST), Government of India is the nodal department for promoting new areas of science & technology and strengthening of national capacity in science, technology and innovation in the country. The agenda has been served through implementation of several planned initiatives focused on enabling the Indian S&T community for increasing its scientific and technological outputs in term of quality and quantity. DST provides the largest extramural research and development support in the country to strengthen national S&T capacity and capability through a competitive mode to scientists cutting across institutions and disciplines. This strategically important function mutually reinforces outcomes of our country's educational, scientific and industrial R&D initiatives and helps transform the S&T ecosystem of the country.

Important highlights and achievements of the activities of the Department during 2018 are as follows:

INSPIRE Awards -MANAK (Million Minds Augmenting National Aspiration and Knowledge) is implemented with the thrust on 'Original ideas' having potential to address societal needs through Science & Technology especially in the context of National flagship programmes such as Swachh Bharat, Digital India, Swasth Bharat, Make in India, Energy, Environment, Sanitation etc. So far during the year 2018, 50,279 INSPIRE Awards have been sanctioned with about 43.41 % of the awardees being girls and 25.66% SCs/STs.

INSPIRE programme is to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base. During 2018-19, about 12,000 INSPIRE scholarships with 57% women has been offered to the selected candidates based on their performance (top 1%) in higher Secondary Boards.

Under **KIRAN** programme during the year 2018-19, **334** projects were recommended under WOS-A out of 1383 proposals received, **46** projects were recommended under WOS-A out of 720 proposals received, **104** women have been selected in 10th batch of WOS-C for internship in the domain of Intellectual Property Rights, 20 women Scientists & Technologists have been selected under STEMM fellowship, 15 pilot projects under Vigyan Jyoti were implemented in premier educational institutions in different parts of the country.

Swarna Jayanti Fellowships Scheme: **14** young talents have been selected out of 392 applications for their innovative and inter-disciplinary projects that may result in providing leadership to the country in advanced areas of science and technology

Cognitive Science Research Initiative (CSRI): 44 individual projects and 12 CSRI-PDF projects have been supported. **17** projects have been recommended out of 214 proposals received against 3rd call under Science and Technology of Yoga and Meditation (SATYAM),

FIST: So far, nearly 2817 S&T departments and PG colleges (Level 0- 462, Level I- 2106, Level II- 248 and Level III- 01) have been supported with a total investment of about Rs 2850 crores. More than 450 PG Science/ Engineering/ Medical Colleges have undergone rejuvenation of teaching and research facilities under the programme.

PURSE: There has been significant increase in R & D outputs in PURSE supported Universities. Publications during the period of 1996-2006 and 2000-2010 for the group of 14 Universities have increased by nearly 34% i.e. from 45421 to 60773 and h- Index increased from 540 to 881 in 4 years. Similarly, the increase in publications is about 60% i.e. from 40036 to 63880 for the period of 1998-2008 and 2002-2012 for another set of 30 Universities and h- Index also increased from 970 to 1548 in that corresponding period of 4 years. In the last 4 years, an amount of Rs 308.0 crores has been invested on 44 premier Universities under this Program.

SAIF: Currently, 15 SAIF Centres are operating in the currently with the support of DST. These facilities have been utilized by over 19,000 users, over 1,10,000 samples have been analysed during the year

State S&T Programme (SSTP) provided support to 28 State Councils for S&T. 36 new projects/programmes were supported to address the State Specific S&T challenges including S&T surveys and studies

Patent Facilitation Cell (PFC) has provided support to the 24 Patent Information Centres established at various State Councils during FY 2017-18 and current F.Y till date.

DST-Centers for Policy Research (CPRs): Three research studies have been completed and the publications emanated from them have been launched on May 11, on the occasion of National Technology Day held at Vigyan Bhawan, New Delhi.

Centre for Human and Organisational Resource Development (CHORD) programme has brought out the publication entitled ‘**Directory of R&D Institutions 2018**’, eleventh in the series, containing list of around 6862 R&D institutions with complete addresses arranged alphabetically by S&T sectors.

Nano Science & Nano Technology: A total of 22 new individual scientist-centric R&D projects have been recommended under NSAG and 72 proposals, a total of 24 projects were recommended under NATAG. Cooperation with DBT, BIS and MEITY are in process for Nano- Regulatory Aspects.

Climate Change Programme is implementing two national missions on climate change i.e. NMSHE and NMSKCC under the National Action Plan on Climate Change (NAPCC). Three new programmes; National Network Programme on Urban Climate with 05 projects, Human and Institutional Capacity Building (HICAB) for the Himalayan region with 18 projects, National Network Programme on Climate Change & Himalayan Cryosphere with 06 projects have been initiated. Three State CC Cells one each in the states of Gujarat, Assam and Bihar have been supported.

Mega Facilities for Basic Research Programme: Indian scientists and research students continued their participation in Compact Muon Solenoid (CMS) experiment, a Large Ion Collider Experiment (ALICE).

National Supercomputing Mission (NSM): The NSM will be setting up 2 Supercomputer Systems under “Build” approach at IIT-Varanasi and IIT-Kharagpur before 31st March, 2019. The remaining 4 systems under Phase I are likely to be installed and operationalised before 31st May, 2019.

International Bilateral Cooperation: The 24th edition of the DST-CII **Technology Summit** was held in New Delhi during October 29-30, 2018 with Italy as partner country. Inter-governmental Agreement on Cooperation in the field of Science, Technology and Innovation were signed with Denmark, Indonesia and Uzbekistan. Established a US\$ 40m “India-Israel Industrial R&D and Technological Innovation Fund (I⁴ Fund)” for a period of five years to support joint R&D projects aimed to co-develop innovative

technology-driven products, services or processes.

International Multilateral and Regional S&T Cooperation: Under the framework of BRICS Memorandum of Understanding in Science, Technology and Innovation, more than 50 multilateral BRICS R&D projects with joint co-investment of about US\$ 20 million by eight BRICS STI funding agencies were supported. The 3rd Phase (2018-2023) of Research & Training Fellowship for Developing Country Researchers (RTF-DCS) was launched for another 5 years starting from April 2018

Technology Development Programmes: 37 new projects were sanctioned to promote development of advanced manufacturing technologies. 17 new projects were sanctioned for development of biomedical devices. 11 new projects were sanctioned for development of new devices. 1 new project were sanctioned for development of novel technologies.

Clean Energy Research Initiative: The first supercritical Brayton Cycle CO₂ test facility at IISc was inaugurated which has the potential to pave the way for highly efficient compact power plants driven by wide range of heat sources including Solar. A National Centre for Development of Advanced Materials and Manufacturing Processes for Clean Coal Technologies for Power Applications has been supported

Water Technology Initiative: A Water Innovation Centre has been initiated for Sustainable Treatment, Reuse and Management at IIT Madras with eight partnering institutions. A Water Innovation Centre has been established at Indian Institute of Technology Bombay, Mumbai.

Drugs and Pharmaceuticals Research Programme: 22 project proposals have been recommended out of the 159 proposals received.

Interdisciplinary Cyber-Physical Systems: The National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS) has been approved on 6th December, 2018 at a total out lay of Rs. 3,660 Crore for a period of five years. A new directed research programme on “**Quantum Information Science and Technology (QuST)**” has been initiated. 37 generic technologies, 7 prototypes and scaled models have been developed and also demonstrated under **Indian Heritage in Digital Space**.

Building Geospatial Capacity: A draft National Geospatial Policy (NGP) has been constituted and is ready for consultation with stakeholders. State Geo-Portals have been set-up in 10 states to provide information requirement for implementing various developmental schemes in the states. New programmes on Coastal Hazard and Risk Assessment has been initiated.

S&T Programme for Socio-Economic Development: Semi-mechanized ferro-cement based panels for housing, Micro Solar Dome for lighting, hand washing devices using bamboo and development of Bio-Solar ATM prototype have been developed for improving rural livelihoods. Women Technology Parks (WTPs) were established in Kerala, Meghalaya, Assam and Uttar Pradesh for empowering women through specific technologies.

S&T led Entrepreneurship and Innovation Promotion: Under the flagship program NIDHI Technology Business Incubators (TBIs), department has established more than 130 Technology Business Incubators (TBI) and Science and Technology Entrepreneurs Parks (STEP) and several among them have matured and developed competence to become state-of-the-art Incubators.

National Council for Science and Technology Communication: A National Science Channel has been recently developed to disseminate Science, Technology & Innovation related knowledge. National

Children Science Congress was organized with a theme of Science Technology and Innovation for Clean, Green and Healthy Nation.

The Department of Science and Technology nurtures 25 **Autonomous Bodies** (ABs) that include 16 research institutions, 4 specialized knowledge institutions and S&T service organizations and 5 professional bodies.

The competitive mode of funding schemes by the **Science and Engineering Research Board** (SERB) has strengthened the operational flexibility of Project Investigators through rationalization of budget heads. Young Scientists in the country have received overwhelming R&D support through the Early Career Research Award (ECRA) Scheme, National Postdoctoral Fellowship (NPDF) Scheme, J.C Bose Fellowship, Ramanujan Fellowship. The Board has initiated a new scheme titled 'Visiting Advanced Joint Research (VAJRA) Faculty' to tap the expertise of overseas faculty / scientists including Non-resident Indians (NRIs) & OCIs. The Board was able to support close to 1700 new researchers through core support grant and Young Scientist Schemes.

S&T INSTITUTIONAL AND HUMAN CAPACITY BUILDING PROGRAMME

INSPIRE AWARDS - MANAK PROGRAMME

MANAK (Million Minds Augmenting National Aspiration and Knowledge) is a national programme implemented by the Department of Science and Technology in which the thrust is on ‘Original ideas’ having potential to address societal needs through Science & Technology especially in context of National flagship programmes such as Swachh Bharat, Digital India, Swasth Bharat, Make in India, Energy, Environment, Sanitation etc.

- In so far as INSPIRE AWARDS–MANAK programme is concerned, during the year 2018-19, 50,279 INSPIRE Awards have been sanctioned. About 43.41 % of the awardees are girls and 25.66% SCs/ STs. The Department has so far conducted six National Level Exhibition and Project Competitions (NLEPCs) starting from 2011, every year. A total of 4716 awardees have so far exhibited their projects/models in these exhibitions held so far. Patent Facilitating Centre (PFC) of TIFAC along with its team of patent experts scrutinized the exhibits and scouted the patentable inventions for patenting. 20 projects were filed with complete specification.
- **Japan Science and Technology Agency (JST) under the SAKURA Science High School Program** invites INSPIRE Awardees to visit excellent Universities, research institutions in Japan and also to experience Japanese culture. In 2018, a total of 32 INSPIRE Awardees and 7 supervisors have successfully participated in the Programme during 20-26 May, 2018 and visited Japan.

INSPIRE PROGRAM

Innovation in Science Pursuit for Inspired Research (INSPIRE) is one of the innovative programs by the Department of Science & Technology, GOI for attraction of talent to science. The basic objective of INSPIRE is to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base.

INSPIRE Internship is the second component of the **Scheme for Early Attraction of Talent for Science (SEATS)**. It aims at providing exposure to young science students by organizing Science Camps either in summer or winter days. During 2018-19, more than 25,000 students of Class XI pursuing science in any school are invited to participate at the 5 days’ science camps and provided opportunity to interact with the Science icons from India and abroad including Nobel Laureates to experience the joy of innovations through **INSPIRE Internship**.

Scholarship for Higher Education (SHE) aims at enhancing the rate of attachment of talented youth to undertake higher education in science intensive program by providing scholarships and mentoring through summer attachment to performing researchers. The scheme offers 12,000 Scholarship every year @ Rs 0.80 lakh per year for undertaking Bachelor and Masters level education in natural and basic sciences for the talented youth in the age group 17-22 years. The main feature of the scheme is in mentorship support

to carry out research during vacation period for every scholar through **INSPIRE Scholarship**. During 2018-19, about 12,000 INSPIRE scholarships has been offered to the selected candidates based on their performance (top 1%) in + 2 examination of State/Central School Education Examination Boards and through competitive examination basis, for pursuing academics at undergraduate /integrated post graduate levels in basic and natural sciences. Out of the total offered INSPIRE Scholarship candidates 57% are women.

INSPIRE Fellowship is offered to students having secured 1st Rank in Basic & Applied Sciences including engineering, medicine, agriculture, veterinary at the University/ academic institute of national importance i.e. IITs, NITs, IISERs level examination as well as Inspire Scholars having secure 70% marks in aggregate at the M.Sc. level which are eligible for admission to the PhD Program in any recognized University/ academic Institutions in the country. The Fellowship shall be tenable maximum for 5 years (2 years as JRF and 3 years as SRF) or completion of PhD, whichever is earlier to pursue full-time PhD program. The Fellowship amount including the contingencies is equivalent to CSIR-UGC NET Fellowship and is governed time to time as per GOI norms & regulations. During 2018-19, 1000 fellows are awarded the INSPIRE fellowship and are pursuing their Ph.D. in Basic & Applied Sciences including engineering, medicine, agriculture, veterinary at the University/ academic institute of national importance. Out of the awarded INSPIRE Fellows 61% are women. Nearly, 30-35% INSPIRE Scholars have come back to pursue their doctoral degree in science after availing 5 years INSPIRE scholarship to study science subjects. Besides this, 8 INSPIRE Fellows working as Senior Research Fellows have been selected for participating at the HOPE meetings at Japan and ~26 INSPIRE Fellows working as Senior Research Fellows and ~03 UK fellows are selected for participating short-term Research Internship Program at the various Laboratories/ Universities of UK and India respectively through Newton-Bhabha Program of DST and UK.

INSPIRE FACULTY AWARD assures opportunities for post- doctoral researchers in the age group of 27-32 years through contractual and tenure track positions for 5 years in both basic and applied sciences area including engineering, agriculture, veterinary and medicine. It aims at following:

- To provide attractive opportunities to young achievers for developing independent scientific profiles and launch them in fulfilling long term careers.
- Expected to augment high quality scientific manpower for scientific and educational institutions, specially the Central and State universities.
- While the vertical migration among students in different INSPIRE components would be encouraged, the Scheme would also provide opportunity to students for lateral entry into this component.
- This component would provide an independent research opportunity and not a guarantee for tenure positions after 5 years.

During 2018-19 about 159 fellows are provided an opportunity to pursue post- doctoral researcher through contractual and tenure track position for 5 years in both basic and applied sciences area including engineering, agriculture, veterinary and medicine. Out of the total INSPIRE Faculty awardees 31% are women beneficiaries.

KIRAN (KNOWLEDGE INVOLVEMENT IN RESEARCH ADVANCEMENT THROUGH NURTURING)

KIRAN embraces women-exclusive schemes of DST with the mandate to bring gender parity in S&T through gender mainstreaming. The achievements of various programs under KIRAN during the year 2018-19 are as follows:

i. Women Scientists Scheme:

- **Women Scientist Scheme-A (WOS-A):** In the year 2018, 1383 project proposals were received under WOS-A out of which **334** projects (Life Sciences–150, Chemical Sciences–62, Physical and Mathematical Sciences–59, Earth and Atmospheric Sciences–13, Engineering Sciences–50) were recommended.

- **Women Scientists Scheme-B (WOS-B):** In WOS-B, 720 project proposals received out of that 134 proposals were screened for presentation and finally **46** projects (Agriculture & Allied Sciences-18, Health, Food & Nutrition-19 and Engineering & Technology Development-9) were recommended for budgetary support.

- **Women Scientists Scheme-C (WOS-C):** **104** women have been selected in 10th batch of WOS-C for internship in the domain of Intellectual Property Rights.

ii. **Indo-US Fellowship for Women in STEMM:** 20 women Scientists & Technologists have been selected under this fellowship to work in state-of-the-art laboratories in USA.

iii. **CURIE (Consolidation of University Research for Innovation & Excellence in Women Universities):** Since the inception of CURIE in 2009, 7 Women Universities have been supported for a period of 3 years to strengthen R&D infrastructure & facilities. In 2018, 7th university i.e. Indira Gandhi Delhi Technical University, Delhi was supported under CURIE. Proposal to include 8th women university in CURIE is also in pipeline.

iv. **Sensitization Meetings:** A sensitization meeting has been organized in September 2018 at KIIT University, Bhubaneswar for outreach of various women centric programmes under KIRAN. Participants from aspirational districts of Odisha have also attended this sensitization meeting.

v. **Training and Capacity Building:** During 2018-19, Nine (9) training programmes have been organized under National Training Program specifically for women scientists & technologists working in Government covering multifarious themes. Around 200 women benefitted through these programs. Besides this, two hands-on workshop on ‘Proteomics Approaches’ have been organized at University of Mysore, Mysuru wherein more than 50 young women scientists have been trained in this important methodology of Life Sciences.

vi. **Vigyan Jyoti:** In 2018, Fifteen (15) pilot projects under Vigyan Jyoti were implemented in premier educational institutions in different parts of the country. Under these projects, three weeks’ residential programme was conducted for meritorious girls studying in Class IX and XI wherein around 450 students were mentored to pursue higher studies and careers in Science & Engineering. In order to inculcate scientific temperament at early stage, one pilot project was also conducted for students (both girls and boys) of Class VI to VIII with focus on learning of scientific principles through live models. Sixty (60) students were benefitted by this project.

SWARNAJAYANTI FELLOWSHIPS SCHEME

The **SwarnaJayanti Fellowships Scheme** was initiated by the Government in 1997-1998 to commemorate 50th year of India's independence. The objective of this Fellowship Award Scheme was to award talented young scientists, upto 40 years of age, in their innovative and inter-disciplinary projects that may result in providing leadership to the country in advanced areas of science and technology.

The selection process is competitive and the candidates are selected through a three-tier rigorous screening process.

The following table summarizes the process of selection in each discipline in current year:

Broad Area	Applications received	Screened-in for Presentations	Selected for presentation National Core Committee (NCC)	Nominated by NCC
Chemical	40	16	4	2
Earth&Atmospheric	15	06	3	2
Engineering	123	13	6	3
Life	139	14	5	3
Mathematical	19	03	2	2
Physical	56	14	5	2
	392	66	25	14

Cognitive Science Research Initiative (CSRI)

Cognitive Science Research Initiative (CSRI) provides support for multi-centric mega projects, individual projects, Post-Doctoral Fellowship (PDF) and also facilitates infrastructure development, sharing of experiences and networking activities.

During the year, 44 individual projects and 12 CSRI-PDF projects have been given financial sanction. Budgetary support has also been extended for 24 ongoing projects. In 2018, Call for proposals was also made against which DST received 401 individual project proposals and 88 applications for PDF. The process of scrutiny and shortlisting has been completed.

Science and Technology of Yoga and Meditation (SATYAM):

Science and Technology of Yoga and Meditation (SATYAM) aimed to foster scientific research on the effects of yoga and meditation on physical & mental health besides on cognitive functioning in not only in patients with disorders but also in healthy people. Against 3rd Call for Proposals made in 2017, DST received 214 research proposals from across the country. Out of 214 proposals received in SATYAM against 3rd call, 17 Projects have been recommended for financial support. The 4th Call for Proposal for 2018-19 was also made in second half of 2018 and DST received 456 proposals which are in process of scrutiny. The budgetary support to the recommended cases will be extended during 2019-20.

Support for Conferences/Workshops:

- i. **Fourth Annual Conference of the Association for Cognitive Science (ACS):** The 5th Annual conference of ACS was organized by Indian Institute of Technology, Guwahati to provide a forum for exchange of ideas and research results followed by fostering interaction and discussion among all participants including graduate students, Ph.D scholars and Post Docs with faculty working in Cognitive Science and related areas.
- ii. **International Symposium on Bilingualism and Cognition (ISBC-2018):** The symposium was organized at Birla Institute of Technology and Science, Goa. Core themes of the symposium were to discuss the effects of bilingualism on cognitive functions like speech, rehabilitation through speech therapy, memory, investigating the science of bilingualism, etc.
- iii. **International Conference on Cognitive Science and Artificial Intelligence:** The conference was organized at Institute of Bioinformatics and Computational Biology, Visakhapatnam. The focus of this conference was on knowledge sharing on advancement of Artificial Intelligence and Cognitive Science.

CAPACITY BUILDING OF R & D INSTITUTIONS

FIST

Objectives: “Fund for Improvement of S& T infrastructures in Universities and Higher Educational institutions” (FIST) Program was initiated by the Government during FY 2000-01, to facilitate support towards augmenting higher education and research largely at the University and Academic sectors by augmenting basic infrastructural facilities for teaching as well as for conducting research in basic or applied science areas. The Program has enabled many Departments across the country to perform cutting edge competitive research activities and establish modern teaching facilities.

Currently, the Program is operated in competitive mode of support at four levels i.e. Level 0, Level 1, Level II and Level III covering six subject areas (Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth & Atmospheric Sciences, Mathematical Sciences) and PG Colleges. While support under Level 0 is provided to all PG Science & Applied Science Departments as a composite project in “Colleges as a whole” mode, supports under Level I/ Level II/ Level III are meant for Science/ Applied Science Departments of Universities / Academic Institutions. The financial support circumscribes four basic purposes i.e. Equipment, Networking & Computational Facilities, Infrastructural Facilities and Maintenance. Depending on the level, the total financial support is limited to Rs 1.50 Crore, Rs 3.0 Crore Rs 10.0 Crore and Rs 20.0 Crore for Level 0, Level I, Level II and Level III, respectively.

For self-financed post-graduate departments and Private Universities/ Academic Institutes including PG Colleges, support shall be considered only for research, having at least 50% research students in the Department/ PG College pursuing their PhD as full time Research Scholar and receiving their fellowships either by virtue of NET/GATE qualification or holder of Institute/any other agency fellowship and such department/ PG College would also need to contribute 50 % of total recommended budget. Thus, the recommended support is to be shared in 50:50 basis mode for the private Universities/ Academic Institutes/ PG Colleges.

Initial period of every year, fresh proposals are invited from eligible S&T related Departments and PG Colleges, through advertisements, for consideration of support under this Program. The selection of the

Departments/ PG Colleges is through a peer review mechanism and visit to the Department, if necessary. There is a two tire mechanism adopted under the Program i.e. Screening and Presentation of proposals before the seven Subject Expert Committees followed by final recommendations by the FIST Advisory Board. So far, nearly 2817 S&T departments and PG colleges (Level 0- 462, Level I- 2106, Level II- 248 and Level III- 01) have been supported with a total investment of about Rs 2850 crores.

Outcome: Ever since its inception, the FIST Program has provided sustainable funding over more than a decade that has made deep impacts in many departments across the country to carry out advanced research in contemporary areas of science and technology and also set-up modern teaching facilities. FIST Program has been instrumental in establishing state-of-the-art facilities for performing high end research and has thus benefited academicians and researchers across the country. Some of the major facilities installed/ recommended for support under the Program are: Micro CT, Micro-scale thermophoresis, Reflection High Energy Electron Diffraction, Femto-second Ultrafast Spectrometer, Scanning Near Field Optical Microscopy, Electron Probe Micro Analyzer, High Resolution Transmission Electron Microscopy, FIB Based Scanning Electron Microscope, 600 MHz NMR, Thermo-Mechanical Stimulator, Hyper-spectral Imaging System and X-ray photoelectron spectroscopy (XPS) etc. domain

The realm of the FIST Program has benefited many prestigious medical/ veterinary/ paramedical institutions in the country like All India Institute of Medical Sciences, New Delhi; Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow; Postgraduate Institute of Medical Education and Research, Chandigarh; Maulana Azad Medical College, New Delhi; University College of Medical Sciences, Delhi; Mahatma Gandhi Institute of Medical Sciences, Wardha; JIPMER, Pondicherry; Christian Medical College, Vellore; Cancer Institute, Chennai; All India Institute of Speech and Hearing, Mysore; Institute of Post-Graduate Medical Education & Research, Kolkata etc.

Further, several departments of renowned Agricultural Universities have been regular recipients of the FIST Projects both at level I and II. This Program has significantly contributed to the enhancement of teaching and research infrastructure in many Universities including Assam Agricultural University, Jorhat; University of Agricultural Science, Bangalore; University of Agricultural Science, Dharwad; CCS Haryana Agricultural University, Hisar; CSK Himachal Pradesh Krishi Viswavidyalaya, Palampur; Dr Y S Parmar University of Horticulture & Forestry, Solan; Punjab Agricultural University, Ludhiana; Tamil Nadu Agricultural University, Coimbatore; GB Pant University of Agriculture, Pantnagar etc..

Alongside facilities for capacity building of teaching and research, computational facility is also provided to the departments supported under this Program. The Program has promoted Communication Technology based infrastructures such as Grid Computing, Networks and Communications systems, Cloud Computing infrastructure in many engineering departments. Several departments across numerous Universities and many PG Colleges have also been supported with grant to acquire Books for the Departmental/ College library.

More than 450 PG Science/ Engineering/ Medical Colleges have undergone rejuvenation of teaching and research facilities during the last seventeen rounds of support.

Promotion of University Research and Scientific Excellence (PURSE)

Objective: Department of Science & Technology (DST), New Delhi has proactively initiated a scheme “**Promotion of University Research and Scientific Excellence (PURSE)**” during 2009. The scheme was initiated with the purpose of building the research capacity of Indian Universities. The main objective

of the scheme is to pro-actively support for strengthening the R&D base of the performing Universities in the country with adequate financial support and associated flexibility. It is formulated on the basis 10 years aggregate publications and h-index towards creating and nurturing the research ecosystem among performing universities in the country

Under this program large investments have been made to encourage, nourish and sustain research performance of the leading universities. The grant released in the scheme is for augmentation of research infrastructure at the University level. The Universities supported under the PURSE scheme are provided immense flexibilities with respect to choice of budget projection and selection of equipment required for conducting research etc. Under the PURSE initiative support is provide to acquire research equipments, research man-power cost, augmentation of computational facilities, establishing research infrastructure, acquiring research consumables, fund for travel, organizing workshops and conferences, contingencies and maintenance of the facilities._

Criteria: Pro-actively DST announces quantum of funds to an University based on Study Commissioned by DST for assessing the performance of Universities in the country with respect to their 10 years aggregate Research performance in terms of h-Index & Publications through SCOPUS Database. So far based on 4 different studies, 50 performing universities whose h-index ranging from 70 to 26 have been supported/ identified ranging from Rs 30.0 Crores to Rs 6.0 Crores for 4 years period. The list of Universities supported under PURSE is at Annexure -1.

Table- 1: Criteria for Support in PURSE Program

Initial h-Index	Revised h-index	Research Grant for 4 years
More than 50	More than 70	Category A (Rs 30.0 cr.)
40-49	60-69	Category B (Rs 15.0 cr.)
30-39	50-59	Category C (Rs 9.0 Cr.)
26-29	45-49	Category D (Rs 6.0 cr.)

Monitoring Mechanism: DST has re-constituted Program Management Board (PMB) to guide the DST on PURSE and to review the progress in PURSE Project at performing universities. Regular reviews of the PURSE Projects at various Universities have been performed. The monitoring has been further strengthened by introducing recently another review process at the University site under the chairmanship of the concerned Vice-Chancellor of the University.

Review of the Scheme: The scheme was reviewed in the month of November 2016 by the Program Management Board (PMB) under the Chairmanship of Dr Krishan Lal, Ex-President, INSA, New Delhi duly constituted by the competent authority of the DST. PMB strongly recommended continuation of the PURSE program.

Recently, DST had commissioned a study with Elsevier using SCOPUS database for studying performance of universities and academic institutes for the period 2002-2012. Based on the recommendations of the Program Management Board (PMB) on PURSE, 30 Universities have been identified by the department to consider of varying quantum of support depending upon the h-index value. This includes 6 new Universities in this list and dropping of 6 Universities supported in previous round based on their performance. These 30 Universities will be supported under PURSE for their 2nd round of support (first 24 Universities) at

a total planned investment of Rs 350 cores for 4 years'. The support to select all 30 Universities will be made available in the current financial year along with the second round of support to the ongoing set of fourteen Universities.

Outcome: PURSE Scheme has provided a triggering mechanism for promoting publication oriented research in the University sector deploying evidence based approaches. There has been significant increase in R & D outputs in PURSE supported Universities. Performance for the period of 1996-2006 and 2000-2010 for Set of 14 Universities has also been compared. Publications of this group of 14 Universities have increased by nearly 34% i.e. from 45421 to 60773 and h- Index increased from 540 to 881 in 4 years. Similarly, the increase in publications is about 60% i.e. from 40036 to 63880 for the period of 1998-2008 and 2002-2012 for another set of 30 Universities and h- Index also increased from 970 to 1548 in that corresponding period of 4 years. In the last 4 years, an amount of Rs 308.0 crores has been invested on 44 premier Universities under this Program.

Sophisticated Analytical Instrument Facility (SAIF)

SAIF program is being implemented by the department to provide the facilities of sophisticated analytical instrument to the research in general and specially from the institutions which do not have such instruments to enable them to pursue R & D activities requiring such facilities and keep pace with development taking place globally.

Currently, 15 SAIF Centres are operating in the currently. These are mostly located in Academic Institutions or Research Organisations with Grant-in-Aid support from Government through DST.

These facilities have been utilized by over 19,000 users, over 1,10,000 samples have been analysed, about 40 Workshops/Training Programs have been conducted, over 1290 Publications have come out from the users of these facilities. These facilities have also generated a revenue of about Rs.10.40 Crores during 2017-18. These figures are expected to increase during the F.Y. 2018-19.

Efforts are being made to augment the existing Facilities/Centres with replacement of existing obsolete instrument and with addition of latest State-of-Art instruments.

In order to expand the existing SAIF Program, action has been initiated to set up 4 New SAIF Centres in different regions of the country. These Centres would have latest instruments for cutting edge Research. The investment would be around Rs.500 Crores for a period of 3 years. The selection of such Centres would be through a competitive mode of selection process.

STATE SCIENCE & TECHNOLOGY PROGRAMME

This Department has been playing a proactive role by encouraging Central/State academic institutions & laboratories through providing location specific S&T related interventions under State S&T Programme at the State level to achieve specific S&T objectives of States. State S&T Programme (SSTP) provides core support to the State S&T councils besides providing funding support for location specific research, technology development and demonstration. The programme also supports studies and surveys on local S&T related issues etc.

During the FY 2017-18 & current financial year till date, the major achievements under the programme are as follows:

1. 28 State Councils for S&T were supported by providing grant in aid of Rs. 22.15 Crores.
2. 36 new projects/ programmes were supported to address the State Specific S&T challenges including S&T surveys and studies.
3. The process initiated for establishment of 2 new Technology Demonstration Centres (TDC) at:
 - 1) Arunachal Pradesh State Council of Science & Technology (APSCST), Dept. of Science and Technology, Govt. of Arunachal Pradesh, ESS Sector, Maung- phi Complex, Itanagar- 791 113.
 - 2) Tamil Nadu State Council for Science and Technology, DOTE Campus, Chennai – 600025, Tamilnadu.
4. The Annual Conclave of the State S&T Councils was organized at State Council for Science Technology & Environment, Shimla, Himachal Pradesh during 7th-8th June, 2018 to review the progress of ongoing activities of various State S&T Councils in the country. Around 27 States participated in the Conclave and discussed the future course of actions to be taken for S&T development in States.
5. A Standing Finance Committee (SFC) was constituted for the formulation of the SFC document of the State Science & Technology Programme under chairmanship of Secretary, DST. The Committee recommended for the continuation of the programme for a period of 3 years from 01.04.2017 to 31.03.2020 with a total budget of 186.0 Crore.

PATENT FACILITATION CELL PROGRAMME

Department of Science & Technology (DST) have established Patent Facilitation Cell (PFC) in TIFAC in the year 1995 and subsequently 24 Patent Information Centres (PICs) in various states under Patent Facilitation Cell (PFC) programme of the Department, for creating awareness and extend assistance on protecting Intellectual Property Rights (IPR) including patent, copyright, geographical indication etc. at state level. These PICs have also established Intellectual Property Cells in Universities (IPCU) of their respective states to enlarge the network. As of now 71 IPCU's have been created in different universities of the states. In addition, they are also liable to provide assistance to the inventors from Govt. organizations, State Universities, Govt. industries for patent searches to find out the potential and assessment of the invention.

During the FY 2017-18 and current FY till date, the following major activities were carried out:

1. The financial support provided to the 24 Patent Information Centres established at various State Councils in the tune of Rs. 2.5 Crore.
2. The Annual Review meeting of the Patent Information Centres established at various State Councils for S&T was organized at Assam State Council for Science & Technology, Guwahati during 31st Oct'2018 to 1st Nov 2018 at Hotel Parag, GS Road, Guwahati to review the progress of the various State S&T Councils in the country.
3. A Standing Finance Committee (SFC) was constituted for the formulation of the SFC document of the Patent Facilitation Cell Programme under the chairmanship of Secretary, DST. The Committee recommended for the continuation of the programme for a period of 3 years from 01.04.2017 to 31.03.2020 with a total budget of 17.0 Crore.

4. Various awareness programmes, sensitization workshops, regional workshops, national workshops organized to create awareness on national intellectual property right policy among the stake holders.

POLICY RESEARCH

The Department is mandated to develop and deliver public policy support for the promotion of R&D in the country. Science, Technology, and Innovation (STI) are recognized to play a significant role in advancing human, social, and economic development to meet the aspirations of people. To understand STI processes and exploring ways to strengthen them and link this to make effective policies making, five DST-Centers for Policy Research (CPRs) established in academic institutions across the country were given continued support. These centers are engaged in targeted research in number of key areas relevant to the country, train young scholars in STI policy research, and contribute towards better STI policy making by providing inputs to Government's agencies/departments. It is expected that the conducive policy environment will give a major push for the country to gain global leadership in S&T. The DST-CPRs are also engaging itself with stakeholders, national and international experts and others to develop policy related papers. Apart from this, STI Fellowships at post-doctoral level was announced to generate a critical mass of policy researchers. It has provided an opportunity to develop the skills of young-scientists and engineers who are interested in engagement with the STI policy domain and/or as STI policy researchers.

During the year, all the DST-CPRs have continued its ongoing work on research related to their thematic areas. They also organised conferences/seminars/meets involving scientists engaged in industry oriented research, societal sectors etc. A discussion cum review meeting of the above Centres was organised at Indian Institute of Technology, Delhi. During the meeting, discussions were made on the progress in the various research activities that have been entrusted with the five DST-CPRs. A review of the ten ongoing STI Fellows was also conducted at IIT Delhi. A discussion meeting of the national level Expert Panel constituted for drafting Policy on *Technology led Innovation* was organised at IIT Delhi. To generate a critical mass of policy researchers, four new STI Fellows at post-doctoral level were selected.

Following three research studies have been completed by DST-CPRs and the publications have been launched by Dr. Harsh Vardhan, Hon'ble Minister for S&T on May 11, on the occasion of National Technology Day held at Vigyan Bhawan, New Delhi.

- i. Enhancing S&T-based Entrepreneurship: The Role of Incubators and Public Policy
- ii. STI for Inclusive Growth in India: Building Strategic Perspective from Evidences,
- iii. Mapping of a Patents and Research Publications of Higher Education Institutes and National Research Laboratories of India

The Department participated in ASIAN STI THINK TANKS NETWORK (ASTN) Roundtable and 4th Asian Innovation Forum meetings during July 09-11, 2019, co-hosted by Korea Institute of S&T Evaluation and Planning (KISTEP) and S&T Policy Research and Information Center (STPI) at Taipei, Taiwan. To understand USA's Science & Technology Landscape, Science & Diplomacy, a one week experiential visit for STI Postdoctoral fellows was organised to American Association for the Advancement of Science, Washington DC, USA. They also visited to National Institute of Health (NIH) and National Science Foundation (NSF), USA.

Strengthening STI information system

Centre for Human and Organisational Resource Development (CHORD) division formerly National Science & Technology Management Information System (NSTMIS) continued its efforts of generating and making available information on resources both manpower as well as financial devoted to scientific and technological (S&T) activities by conducting national surveys both through in-house as well as sponsored studies.

i.. S&T Resources Studies

The National Survey 2017-18 on resources devoted to research and development activities was launched in online mode. The survey outcome would lead to the next issue of national publication “**Research and Development Statistics**” which serves as an evidence base for the policy formulation in the S&T sector.

The division brought out the publication entitled ‘**Directory of R&D Institutions 2018**’, eleventh in the series, containing list of around 6862 R&D institutions with complete addresses arranged alphabetically by S&T sectors. The Directory is widely used by professional engaged in policy making, planning science, administration, industry, teaching and research apart from other stakeholders active in S&T sector in the country.

Bibliometric Studies were commissioned on India’s research output, collaboration and comparative performance based on the global databases SCI and SCOPUS to bring out a new set of Bibliometric Indicators for the time window 2011-2016. These studies/reports are expected to be finalized this year and would serve as an evidence base leading to evaluation and monitoring of scientific research for policy planning.

A brainstorming session on “**Guidelines on Ethical Practices in Bibliometrics**” was held at University of Hyderabad, Hyderabad in September, 2018 with various stakeholders and experts to discuss various issues including strategies to combat menace of Predatory journals affecting the Indian scientific research publications. The outcome of the BSS led to many important suggestions such as formation of a regulatory body (representing a consortia of various stakeholders) on good practices in research publishing, alternative mechanism of publishing research papers by public research organizations, use of advanced technology etc.

Another brainstorming session was held at Udaipur in July, 2018 with experts on **Social Scientific Responsibility (SSR) in S&T** to discuss various issues such as definition, different types of SSR activities, level/mode of operation, measurement/developing suitable indicators etc. This has led to evolution of study proposal for assessing existing status of SSR in India, documentation of best practices, its impact and associated policy recommendations.

Considering the importance of innovation, the department is planning to launch the next **National Innovation Survey (NIS)** in collaboration with UNIDO, Austria. A series of meetings were held with stakeholders and experts to discuss various aspects of the NIS proposal submitted by UNIDO so as to build synergy with relevant stakeholders, avoid overlaps and explore possibility of its co-funding.

ii. S&T Policy

The Division framed a Draft Policy Document: **Scientific Research Infrastructure Sharing Management and Networks (SRIMAN)** after detailed deliberations with experts and stakeholders in the S&T sector. The policy primarily focuses on access and sharing apart from addressing issues such as procurement, maintenance, disposal, capacity building etc., for effective utilization of public research infrastructure in all scientific departments and research organizations. The first Steering Committee meeting towards finalization of Draft SRIMAN Policy Document was held on 14th November, 2018 in New Delhi to be followed by series of workshops with stakeholders across the S&T sector leading to finalization of the Policy Document.

iii. Information System/Database Activities

With a view to disseminate information on sponsored research and development (R&D) projects for the benefit of different stakeholders, NSTMIS since 1990-91, has been continuously engaged in compiling information on extramural R&D projects funded by various central S&T agencies and publishing an annual *Directory of Extramural R&D Projects*. The latest directories “**Directory of Extramural R&D Projects**” for the years **2015-16 and 2016-17** are being compiled and would be published together during this year.

iv. NSTMIS Sponsored Studies

As a part of its outreach research programme, NSTMIS has sponsored several research studies/projects to various stakeholders viz. research institutions, universities, colleges, NGOs and consultancy organizations spread across the country. At present, there are 80 ongoing projects out of which 30 new projects are initiated and 7 projects got completed during 2018-19. Network projects involving multiple agencies are being evolved and catalyzed by conducting Brainstorming Sessions (BSS) in areas such as **Impact of Government Policies on Improvement of Status of Women in Science** and **Impact of DST-FIST programme**.

The completed project reports/studies are available in public domain through a **web-based digital repository** (<http://www.nstmis-dst.org/NSTDRepository.aspx>).

v. International Collaboration\

The Department has actively participated and contributed in the UNESCO Institutes of Statistics (UIS) and Organization for Economic Cooperation and Development (OECD) meetings for the development and revision of standards/concepts/definitions used for collection of Science Statistics and development of Science, Technology and Innovation Indicators. The department also provided information for the country on Science & Technology Indicators to UNESCO Institute for Statistics for the Global database on S&T Indicators and other related publications such as UNESCO Science Report etc.

TRAINING OF SCIENTISTS AND TECHNOLOGISTS WORKING IN GOVERNMENT SECTOR

The Department of Science & Technology, in consultation with the Department of Personnel and Training, other scientific departments and various organisations initiated an ambitious project of human resource development namely, “National Programme for Training of Scientists & Technologists working in

Government Sector” during the X Plan to meet the challenges of national development and international competitiveness in S&T area. Considering the efficacy of the scheme, the Department decided to continue it through the XI, XII Plans and up to 2018-19 as well.

The target groups for the training are scientists/ technologists holding scientific posts/ working in scientific ministries/ departments, autonomous institutions, public sector undertakings (PSUs) research & development (R&D) institutions, research laboratories, universities of Central and State Governments and State Science & Technology Councils.

During FY 2018-19, thirty-six training programmes were held under the “National Programme for Training of Scientists & Technologists working in Government Sector” in which a total of about 800 participants benefitted from them.

Women Component Plan – Under this component of the scheme, nine programmes were conducted exclusively for women belonging to the target groups during FY 2018-19, in which about 250 participants benefitted.

RESEARCH & DEVELOPMENT

NANO SCIENCE & NANO TECHNOLOGY

Nano Mission is an umbrella programme to promote R&D in this emerging and active area of research. Its objectives can be broadly classified as follows:

- Basic Research Promotion (NSAG)
- Infrastructure Development for Nano Science & Technology Research
- Nano Applications & Technology Development Programmes (NATAG)
- Human Resource Development.
- International Collaborations
- Nano Regulatory Aspects

Highlights of Nano Mission Activities:

Reconstitution of committees:

- 1) **NATAG:** Merging of NATAG-POCC and NATAG into **NATAG** with an enhanced approval limit of Rs 250 lakh without Industry support and Rs 300 lakh with Industry support.
-The NATAG committee has inducted representatives from Industries too.
- 2) **NSAG:** Merging of NSAG-I & NSAG-II into **NSAG** with an enhanced approval limit per project to Rs 150 lakh.
-NSAG along with DBT & other members decided that proposals that are based on drug delivery and focus on pure biotechnology be, sent to DBT, so as to help decentralize and widens DBT's scope of funding those proposals.

Review committee on ongoing projects:

NSAG- A 3rd Party Review Committee meeting for *reviewing of 40 Nano Science & Nano Biology projects* was held. Out of 35 presentations 25 scored between Very Good & Good while 3 PIs scored an Excellent.

NATAG- A review meeting of nano technology – for monitoring of ongoing projects along with presentation of new proposals was held yesterday. 10 projects were reviewed, of which mostly scored between Very Good & Good and one was termed excellent in its performance.

Basic Research Promotion

During this year, so far:

- 1) Under NSAG (Nano Science Advisory Group), 2 meetings were held. A total of 22 new individual scientist-centric R&D projects have been recommended and supported through release of grants.

From the 2nd NSAG meeting 2 recommended proposals were referred to NMC out of which 1 has been duly approved for sanctioning.

- 2) Under NATAG (Nano Applications and Technology Advisory Group) this Year, out of 72 proposals, a total of 24 projects were recommended and most of them have been processed too.

Technology development & transfer:

Under Joint Institute-Industry Programme, as approved by NMC (Nano Mission Council), a project between IIT' Madras and Tube Investment of India limited (Industry partner), of the order of 10.9 crores, of which Industry is contributing INR 1.09 Crores (towards Manpower, Consumables and travel head) and IIT Madras would contribute INR 6.5 crores towards existing Equipment upgradation & for procuring some New Equipments

Human resources development:

1. Support for ongoing Post Graduate programmes [M.Sc./M. Tech in Nano Science & Technology] has continued at few institutions. However, the support would be discontinued from Apr 2019 onwards (as per recent NMC recommendations)
2. 14 Institutions with established research infrastructure and having established profile in Nano S&T in the country were chosen to implement a new programme titled Nano Science & Nanotechnology Visiting Associateship (NS&T-VA) – 3 Associates have been recently selected to get mentored at IIT' Delhi, CECRI-Karaikudi Lab & at IIT Guwahati.
3. Post-doctoral Fellowships (through Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore) – 3 Fellows have been sent under NATAG programme to 3 different laboratories to upgrade their knowledge base and hone skills to develop good proposals
4. Nano S&T Overseas Fellowship: While 2 Fellows are continuing their Fellowship, their terms have been further extended by a year. 3 more fellows are selected for Fellowship his Year.
5. *DST- CEFIPRA-ESONN Fellowship Programme*: Indo-French Centre for the Promotion of Advanced Research (CEFIPRA/IFCPAR) supported participation of 8 Indian PhD students for ESONN session 2018.

International Collaborations:

Under this collaboration, participants are supported to go abroad to utilize following facilities:

- 1) India-Japan Beamline Phase-II
- 2) Beam lines of ISIS neutron scattering facility at Rutherford Appleton Laboratory (RAL), UK
- 3) PETRA-III Synchrotron Radiation Facility at DESY, Hamburg, Germany: So far in this year we have successfully utilized 758 hours, using 24 beam lines. 74 Institutes/ Universities have used this facility of which 84 scientists got benefitted out of it.

Additionally, there are few more MoUs signed with other countries to utilize facilities.

Nano- Regulatory Aspects:

- 1) **Cooperation with DBT** on Nanobiotechnology Regulatory Aspects (*with focus on Nano Medicines/ Nano-Pharmaceuticals*)
- 2) **Cooperation with BIS (Bureau of Indian Standards)** towards Review of Standards as per the scope of Medical Biotechnology and Nanotechnology Sectional Committee, MHD 20
- 3) **Cooperation with MEITY:** Technical Review and Advisory Committee
(TRACs) for the Project “*Nanoelectronics Network for Research and Applications (NNetRA)*” discussing technical aspects and review procedure of projects related to Safety, Energy & Environment, Agriculture, Healthcare & Nano devices & Systems and Others

CLIMATE CHANGE PROGRAMME

Climate Change Programme aims at implementing two national missions on climate change i.e. (a) National Mission for Sustaining the Himalayan Ecosystem [NMSHE] and (b) National Mission for Strategic Knowledge on Climate Change [NMSKCC] launched under National Action Plan for Climate Change [NAPCC]

Major Achievements during 2018-19:

The following new programmes have been initiated/supported during the year:

- **National Network Programme on Urban Climate** is formulated to support studies in the area of urban climate change, its impact and adaptation, present state-of-the-art in dealing with the urban climate change issues. Total five projects have been supported under the programme in respect of 3 cities, Bengaluru (Inland), Bhubaneswar (Coastal) and Dehradun (Sub Himalayan).
- **Human and Institutional Capacity Building (HICAB)** programme, an exclusive pan-Himalaya National network Programme has been developed during the year. Total 18 proposals were recommended for support under the programme in the State of J&K, Himachal Pradesh, Assam, Arunachal Pradesh, Meghalaya and Manipur
- **National Network Programme on Climate Change & Himalayan Cryosphere:** In order to address the issue of Himalayan Cryosphere in a holistic manner a National network Programme on Himalayan Cryosphere has been developed during the year. Total 6 proposals were recommended for support under the programme.
- **State Climate Change Cells:** One of the deliverables of CC missions implemented by DST is to provide assistance to states for implementation of sustainable actions as outlined in their State Action Plans (SAPCCs) linked to NMSHE and NMSKCC missions. To meet this objective, DST initiated an institutional mechanism by setting up of State CC Cells. During the year three State CC cells in the State of Gujarat, Bihar and Assam have been recommended for support.

MEGA FACILITIES FOR BASIC RESEARCH PROGRAMME

This programme is aimed to create Mega Science facilities and launch Mega Science projects in and out of the country to improve access to such state-of-the-art facilities for the Indian scientific community,

especially from the academic sector. Because of technical complexities and requirement of large resources, such projects are manifestly multi-agency, multi-institutional and, most often, international in character. The Department of Science & Technology (DST) and the Department of Atomic Energy (DAE) have been jointly promoting most of such projects in the country. A brief statement of important activities undertaken in such projects is as under:

- Support towards construction of Facility for Antiproton and Ion Research (FAIR), Darmstadt, Germany continued during the year and implementation of the project gained further momentum both at the project site in Germany and in India. While the civil construction work moved ahead at the project site in Germany; the work on building in-kind accelerator and detector items, viz., power converters, vacuum chambers, beam stoppers, superconducting magnets and advanced detector systems in the country also gained further momentum.
- *Indian scientists and research students continued their participation in Compact Muon Solenoid (CMS) experiment, A Large Ion Collider Experiment (ALICE) and activities related to the LHC Computing Grid at the Large Hadron Collider (LHC), European Organization for Nuclear Research (CERN), Geneva and associated work in the country.*
- Support to 13 university groups for the India-based Neutrino Observatory (INO) related detector R&D and prototyping work continued during the year and the progress made in the projects was reviewed by an Expert Committee.
- Regarding the Thirty Metre Telescope (TMT) Project, the matter regarding Permit for Construction at the Mauna Kea site was decided in favor of TMT by the Supreme Court of Hawaii. In parallel, R&D and prototyping related to India's in-kind contributions —Segment Support Assemblies, Actuators, Edge Sensors, Segment Polishing and Segment Coating, Instrumentation (First Light Instruments) and Software (Observatory Software and Telescope Control Systems) —progressed further.
- Support to the Laser Interferometer Gravitational-Wave Observatory (LIGO) project continued during the year. Acquisition of land for the project and other preparatory activities like geotechnical, seismic and topographic studies at the project site in Hingoli district in Maharashtra progressed satisfactorily.
- The Square Kilometre Array (SKA) will be the most powerful radio telescope co-located in Australia and South Africa and it is an international venture. India has successfully participated in the design phase and process for participation in construction phase has started.
- Utilization of the twin Indian beamlines, XRD2 and XPRESS at the Elettra Synchrotron Facility, Trieste, Italy for carrying out frontline scientific research using diffraction techniques by the Indian scientific community continued during the year.
- Support to the Low-Energy Ion Beam Facility at Kurukshetra University and High-Fluence Ion Beam Facility at Allahabad University continued during the year and scientific studies utilizing these facilities have started.
- The process for seeking financial approval for the National Large Solar Telescope (NLST) project at Merak, Ladakh advanced during the year.

NATIONAL SUPERCOMPUTING MISSION (NSM): BUILDING CAPACITY AND CAPABILITY

The NSM was approved by the Government on 25th March, 2015 at a total cost of Rs 4500 crore over a 7-year period of implementation. The Mission is being jointly steered by the Department of Science and Technology (DST) and the Ministry of Electronics and Information Technology (MeitY) along with the Implementing Agencies viz. Indian Institute of Science (IISc), Bengaluru and Centre for Development of Advanced Computing (C-DAC), Pune.

The mission aims to enhance the research capacities and capabilities in the country by connecting them to the Supercomputer grid, with National Knowledge Network (NKN) as the back bone. The NSM intends to set up a grid of supercomputing facilities, using both “buy” and “build” approach at academic and research institutions across the country.

The NSM will be setting up 2 Supercomputer Systems under “Build” approach at IIT-Varanasi and IIT-Kharagpur before 31st March, 2019. The remaining 4 systems under Phase I are likely to be installed and operationalised before 31st May, 2019.

The Executive Board (EB) of NSM has approved five R&D proposals with four of them aiming towards Exascale Computing and one for developing indigenous cooling system for supercomputers.

Under development of Human Resources, Short term and Medium term training courses have been conducted along with 1 day HPC Awareness programmes. The C-DAC had successfully organised an Open ACC HPC Hackathon. For further proliferation of these courses, two HPC nodal centres have been identified.

The Executive Board (EB) of NSM has also 6 application programmes in the following areas:

Genomics & Drug Discovery; Urban modelling; Flood early warning and Prediction; Reverse Time Migration for Seismic imaging; CFD Application; and Materials & Computational Chemistry

The mission supports the government’s vision of “Digital India” and “Make in India” and would also generate highly skilled manpower for multi-disciplinary application development and also for meeting requirements of the scientific community.

INTERNATIONAL BILATERAL COOPERATION

1. The 24th edition of the DST-CII **Technology Summit** was held in New Delhi during October 29-30, 2018 with Italy as partner country. The Summit was jointly inaugurated by Union Minister for Science & Technology and Earth Sciences, Dr Harsh Vardhan and Italian Deputy Minister of the Ministry of Economic Development, Dr Michele Geraci. The Prime Minister, Shri Narendra Modi and the Prime Minister of Italy, Mr. Giuseppe Conte addressed the valedictory session of the Summit on 30th October 2018.
2. **Inter-governmental Agreement on Cooperation** in the field of Science, Technology and Innovation were signed with Denmark, Indonesia and Uzbekistan.
3. The Department of Science and Technology and the National Technological Innovation Authority of Israel have jointly established a US\$ 40m “India-Israel Industrial R&D and Technological Innovation Fund (I⁴ Fund)” for a period of five years to support joint R&D projects aimed to co-

develop innovative technology-driven products, services or processes that have potential for commercialization.

4. **Programmes of Cooperation** in S&T were concluded with Bulgaria, Czech Republic, and Denmark.
5. **Joint Commission/Committee Meeting for Science & Technology (S&T)** cooperation were held with Austria, Belarus, Brazil, Bulgaria, Denmark, France, Hungary, Italy, Netherlands and Ukraine.
6. **Bilateral meetings** to foster the research areas in the field of Clean Energy, Sustainable Agriculture, Renewable Energy, Metallurgy, Physics& ICT were held with Denmark, Egypt, Korea, Mexico, United Kingdom, and Uzbekistan.
7. Establishment of Indo-Korean Center for Research and Innovation (IKCRI) and Indo-Mexico Centre in areas of energy, water, food security and air quality was agreed to during Minister's visit from respective countries.
8. Under Mission Innovation programme, meetings were held with Swedish Minister for Innovation and Enterprise, Governor of Skåne, Director of Brazilian Innovation Agency (FINEP), Minister for Science and ICT of the Republic of Korea, Deputy Prime Minister of Uzbekistan, Mexico's Ambassador to India were held to identify potential areas of interest in domains covering clean transport, clean energy, smart grids, smart industry & advanced manufacturing, medical sciences, circular and bio-based economy.
9. Implementation of inward fellowships for the citizens of Afghanistan, Bangladesh, Bhutan, Maldives, Myanmar, Nepal, Sri Lanka and Thailand under India S&T Fellowships and to African researchers under CV Raman Fellowships to work in Indian Universities and Research Institutions.
10. Bilateral workshops/ symposia were organised with Germany, Italy and UK in the field of frontiers of engineering, multiple aspects of energy and medical field.

INTERNATIONAL MULTILATERAL AND REGIONAL S&T COOPERATION

DST continued to foster its S&T Cooperation with various Multilateral and Regional entities and also continued to engage with various Global S&T platforms. The significant achievements for the year 2018 are briefly described below.

BRICS Science, Technology and Innovation Cooperation (BRICS STI Cooperation)

Under the framework of BRICS Memorandum of Understanding in Science Technology and Innovation signed in 2015, more than 50 multilateral BRICS R&D projects with joint co-investment of about US\$ 20 million by eight BRICS STI funding agencies were supported. The 6th BRICS STI Ministerial on the theme: *Leveraging BRICS Science, Technology and Innovation to Enhance Inclusive Growth and Development* on 2-3 July 2018 at Durban, South Africa endorsed implementation of 31 new BRICS R&D projects under BRICS Framework Call for Proposal 2017 with India partnering in 26 projects, exploring the scope of establishing a 'BRICS Vaccine Research and Development Centre', BRICS partnership on New Industrial Revolution with focus on innovation ; BRICS Virtual Centre and Integrated Hub for BRICS Innovation collaboration on ICT and High Performance Computing; and a BRICS Technology Transfer Centre The meeting also favoured the idea of to explore permanent mechanism to coordinate and manage the growing numbers of BRICS STI activities.

As a step towards development of BRICS Global Research Advanced Infrastructure Network' (GRAIN), a BRICS Research Infrastructure platform/ Web Portal has been created that will include research infrastructures that countries voluntarily want to give access to stakeholders of other BRICS countries. Under BRICS collaboration on Astronomy, detailed proposals in the subject areas of optical transient network; neutral hydrogen cosmology; and big data as applied to large telescopes would be called. 27 Young Indian Scientist / Innovators participated in 3rd BRICS Scientist Conclave held in Durban (South Africa) during 25-29 June 2018, on the 3 themes namely Energy, Water and Use of ICT for Societal applications. One Indian innovator aged 23 years was awarded the “BRICS most promising Innovator” during the BRICS Young Innovators Award competition held during the Conclave. India also hosted the BRICS Young Scientist (YS) Conclave Alumni meeting at National Institute of Advanced Studies (NIAS), Bangalore during 2-3 December 2018.

India-EU STI Cooperation:

Under the framework of India-European Union (EU) scientific & technological cooperation agreement, both sides (DST and DBT from Indian side and Directorate of Research and Innovation from European Commission) agreed to co-invest € 30 million to support research and innovation in water sector focusing on drinking water purification, wastewater treatment and real time water quality monitoring. Under the Joint Call of Proposal 2017, 12 Proposals were recommended and 7 proposals were agreed for funding.

DST participated in the “MEA led delegation on “Brainstorming Session on elements of new European Union Strategy on India” hosted by European External Action Services in Brussels on September 17, 2018 and suggested upscaling India-EU STI partnerships with co-investment of higher level of resources. The Brainstorming Session concluded that Ideation, Innovation and incubation of startups (in Renewable energy, water, epidemics, advanced manufacturing, robotics, AI, healthcare); energy sector (smart grids Solar, wind, bio-fuels and hybrid technologies in the transportation) could be areas of India-EU collaboration. These collaborative areas will be discussed in the forthcoming 12th India_EU Joint STI Steering Committee Meeting to be held in New Delhi on March 1, 2019.

India-ASEAN STI Cooperation

1st ASEAN-India InnoTech Summit: The 1st ASEAN-India InnoTech Summit was hosted by India in New Delhi during 29-30 November 2018, inaugurated by Dr Harsh Vardhan, Hon'ble Minister of Science & Technology. The main objective of the Summit was to exhibit and build networks between Indian and ASEAN researchers. About 250 delegates from India and about 65 delegates from ASEAN Member States attended the event. Hon'ble Minister of Science & Technology announced that the InnoTech Summit shall be organized annually.

ASEAN-India Grass-root Innovation Forum event was organized in Jakarta, Indonesia during 27-30 September 2018. The event included Innovation Competition (Students and Grass-root Innovators) and a workshop on Innovation ecosystem in India and ASEAN. Two Innovators from India won second prizes in each category of Students and Grass-root Innovators. Seven India-ASEAN projects were awarded grants under ASEAN-India Science and Technology Development Fund (AISTDF) for period of 2 years in the areas of Physics, Material Sciences, Biotechnology and Electronics with a total funding support of about Rs. 1.5 Crore. 31 ASEAN School Children and Teachers participated in the 26th National Children Science Congress (NCSC) -2018 held at Bhubaneswar, Odisha during 27-31 December 2018.

Shanghai Cooperation Organization (SCO) S&T Working Group Meeting

Pursuant to India becoming a full member of Shanghai Cooperation Organization(SCO) and joining the SCO Agreement on Scientific and Technological Cooperation in 2017, The SCO S&T Working Group meeting held on 11-12 September 2018 in Beijing, China, finalized the draft Plan of practical measures (“Roadmap”) on Cooperation of Scientific Research Institutions of the SCO Member States for 2019-2020. This Roadmap has finally been adopted by all SCO Member States. The Roadmap envisages mobilization of resources for joint R&D projects, exchange of experts and scientists, exchange of experts and scientists.

DST initiative on Promoting Science Diplomacy:

Launch of the Joint Programme in ‘Science Diplomacy’: A joint Programme in Science Diplomacy was initiated by DST for implementation by the Research and Information System for the Developing Countries(RIS) New Delhi and the National Institute of Advanced Studies (NIAS) Bangalore, at a cost of Rs 151,50,000/- for three years. It aims at realizing the potential of science diplomacy in areas of critical importance for national development through, inter-alia, (i) enhancing capacity in science diplomacy, (ii) utilization of expertise in selected fields, (iii) providing policy inputs, and (iv) conducting research on strategic affairs in science and technology. RIS has since launched a Forum for Indian Science Diplomacy (FISD) and a web site (www.fisd.in), issuing new Alerts on Science Diplomacy.

Award of ‘ICTP Ramanujan Prize 2018’ to an Indian Mathematician

In order to Promote Mathematics in developing Countries and enlarge the Legacy of Ramanujan - the Great India Mathematician, the ICTP ‘Ramanujan Prize of US\$ 15000, instituted in 2005 by International Centre for theoretical Physics (ICTP), Trieste for outstanding contributions by Young Mathematician/ Statisticians from the developing countries, is being funded by the Govt of India (DST) since 2014. Dr. Ritabrata Munshi from Indian Statistical Institute (ISI) Kolkata/TIFR Mumbai) was awarded the 2018 Ramanujan prize in recognition of his work in Number Theory.

DST engagement with the Global S&T Platforms

DST engagement with STS Forum Japan: DST remained engaged with the Global S&T Platforms such as the Science and Technology in Society (STS Forum Japan) to influence the S&T landscape of the world. It participated in the 3rd STS Forum workshop on 28th February 2018 in New Delhi held on the theme of (1) Innovation and Entrepreneurship driven by S&T (it called for sharing of complementary strengths and experiences; jointly funded research, a Japan–India Fund for start-ups and Joint incubation of start-ups.) and (2) AI, Robotics and the Impact on Society(DST among others called for co-development and co-funding of start-ups and emphasized on the new technologies contributing to creation of jobs and meeting and sough Japanese technologies for India’s 21 Million differently able people.

DST also contributed to World Wide Development of Research Infrastructures and participated in the 11th meeting of the Group of Senior on the development on Global Research Infrastructures (GSO-GRI), hosted by the National Science Foundation, USA. It was decided to include ‘Laser Interferometric Gravitational Wave Observatory (LIGO) having a node in India, as a future case study of Global Research Infrastructures.

Research & Training Fellowship for Developing Country Scientists (RTF-DCS):

The 3rd Phase (2018-2023) of Research & Training Fellowship for Developing Country Researchers (RTF-DCS) was launched for another 5 years starting from April 2018 aimed at 60 Fellowships to developing countries scientists to carry out their research work at any of the Indian research/ academic institute/ university for a period of 6 months.

INNOVATION, TECHNOLOGY DEVELOPMENT AND DEPLOYMENT

TECHNOLOGY DEVELOPMENT PROGRAMMES

Advanced Manufacturing Technology (AMT): 37 new projects were sanctioned to promote development of advanced manufacturing technologies. A technology developed for recycling of Aluminum scrap through AMT has been transferred to industries. The newly developed method recycles aluminum scrap with existing facilities economically at higher efficiencies and reduced pollutants which involves adding of chromium, zinc, boron, manganese and strontium to aluminum that enhance the metal properties.

Waste Management Technologies (WMT): The stakeholder consultation meeting of Industrial Hazardous and Non- Hazardous Waste Management Technologies and a two day Sensitization workshop on Bio-Medical and Electronic Wastes Management Technologies was organized at Coimbatore on November 26th and 27th, 2018, and Vijayawada on December 10th and 11th, 2018 respectively under the banner of **DST's Swachhata action plan 2018-19** aligning to **Swachha Bharat Abhiyan**, Four Industry forums along with 150 scientific participants from academic and research organizations including IITs NITs and CSIR laboratories have been participated.

An eco-friendly technology for the recycling of plastic and metallic components from waste electric and electronic equipments developed with the funding support through (WMT) Program of DST has been successfully transferred to industry.

Sanitary Landfill Reclamation: A Scientific Advisory Committee (SAC) for Landfill Reclamation was formed on the request of Government of NCT. A site visit and a brainstorming meeting, to address the issues in dealing with Landfill Reclamation at Bhalswa SLF site was organised on 12th Oct. 2017 and for Ghazipur SLF site was organised on 15h Jan,2018. Detailed Scientific suggestions were submitted to the Delhi Government/Respective Municipal Corporation.

Science and Heritage Research Initiative (SHRI) envisages to engage experts from diverse fields for data capture and analysis to form new collaborations and provide viable technology to address cultural heritage related issues. 212 proposals were received against the call and 40 proposals were shortlisted for funding by the department.

Biomedical Device and Technology Development Program (BDTD): 17 new projects were sanctioned for development of biomedical devices. Some of the demonstrated technologies include: a non-invasive screening device based on spectroscopy for monitoring skin perfusion and collagen content in scleroderma, a rapid serological test kit for Paragonimiasis and its morphological identification, an amalgamated/single unit alveolar distractor implant system for oral rehabilitation and a 3-lead wearable continuous rechargeable ECG monitoring device for arrhythmia and ischemia detection.

Device Development Program (DDP): 11 new projects were sanctioned for development of new devices. The devices such as electronic nose for fish quality assessment, Compact Portable Scanning Tunneling Microscope, a high-volume PM_{2.5} impactor sampler for air quality monitoring, a system for converting nonwoven fabric into fruit bags & a mechanised technique for fruit bagging for horticultural application were successfully demonstrated.

Technology Development Program (TDP): 1 new project were sanctioned for development of novel technologies. A Brainstorming session to identify new areas of researchable technologies with respect to agricultural engineering was held on 18 June, 2018 at NASC Complex, New Delhi organized by Indian Society of Agricultural Engineers.

TECHNICAL RESEARCH CENTRES (TRCs)

Setting-up of 5 Technical Research Centres (TRCs) was announced during the budget speech of 2014-15. Accordingly, 5 TRCs were established in 5 DST institutions viz. Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum; International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad; Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru; Indian Association for the Cultivation of Science (IACS), Kolkata; and S.N. Bose National Centre for Basic Sciences, Kolkata during 2015-16. Brief on activities of these TRCs are as following:

Twenty eight applied R&D oriented projects are in progress in areas viz. Neuro-Prosthetic Devices, Cardiovascular Devices, Hard Tissues Devices, Biological and Combinational Products and Product/Material Evaluation/Support at SCTMIST.

Sixteen R&D projects are in progress in the areas viz. solar energy (concentrated solar-thermal power, photovoltaic), energy storage (batteries and super capacitors), energy efficiency (motors, waste heat recovery, magnetic refrigerator, turbines and coatings), energy conversion (fuel cells) and electric/hybrid vehicle systems (involving Li-ion batteries with battery management systems, electric motors etc.) at ARCI. 14 Indian industries have expressed interest in these technologies.

Eight applied R&D projects are in progress in the areas viz. Application of SERS for non-PCR based RNA/DNA detection of HIV, Development of diagnostic probe/agents for Alzheimer's disease (in-cellulo studies), Materials and devices for 'Waste heat to electrical energy' conversion, Diagnostics for Candida species detection in clinical samples, etc. at JNCASR.

Applied R&D projects are in progress in four areas viz. Quantum materials for application; Materials for energy and environment; Polymers, disordered, soft and nano-bio materials for devices, diagnostics and therapeutics; and Molecules understanding, making and exploring commercial viability at IACS.

Applied R&D projects are in progress in four areas viz. non-invasive diagnostics; environment; mitigation of food adulteration and food security; and Metal and alloy industry at S.N. Bose National Centre for Basic Sciences, Kolkata.

CLEAN ENERGY RESEARCH INITIATIVE

Clean Energy Research Initiative (CERI) aims to develop national capacities and capabilities in developing research led competitive and cost effective clean energy and energy efficiency options for power and non-power applications. The areas of research are identified through stakeholder consultation based on national needs. The research spectrum covers entire gamut of clean energy viz. smart grid, off grid, energy storage, building energy efficiency, cleaner fuels, clean coal and energy materials. It supports both upstream end of research where knowledge, more advanced than the current practice in the industry finds a space. It also envisages to successively enhance Technology Readiness Level (TRL) of promising options in partnership with industries and other stakeholders. The programme has close linkage with concerned line ministries

and stakeholders for identification of research needs. During the year 2018-19, several new dimensions were added to the programme to accelerate the pace of clean innovations to meet national needs, which are as under:

1. New Initiatives:

1. Hon'ble Union Minister for S&T and ES Dr. Harsh Vardhan inaugurated India's first supercritical Brayton Cycle CO₂ test facility at IISc which has the potential to pave the way for highly efficient compact power plants driven by wide range of heat sources including Solar.
2. A programme to develop low global warming potential refrigerants and efficient cooling solution was formulated.
3. A National Centre for Development of Advanced Materials and Manufacturing Processes for Clean Coal Technologies for Power Applications has been supported to develop processing and fabrication technologies namely, coating welding machining and new materials for the high performance power generating systems (HPPGS) in coal based power plants.
4. A Pilot Project having Smart Control Architecture with Real Time Smart Meter Data has been setup at the corporate office of Bangalore Electricity Company Limited (BESCOM). The system architecture has the ability of intelligent monitoring of consumer load on distribution network. Activation /De-activation of the load can be done remotely to have better assets management.
5. A project on demonstration of MW scale solar energy Integration in weak grid using Distributed Energy Storage architecture (D-SIDES) project under Mission Innovation Challenge on Smart grids was launched at IIT- Roorkee.

1. New Launches and Events

1. DST participated in "International Conference on Sustainable Biofuel 2018" on 26th-27th February, 2018 at Indian Habitat Centre, New Delhi, India and showcased models developed under the aegis of DST such as 'Surya Jyoti – Micro Solar Dome'.
2. Smart Grids R&D Conclave was organised on 27th August, 2018 at IIT Delhi, New Delhi to create possible collaboration among academic institutions, utilities and industries to exploit for its commercialization and deployment in real time.
3. Swachhta Pakhwada" exhibition & expert's talk was organised on 7th May to 10th May, 2018 at DST. (Water & Energy).
4. DST participated in World Environment day 2018 at Vigyan Bhawan, New Delhi, India and showcased Clean Energy models developed under the aegis of DST such as 'Surya Jyoti – Micro Solar Dome'.
5. DST represented India in the Renewable and Clean Hydrogen Challenge of Mission Innovation at Berlin, Germany.
6. An "Indo-UK collaborative technical workshop" on joint clean energy centres was held during 18th-20th September 2018 at Loughborough, United Kingdom The three joint virtual centers supported by India & UK disseminated their strategy to achieve advanced hybrid microgrids

capable of operation in grid connected & isolated mode with seamless mode transition.

- Two regional events were held on December 11, 2018 in Mumbai and December 13, 2018 in Chennai to create awareness on the Global Cooling Prize, the technical criteria for the prize and evaluation process of the prize.

II. Reports

- Prepared a compendium on Smart Grids Innovation Challenge and Synergy on a global outreach report on Smart Grids. The compendium and synergy was released by Hon'ble Minister for Science and Technology, Forest and Climate Change and Earth Sciences, Dr. Harsh Vardhan on 22nd May, 2018 at Copenhagen, Denmark.

WATER TECHNOLOGY INITIATIVE

DST is implementing an initiative on Water Technology research and innovations to find out appropriate technological solutions through field level interventions to demonstrate technical, social, environmental and eventually economic sustainable solution for water challenges. DST is supporting research and technology development in various water related areas. The research outcomes are expected to feed in and dovetailed with major national missions. DST moved into a thematic call based approach for soliciting proposals in identified water challenges of relevance to country. Several achievements made during the FY 2018-19 are as under:

I. New Initiatives/ Projects

- An IoT based integrated water management project having innovative water harvesting in situ quality and quantity sensing and monitoring and novel water disinfection and treatment system has been initiated in 16 villages of Buhana Panchayat in Jhunjhunu, Rajasthan.
- A Water Innovation Centre has been initiated for Sustainable Treatment, Reuse and Management for Efficient, Affordable and Synergistic solutions for Water at IIT Madras with eight partnering institutions.
- Demand Driven Mission projects for supply of clean drinking water through IoT based solar powered station at a large village in Haryana facing brackish water challenge through automated dispensing and improving the water table has been initiated.
- A Water Innovation Centre has been established under WTI for “**Water Innovation Center: Technology, Research & Education (WICTRE)**” by Indian Institute of Technology Bombay, Mumbai. The lead organisation is Indian Institute of Technology Bombay and has three partnering institutions named National Chemical Laboratory Pune, IIT Hyderabad and PDPU Gujarat in the networking virtual Water Innovation Centre that aims to create awareness about water contamination/purification along with to work on mapping of water stressed areas which are ecologically diverse, development of economical sensors for various chemical, physical and biological contaminants and understanding the microbial diversity and structure of the impacted waters. .
- A call inviting proposals on “Optimum Water Use in Industrial Sector” received 118 from premier institutions and organisations across the country.

II. Technology Solutions

1. 39 solution providers have been enrolled for various desalination technologies.
2. IIT Kanpur along with MNIT Jaipur and MBM College of Engg, Jodhpur have set up a pilot plant of 10 KLD capacity comprising sensitive photo catalytic filters for visible light catalysis and carbon nano-mat fiber filter for treatment of the effluent of Common Effluent Treatment Plant, in Jodhpur.
3. A research programme on Optimal Operation of Water Distribution Networks has resulted in development and deployment of a low power wireless sensor and actuator network for monitoring and control of water distribution networks in IIT Madras. The network consists of low cost water level measurement modules (remote node), relay nodes, gateway nodes and actuator nodes. This model will now be replicated in multi village and industrial township schemes.

Mitigation of Air Pollution

Air pollution is a major risk factor for heart disease, stroke, chronic obstructive pulmonary disease (umbrella term for several progressive lung diseases including emphysema) and lung cancer, and increases the risks for acute respiratory infections and exacerbates asthma. Air pollution in India is a serious issue with the major sources being fuelwood and biomass burning, fuel adulteration, vehicle emission and traffic congestion. DST is also making concerted effort in R&D towards mitigation of air pollution.

I. Meetings/ Review meeting

An Expert Panel meeting was held on May 07th, 2018 at IIT Delhi to support the projects on mitigation of Air Pollution; A meeting was held on 1st July, 2018 at IIT Delhi, New Delhi on Air pollution “Technology Solutions for Mitigating Air Pollution”; A meeting was held on 2nd July, 2018 at DST, New Delhi on Air pollution “Demonstration and Assessment of Technologies for Air pollution control equipment”; An Expert Panel meeting was held on 9th July, 2018 at IIT, New Delhi on Air pollution “Technology Solutions for Mitigating Air Pollution”; The meeting of committee for “Evaluation of Differential Optical Absorption Spectroscopy (DOAS) Technology / Methodology for Monitoring of Ambient Air Pollution” was held on 24th May, 2018 at CPCB, New Delhi.

II. Technologies Developed

An air pollution mitigating device **WAYU (Wind Augmentation and purifying Unit)** was inaugurated by Hon’ble Union Minister **Dr. Harsh Vardhan** at ITO intersection and Mukarba Chowk on **25th September, 2018**. WAYU helps in reducing ambient air pollution levels ejected by vehicles at places, which have high concentration of pollutants. WAYU can reduce PM10, PM2.5, CO, VOCs, HC emitted in the atmosphere. The cost of device is Rs.60, 000 per device with a maintenance cost of Rs.1500 per month.

DRUGS AND PHARMACEUTICALS RESEARCH PROGRAMME

The Drugs and Pharmaceuticals Research Programme (DPRP) has being setup for promoting Industry – Institutional collaboration in the sector of drug and pharmaceuticals. This programme aims at enhancing capabilities of institutions and Industry towards development of New Drugs in all systems of medicine. The specific objectives of this scheme are:

- To synergize the strengths of publicly funded R&D institutions and Indian Pharmaceutical Industry in developing drugs in areas of national relevance;
- To create an enabling infrastructure, mechanisms and linkages to facilitate new drug development; and
- To stimulate skill development of human resources in R&D for drugs and pharmaceuticals.

Under this programme during the financial year 2018-19, a call for proposals were made, against which 159 proposals were received by the division. These project proposals were shortlisted through Internal Screening Committee and the screened-in proposals were evaluated by the Expert Committee of DPRP. The Expert Committee recommended financial support to be granted to 22 project proposals.

For ongoing project, clinical trials are being conducted at the designated sites as per the approved protocol on “A clinical drug development programme to evaluate and compare safety and efficacy of new regimens of Lifecare’s Liposomal Amphotericin B (FUNGISOME™) alone or in combination with Miltefosin compared with Single Dose Treatment Regimen of AmBisome® for Visceral Leishmaniasis in India” by Lifecare Innovations Pvt. Ltd., Gurgaon.

INTERDISCIPLINARY CYBER-PHYSICAL SYSTEMS

The Union Government has approved the National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS) on 6th December, 2018 at a total out lay of Rs. 3,660 Crore for a period of five years.

The main objectives of NM-ICPS are:

- i) To promote basic and translational research in CPS technologies.
- ii) To develop and demonstrate CPS technologies, prototypes and associated applications, keeping in view national priorities.
- iii) To increase the number of scientists and technologists to cater to present and future needs of the country and to generate skilled workforce in these emerging areas.
- iv) To create innovation, incubation and start-up ecosystem in CPS technologies.
- v) To establish and strengthen the international collaborative Research.

The Mission targets the establishment of:

- 15 Technology Innovation Hubs (TIH) to focus on generation of new knowledge through basic and applied research in areas that is mandated to them. TIHs will be the source for fundamental knowledge/ technologies that will be needed to keep India prepared for the next generation of technologies.
- 6 Application Innovation Hubs to carryout translational research and work with Line Departments to develop prototypes, product development and implementations.
- 4 number of Technology Translation Research Parks (TTRP) with a focus to deliver products/ technology ready for deployment or commercialization, picking up from any of the previous technology readiness levels (TRL).

New directed research programme on “Quantum Information Science and Technology (QuST)”:

ICPS Division has initiated a new directed research programme on “Quantum Information Science and Technology (QuST)” with the following broad objectives:

- Development and demonstration of quantum computers.
- Development and demonstration of quantum communication & cryptography.
- Development of quantum-enhanced and inspired technology.
- Development of advanced mathematical quantum techniques, algorithms and theory of quantum information systems.

Quantum enabled Science & Technology (QuST) programme were evolved and cluster based networked programme has been developed.

Indian Heritage in Digital Space (IHDS):

The project has generated methodologies and technology for digital preservation and presentation of tangible and intangible heritage. These techniques can bring to life old Indian traditions for the present generation. It provides mechanisms to tourists for more informed tour of the site. The project has created a set of technologies and tools that can be used for any heritage sites and has established a close collaboration at national and international agencies. As an outcome of the IDH Scheme, a total of 37 generic technologies, 7 prototypes and scaled models have been developed and demonstrated. These technologies are generic in nature and thus can be applied on any monuments. Developed technologies broadly relates to Murals, Knowledge bank, Interfaces, Intangible, Memorialization, Design, Crafts, the 3D Printing, Features, Resurrection, Ontologies, Representation, 3D Surface, Preservation, Immersion, Reconstruction, Haptic, Walkthrough, Scaling etc. Three Start-up Companies spinned off from IHD research and technologies.

Epidemiology Data & Analytics (EDA):

The objective of the programme is to carryout analytics over the data, examine and evaluate data about epidemiology, diseases burden, clinical trials being generated all over the country. For the purpose DST will partner with Digital India, DeITY, DBT and ICMR and facilitate seamless access of the data. The EDA scheme initiated. An advanced data analytics technology platform is being created to meet the stakeholder’s requirements.

Imaging Spectroscopy & Applications Programme

Imaging Spectroscopy & Applications (NISA) is a cluster based multidisciplinary Networked scheme to promote research on various aspects of Imaging Spectroscopy and Applications (ISA). This scheme is expected to evolve reference standards, protocols, database and research methodologies - for adaptation in various fields relevant to society. This networked scheme has 37 projects in seven theme areas (such as geology, agriculture, forestry, water, snow and glacier ice, urban & built-in materials and algorithms). The aim of the NISA Scheme is:

- To acquire and archive spatio-spectral database from field, air, and space borne platforms and augment scientific understanding by conducting synchronous experiments.

- To develop software for hyperspectral data processing comprising India specific atmospheric correction models and the state of the art and conventional tools for a pre-processing, target mapping and sub-pixel classification.
- To identify the scientifically and socially relevant problems in each one of the application areas namely geology, agriculture & soil, forestry, water resource, snow and ice, built in environment and attempt to develop methodology for solving the same using HRS technique.
- To augment human resource and increase of research base.

In this, seven major themes (Geology, Agriculture, Water, Forestry, Snow & Ice, Urban and built in material and Algorithm) are networked with mutual inter-, and intra-theme linkages. The group evolved common protocols for data processing and analysis tools. One of the major advantages of this networked project is the involvement of a number of national government organizations and academic institutions.

BUILDING GEOSPATIAL CAPACITY

Natural Resources Data Management System (NRDMS): Programme aims at promoting R&D in emerging areas of Geospatial technologies and applications for providing relevant inputs to solve area specific problems. Over the years, NRDMS has developed capability for handling resource management at State, District and Panchayat levels. Efforts have also been made to develop capability and capacity to absorb geospatial technologies with the aim to apply the same to provide solutions to deal with the specific issues.

National Geospatial Policy (NGP):

Keeping in mind the importance of geospatial data in the context of national development, a National Expert Committee for developing a draft National Geospatial Policy (NGP) has been constituted. The Policy aims at providing appropriate guidelines for collection, analysis, use, and distribution of geospatial information across India, and to assure data availability, accessibility and quality without compromising the National security. The draft of NGP Policy is ready for consultation with stakeholders.

State Spatial Data Infrastructure (State SDIs):

In order to enhance the applications of Geospatial Technologies in implementing developmental schemes in the country at state and below levels, State Spatial Data Infrastructure (State SDI) was launched about a decade back with the participation of the concerned states and also sharing the cost of the project at the ratio of 70:30 between DST and the concerned state. At present, in 10 states i.e. West Bengal, Haryana, Jammu & Kashmir, Uttarakhand, Karnataka, Odisha, Jharkhand, Madhya Pradesh, Nagaland, and Himachal Pradesh, state Geo-Portals have been set-up to provide information requirement for implementing various developmental schemes in the states.

Health Geospatial Information System:

A sub-programme under NRDMS was conceived and implemented in the country to demonstrate the capability of Geospatial Technologies in monitoring and providing relevant information related to health. In the process, 14 R&D projects addressing various issues such as mapping of disease, impact on health, risk assessment using GIS technologies were completed and final outputs were shared with the Ministry of Health for further views.

Village Information System (VIS):

In order to provide information requirement at village level for implementing the developmental scheme, a comprehensive programme was evolved on VIS with the participation of 10 agencies. Each project covered a cluster of 10 villages to develop comprehensive large scale GIS database and prepare various thematic maps to help in local area planning. As part of the programme, a national VIS atlas is in offing.

Revival of village ponds:

It is seen that ground water table in most of the part of the country is depleting due various environmental reasons. In order to establish the role of village ponds in conventional ground water table rising due to recharge of the aquifers locally, 12 R&D projects have been sanctioned during 2017-2018. The outcome of these studies proving positively to estimate the role of revival of village ponds and in raising the water table in villages. In addition, the ponds will also serve various usage of water in the areas for agriculture, animal and social need at village level. The programme is expected to complete by June 2019.

Landslide Hazard Mitigation:

India has very large scale landslide problems. There is a requirement for monitoring the active landslides and developing the forwarding system. During the Science congress, 2019, Ho'norable Prime Minister emphasizes the need to develop early warning system for landslides particularly for North Eastern States and HP/Uttarakhand states. Under NRDMS, more than 50 R&D projects over 4-5 years have been supported to develop scientific capability and handling the landslide problems with the active participation of the concerned Governments. The notable contribution in this area is, developing landslide hazard and risk assessment mapping of the landslide vulnerable zones, monitoring of the active landslides in different parts of the country to develop capability for fore-warning system. Specific sub-programme on Landslide Hazard Mitigation has been launched in North Eastern States to provide scientific know-how to minimize the landslide impact and save the life of the people.

New initiative sub-programmes under NRDMS

i. Coastal Hazard and Risk Assessment (CHRA):

India is having a very long coast line of 7517 km, approximately including entire East and West Coast spread over several States, have been facing the problem of erosion and deposition of sediments leading to deterioration in coastal eco-system. Coastal land forms and shoreline are the result of geomorphological processes such as erosion, sediment transport and deposition as well as sea level changes. Coastal Vulnerability maps showing likely areas to be inundated is to be undertaken on priority basis using satellite data and other high resolution images. It is seen that when any cyclonic storm is taking place, lot of areas in coastal line are badly inundated and top fertile soil is also eroded. In addition, lot of infrastructure like electric poles, houses, roads, school, hospital buildings are affected. There is no proper integration of geospatial data with the models being developed for forecasting impact of cyclone. Keeping in view of the above, a sub-programme was launched in 2018-2019. In order to co-ordinate the technical activities of the programme an expert committee has been formed to evaluate, monitor and guide the programme. At present, the committee has considered and recommended 12 R&D projects addressing various aspects of the programme and research will be undertaken in various R&D institutions. The outcome of the programme would address the local issues being encountered by the coastal states with the active participation with the other Government departments.

ii. Applications of State SDIs for Urban Governance:

In order to demonstrate the concepts of Spatial Data Infrastructures (SDIs) in Urban Governance and core R&D areas focusing on emerging technologies related to city development using Geo-ICT, an expert committee has been constituted to guide the programme. During current financial year, the committee recommended 29 R&D projects for support.

iii. Gravity Recovery and Climate Experiment (GRACE):

Gravity Recovery and Climate Experiment (GRACE) satellite gravity mission is one amongst latest technological development available to researchers to evaluate changes in the Earth's gravity field caused due to redistribution of mass inside on and around the Earth surface at regular intervals. In the view of contemporarily scientific importance of utilizing GRACE data in particular and other remote sensing data in general, it is important to develop Indian expertise in collaboration with global peers in this cutting edge scientific field. In view of the above, a National network project on 'Assessment of Regional Hydrological Systems using Space Borne Gravity Observations' has been developed. At present, 12 R&D projects have been sanctioned to various R&D institutions to undertake research work. The programme will be technically coordinated by NGRI, Hyderabad and also provide back up support to the other participating institutions.

iv. Capacity Building on Geospatial Technologies

Under NRDMS programme, a number of R&D projects and sub programmes are being supported to develop tools and methodologies for promoting geospatial technologies. In the process, good amount of data bases have been developed to address area specific problems. To disseminate such outputs to the larger scientific community for adoption and replication, efforts are being made to support 32 training programmes on short terms (3 days) and long term (21 days: Level I and Level II) on the subject during current financial year. This will have a major impact to develop a trained manpower and build up a pool of experts. To facilitate this, a portal has been developed to standardize the course curriculum by Bhartiya Vidhyapeeth, Pune. It is envisaged that around 800 stakeholders across the Country will be exposed to the advances in the Geospatial Science and Technology, its application and hands on training. In addition to this, six Geospatial Chairs professors have also been set up in different universities/ Institutions to promote the geospatial technologies along with development of the National Geospatial Ecosystem.

NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI)

National Spatial Data Infrastructure (NSDI)'s vision has been to ensure that "current, accurate and organized geospatial data sets are readily and continuously available and accessible on a national, state, district and village level basis to contribute to economic, environmental and social growth of the country". Five strategic goals set for NSDI include establishing required governance structure, ensuring capture, preservation, and maintenance of both fundamental and non-fundamental data sets; ensuring that the governmental geospatial data sets are readily discovered, appraised, and accessed; ensuring that the geospatial data sets, services, and systems owned by different government agencies are interoperable, and can be combined and reused for multiple times; and providing a coordinating framework for the delivery of the desired product space for its multiple stakeholders. Three core objectives of NSDI are (i) increasing the awareness and understanding of the vision, concepts, and benefits of the NSDI through outreach and education; (ii) providing a single window access to all users of spatial data through contemporary

technologies; and (iii) demonstrating the benefits of participation of the stakeholders in NSDI to existing and prospective participants.

During 2018-19, focus of NSDI has been on developing geospatial applications for panchayats and wards through coordinated preparation of high resolution National Foundation Spatial Data (NFSD); launching National Data Registry (NDR); maintaining the metadata and data nodes in NSDI and various participating Central and State Government Agencies; establishing State Geoportals in uncovered States;; commissioning a Geospatial Cloud Platform proof-of-concept infrastructure for understanding the scale, sizing, and performance issues in reference to geospatial data life-cycle management with the participation of Survey of India;; formulation of geospatial data and process standards with the involvement of the Bureau of Standards (BIS); and training and capacity building.

High resolution National Foundation Spatial Data sets have been identified as starting points for developing geospatial applications for use by the Line Departments at panchayat/ ward levels for developmental purposes. Two 5-day workshops on “Coordinated preparation of High Resolution National Foundation Spatial Data (NFSD) for Gram Panchayat and Ward Level Mapping” have been organised by Haryana Space Application Centre (HARSAC), Hissar and Odisha Space Application Centre (ORSAC), Bhubaneswar on 19-23 March 2018 and 18-22 December 2018 respectively for the officials/ scientists of the respective State Governments and various State SDI teams implementing the State Geoportals for sharing of data sets over the web. It has been recommended to prepare and share through the State Geoportals authoritative, reliable, accurate, up-to-date, seamless and standards-based foundation data sets in 1:4000 (panchayat level, 2D) and 1:2000 (ward level, 2D/3D) scales for preparation of foundation data sets useful for organisations/ agencies to add their thematic details, attach attributes; geo-register their maps; and link & orient their results of applications to the local landscapes.

National Data Registry (NDR) Initiative has been launched with the participation of five Central Government Agencies - Survey of India of DST, Geological Survey of India of Ministry of Mines (MoM), Forest Survey of India of Ministry of Environment & Forests (MoEF), National Bureau of Soil Survey & Land Use Planning of Ministry of Agriculture (MoA), Ministry of Statistics & Programme Implementation (MOSPI) and one State Government Agency i.e. Karnataka State Council for Science & Technology (KSCST), Bengaluru implementing the State SDI. NDR will facilitate registering the data sets and services of various agencies along with their metadata. This will act as a common central catalogue of data sets with unique identification assigned to each data item for searching and discovering geospatial data services through online interoperable access and utilisation in automated development of applications. In order to determine the optimal size and performance of a Geospatial Cloud infrastructure with a view to supporting data life cycle management, bids received by NSDI in response to its Request for Proposal (RFP) have been evaluated. Finalisation of the bid will help operationalise a proof-of-concept cloud infrastructure in Survey of India for evaluating the efficacy of the geospatial cloud approach in the management and sharing of high resolution topographic data sets of Survey of India and cadastral data sets of the State Governments. The cloud infrastructure is proposed to be used in quick on-boarding of the geospatial data services under the State Spatial Data Infrastructure (SDI) Initiative.

NSDI's India Geoportal infrastructure has been upgraded with state-of-the-art blade servers, Graphic Processing Units (GPUs); Network and Security Devices for improving data processing efficiency and preventing cyber-attacks. Software design tools like Feature Manipulation Engine (FME), Enterprise Architect (EA); and the Extensible Mark-up Language (XML) Editors have been made accessible from the India Geoportal for use by the partnering agencies for developing standards-based data services. Training

programmes have been organised by KSCST, Bengaluru for these agencies on basic and advanced features of FME software in May/August 2018 for carrying out data re-engineering - a key component in sharing interoperable geospatial data sets based on standards. An NSDI Application prototype around the open source QGIS Server has been demonstrated for providing application services by utilising data services from multiple sources in a Service-Oriented Architecture (SoA). An NSDI 2.0 conceptual framework has been developed and recommended by the concerned NSDI Advisory Committees with details of the objectives and activities towards establishing a standards-based state-of-the-art NSDI infrastructure. The infrastructure is expected to deliver application and solution services mounted on the distributed data service geoportal network from the Central and State Government organisations/ agencies developed under the on-going Initiative.

State SDI Geoportals of States like Uttarakhand, Jharkhand, Haryana, Odisha, and J&K have been maintained/ developed for providing standards-based interoperable access to the geospatial data sets of the State Governments. All these geoportals have been linked to the India Geoportal that acts as the single window access to the geospatial data assets of the State Governments. Studies have been launched to develop similar geoportals for States like Madhya Pradesh and Himachal Pradesh during the year.

National standards on ‘Rules for Application Schema’, ‘Conceptual Schema Language’; and ‘Geography Mark-up Language (GML)’ etc. have been published by the Bureau of Indian Standards (BIS) with the association of NSDI by co-branding the respective International Standardisation Organisations (ISO) specifications. These standards will be useful to various agencies engaged in the country in establishing standards-based geospatial data sharing mechanism for improving accessibility to geospatial data.

Based on the outcome of the R&D projects completed in the past few years, an edited volume has been brought out on “Geospatial Infrastructures, Applications; and Technologies” that could be used as a reference volume for launching fresh R&D initiatives by the Indian Geospatial Science & Engineering Community.

S&T PROGRAMME FOR SOCIO-ECONOMIC DEVELOPMENT

Science for Equity, Empowerment and Development (SEED) programme aims towards socio-economic upliftment of various sections of the society through technology development, adaptation, deployment and capacity building.

Technology Development

In order to improve the rural livelihood system semi-mechanized ferro-cement based panels for housing, Micro Solar Dome for lighting; hand washing devices using bamboo and development of Bio-Solar ATM prototype have been developed.

For further strengthening the bamboo-based economy of the North East region, tools and fixtures for Bamboo Strip Manufacturing have been developed. These tools have been transferred to the Tool Room & Training Centre (TRTC), Guwahati, an autonomous Body under Ministry of Micro, Small & Medium Enterprises (MSME), for providing training to 2000 artisans every year and up scaling at bamboo clusters. This intervention will improve the quality of products and reduce the drudgery of the artisans.

An array of low cost prototypes like teaching aids for children with learning disabilities, Braille devices, gait analyzer, automatic dispenser systems for oral medication, communication system for comatose and

patients with multiple disabilities, bus identification system for visually challenged, ergonomic designs for old age homes, interline Braille slate, different protocols for treatment of mental disabilities were developed for *Divyangjan* and Senior citizens. Artificial Limbs Manufacturing Corporation (ALIMCO), a PSU under Ministry of Social Justice & Empowerment, Government of India selected (a) Refreshable Braille Display, (b) Interline Braille Slate and (c) Transradial prosthetic Arm, for large scale production and commercialization.

Industrial waste of mango was utilized for mangiferin extraction and development of bio pesticides. The developed product was successfully tested in tomato field with no pest attack.

Capacity Building

Technological Capacity of the farmers has been built up in production and application of liquid bio-fertilizer (*Azotobacter*) as foliar spray and bio-pesticide *Trichoderma* using local resources.

140 fisherwomen of SC community was trained on portable Fiberglass Reinforced Plastics (FRP) Carp Hatchery Technology for common Carp breeding. 60 SC beneficiaries from 4 villages of Kota district, Rajasthan were trained in cultivation, harvesting and processing of stevia crop for making value added products. Women Technology Parks (WTPs) were established in Kerala, Meghalaya, Assam and Uttar Pradesh for empowering women through specific technologies.

Ecofriendly package of practices in Orchid cultivation for Socio-Economic Development in the Tropical Hills was developed and demonstrated to 800 women farmers & youth and 20 children with disability

Value Addition

Economic value of the locally available resources has been enhanced through technology interventions eg., value added products like *meat nuggets, sausage, kababs, patties, milk paneer* with shelf life at room temperature were developed. Six wild edible plants consumed by ST community in Arunachal Pradesh were popularized for cultivation and its nutritional values. Two herbal spices products namely *Ditey* for vegetarian and *Honyar* for non-vegetarian were formulated and are being marketed.

S&T LED ENTREPRENEURSHIP AND INNOVATION PROMOTION

National Initiative for Developing and Harnessing Innovations (NIDHI) is an umbrella programme conceived and developed by the Innovation & Entrepreneurship division, Department of Science & Technology. NIDHI aims to nurture ideas and innovations (knowledge-based and technology-driven) into successful startups through scouting, supporting and scaling of innovations.

The Department is supporting NIDHI Technology Business Incubators (TBIs) primarily in and around academic, technical and management institutions to tap innovations and technologies for venture creation by utilizing expertise and infrastructure already available with the host institution. Under this flagship program, department has established more than 130 Technology Business Incubators (TBI) and Science and Technology Entrepreneurs Parks (STEP) and several among them have matured and developed competence to become state-of-the-art Incubators.

NIDHI-Centre of Excellence (NIDHI-CoE) provides an enabling environment to Technology based new enterprises which are high risk and high growth ventures. NIDHI-CoE strengthens existing capacities of STEP/TBIs and supports potential start-ups with different pursuits and practices in transferring technological innovations into marketable products/high-growth companies.

Seed Support System (SSS) is the scheme vide which DST provides seed support and equips the STEP/ TBI with the much needed early stage financial assistance to be provided timely to deserving start-ups under incubation in a relatively hassle free manner. The Seed Support System **has been revamped to National Initiative for Developing and Harnessing Innovations- Seed Support System (NIDHI-SSS) from 2016-17**, in which the total funding to be made available to TBIs is upto Rs. 1000 lakhs and the upper limit of the seed support to exceptionally deserving startup is Rs. 100 lakhs.

Sr. No.	Name of the programme	Quantitative Achievements
1.	NIDHI Technology Business Incubator (TBI)	10 new TBIs established Incubation space for 200 startups added to the the DST supported incubator network
2.	NIDHI Centre of Excellence (CoE)	1 new CoE established Incubation space for 35 startups being added to the DST supported CoE network
3	NIDHI - Seed Support System(SSS)	6 new TBIs being supported under NIDHI-SSS
4	NIDHI-Accelerator	8 Accelerator programs being supported to scale up 100 startups
5	NIDHI-PRAYAS Idea to prototype funding	10 PRAYAS center will be setup in 10 TBI's to support 100 Innovative Projects.
6	NIDHI-Entrepreneur in Residence – a fellowship program	100 EIR Fellowships Awarded through 10 new TBI's
7	New Gen Innovation and Entrepreneurship Development Center (IEDC)	14 New Gen IEDC being established in 14 Academic / Engineering Institutions
8	Collaborative programs	
8.1	India Innovation Growth Program 2.0 with Lockheed Martin and Tata Trusts	50 startup mentored and 10 awarded with Rs. 10 lakhs and 16 awarded with Rs. 25 lakhs
8.2	India Innovation Design Challenge with Texas Instruments	26511 students from 1760 colleges have submitted 10146 ideas .Selection of teams is underway
8.4	Plugin for Hardware Startups with Intel	15 startups supported
8.5	Women Entrepreneurship Support Programs	163 women entrepreneurs supported and 10 Awarded with Silicon valley visit Women Startup Program initiated in 2018 is also supported by Goldman Sachs.
9	International Programs	
9.1	India Rwanda Growth Program	20 startups supported
9.2	Academia Industry Training Program with Swissnex	12 Researchers to be supported
10	Training Programs on Entrepreneurship	678 training programs supported, 16,170 persons trained including 2950 women.

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY COMMUNICATION

National Council for Science and Technology Communication (NCSTC) has been primarily created for building ‘*Scientific Temper for All*’, a fundamental duty. Notable achievements are flagged as follows:

- 1. S&T Mass communication:** A National Science Channel has been recently developed to disseminate Science, Technology & Innovation related knowledge by producing video contents and programmes to large masses through media services. It has been launched on 15th January 2019 by Hon’ble Minister of Science Technology & Earth Sciences having two approaches of communication through national television as “DD Science” programme on Doordarshan and also as 24x7 India Science Channel on Internet (<https://www.indiascience.in>). Nine (9) Community Radio stations have also been supported and ‘Vaigyanik Drishtikon’, the Science Communication Monthly, has been relaunched and inaugural issue was unveiled by Hon’ble Minister of Science and Technology and Earth Sciences.
- 2. Outreach Programmes for Society at Large:** National Mathematics Day was observed all over the country on December 22, and National Science Day 2018 programme is being supported, both through State S&T Councils/Departments. “Bharat Vigyan Darshan (*STEMM India*)” has organized countrywide activities related to Science, Technology, Engineering, Mathematics and Medicine through more than 56 Stationary and Mobile Exhibitions/Science Fairs & Industrial S&T tours. An activity corner in the DST pavilion during the India International Science Festival (IISF) 2018 from 5-8 October 2018 at Lucknow was inaugurated by Hon’ble Minister for S&T and ES and EFCC. 25th MTNL Perfect Health Mela had NCSTC exhibition from 23-27 October, 2018 at New Delhi. Training workshops were supported to create science communicators on Folk Media (12 Nos), Low cost teaching aids (9 Nos), Explaining Science behind Miracles (20 Nos), along with campaigns in Uttarakhand & Haryana. A “Science Communicators’ Meet” with the aim to encourage, popularize and inculcate scientific temper among the science communicators and promote effective communication of science to diverse audiences was organized during 5-6th January, 2019 during the 106th Indian Science Congress at Jalandhar. Participants from 28 Chapters of Indian Science Congress Association (ISCA) attended which was inaugurated Hon’ble Union Minister of Law & Justice and IT.
- 3. Children Centric Programmes:** National Children Science Congress (NCSC) covered almost all the districts of the country with a participation of over 500,000 students of 10–17 age group, at the 26th edition convened with a theme of Science Technology and Innovation for Clean, Green and Healthy Nation during 27-31 December, 2018 at Siksha O Anusandhan (Deemed to be University), Bhubaneswar. Child Scientists with the best projects participated in Rashtriya Kishore Vigyanik Sammelan, as a part of 106 Indian Science Congress during 4-6 January, 2019 in which 300 students and their mentors participated. India was represented by a team of 26 school students (IX-XII grade) at INTEL International Science and Engineering Fair (ISEF) held in Los Angeles, California, USA during 14-19 May, 2018, and won 15 grand awards while 4 minor planets were named after these students. Make Tomorrow for Innovation Generation was launched with Intel Technologies and Indo-US S&T Forum, during September, 2018 to create inclusive technology innovation amongst diverse underserved youth (14-17 years), and implemented in 14 states. Over 100 child scientists/innovators have participated in National IRIS Fair, held in New Delhi during 2-4 December, 2018 under “Initiative for Research & Innovation in Science (IRIS)”, a PPP of DST, Government of India, Intel and Indo-US Science and Technology Forum (IUSSTF).
- 4. Youth Centric Programmes:** “Augmenting Writing Skills through Articulating Research (AWSAR)”, a National Level Competition was launched to utilize the latent potential of PhD scholars and Post-

doctoral fellows (PDFs) towards science communication in popular format and to promote scientific temper in the country. 2629 stories were received. “Science Media & Communication Research Initiative” was launched as Mission Enlighten for young researchers on June 14, 2018, and support was extended to promoting scientist, media & students connections. “Mission Eco Next” is inspiring Young Change Makers & Eco Creatives for conservation of natural resources, through Eco Eureka, Eco Studios, & E3 (Eco Media, Eco Design & Eco Innovation) workshops, with post-training field engagements. Regional Eco Next Media Labs were organized on 3rd June 2018 (Madurai) and 28th & 29th November 2018 (Bhuj) for eco regional Archaeo-ecology studies.

- 5. Awards for S&T Communication and Popularization:** National awards are given in six categories viz. Outstanding Efforts in General, Print Media including Books and Magazines, S&T Popularization among Children, Translation of Popular Science & Technology Literature in Languages Mentioned in the Eighth Schedule of Constitution of India and in English, Innovative and Traditional Methods, and Electronic Media. At international level, UNESCO Kalinga Awardee (*Biennial Award*) for Science Popularization for 2017, Prof Erik Jacquemyne, Belgium, also to be awarded the Kalinga Chair by India, has been invited by Secretary, Department of Science and Technology to give lectures in India.

AUTONOMOUS INSTITUTIONS

The Department of Science and Technology nurtures 25 Autonomous Bodies (ABs). These include 16 research institutions, 4 specialized knowledge institutions and S&T service organizations and 5 professional bodies. These institutions, with long and varied history and their variety of activities, occupy a very important place in the S&T eco-system of the country. Activities and achievements of autonomous institutes during the year under report are briefly described below:

MACS-Agharkar Research Institute (ARI), Pune

A novel nano formulation of Amphotericin B (Nano-AmB) is found to be highly effective in controlling clinical strains of human pathogenic fungi at half the dose of the commercial formulation thereby increasing its safety.

Medicinal Plants Database of Maharashtra, both in the digitized (mpd.aripune.org) and print form, was released at the hands of the Honourable Chief Minister of Maharashtra, Shri Devendra Fadnavis.

A biocontrol method for the inhibition of sulphate reducing bacteria (SRB) and SRB associated souring of petroleum reservoirs is developed.

Wheat variety MACS 4028 (durum) is notified for rainfed-timely sown condition in Peninsular Zone.

Several new species of fungi and plants are recorded from the Western Ghats and other parts of India.

Programmes including Swachh Bharat, national science day, national technology day, vigilance awareness week, symposium on Rajbhasha, Hindi day, public outreach day, and founder's day were observed. ARI scientists participated in the Indian Science Congress, and the India International Science Festival. An international symposium 'Fungal Biology: Advances, Applications and Conservation' was organized.

An open auditorium has been constructed.

Arybhata Research Institute of Observational Sciences (ARIES), Nainital

Main areas of Astronomy and Astrophysics research of ARIES are; study Sun, Star Clusters and Star Formation, Stellar Variability, Gamma-ray Bursts (GRBs), Supernovae, Active Galactic Nuclei (AGNs) and Quasars. Using ARIES observing facilities in optical/NIR bands and other multi-wavelength national and international facilities, frontline scientific contributions are made in the said research fields.

One of the major achievements of ARIES during the financial year (2018 – 2019) is successful coating of the primary mirror of the 3.6m Devasthal Optical Telescope. This is India's biggest optical/IR telescope for conducting observations of celestial objects in Astronomy and Astrophysics.

Astronomy & Astrophysics and Atmospheric Sciences are the two main topics in which research is conducted in ARIES. Faculty members and research students of ARIES have published a total of 52 scientific papers in refereed journals during the year in high impact factor international journals. One research scholar got his PhD degree and three have submitted their thesis for evaluation during the year.

All the 12 clusters of an indigenously developed wind profiler (ST Radar), at ARIES, Nainital have been radiated successfully. For the first time, observations of light non-methane hydrocarbons (NMHCs) are made using a Gas Chromatograph equipped with Flame Ionization Detector (GC-FID). Observations of BC shows important role of the mixing layer depth in its variabilities. Analysis of satellite data showed that biomass burning leads to significant enhancement in tropospheric pollution loading over the forest (110–176 %) and cropland (34–62 %) regions. A biomass-burning-induced increase in ozone and related gases was also confirmed by a global model and balloon-borne observations over Nainital. Modelling study of one of the important greenhouse gas, CO₂ showed that ocean flux has least contribution (<10%), while dominance of biospheric flux is seen over fossil (>80%) in the study region of Asia.

Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow

Established in 1946, Birbal Sahni Institute of Palaeobotany was renamed as Birbal Sahni Institute of Palaeosciences. Institute carries out research on both fundamental and applied aspects of Palaeosciences and allied Earth System Sciences with an integrated, multi-disciplinary approach. The research activities focus on past life forms, past climates and ecosystems including the origin and evolution of life, vegetation dynamics through time, palaeoclimates and exploration of fossil fuels.

The expertise of the institute scientists is regularly utilized by public sector undertakings / organizations such as Oil India Ltd., Coal India Ltd, Archaeological Survey of India and various universities and research organizations.

In recent years, the Institute has widened its scope of research significantly by setting up of new analytical facilities in 2018- Ancient DNA lab and Vertebrate Paleontology Lab. The presence of a large number of women scientists (more than one-third) on the rolls of the institute is a unique feature of this institute. Several young scientists were selected for prestigious post-doctoral fellowships abroad. The institute has substantially improved its performance during the past few years on various measurable parameters, including the quality of its research output as reflected in the total impact factor, organization of international and national conferences, collaborations, consultancy, student training, awards and international fellowships etc. Institute participated in the IISF (India International Science festival) and organized the *Face to face new Frontiers in Science programme* for school children and college students. Several outreach activities and programmes were also organized in 2018 to familiarize the students with the discipline of Palaeosciences in schools and colleges.

Bose Institute, Kolkata

Bose Institute is a century old institution set up in 1917 by Acharya JC Bose, the founder of modern science in the Indian subcontinent. The areas in which research is conducted in this Institute are: Plant biology, Systems biology, Molecular Medicine, Microbiology, Computational biology, Basic and Applied Physics and Environmental science. Some of the major achievements in 2018 are as follows:

- A novel protein structural motif, *topi*, in which a pair of 2-residue segments hydrogen bond has been reported. Remarkably, *topi* is found within disease causing misfolded proteins, such as the fibrilled form of A β 42, an amyloid β protein found in the brain tissues of Alzheimer disease patients.
- *c-MYC* proto-oncogene harbors a transcription-inhibitory quadruplex-forming scaffold (Pu27) providing anti-neoplastic therapeutic target. A small peptide that stabilized the 5'-propeller loop of *c-MYC* quadruplex has been reported which triggered death of cancer cells.

- Genome-wide mRNA–miRNA profiling uncovered a role of the microRNA miR-29b-1-5p/PHLPP1 signaling pathway in *Helicobacter pylori*-driven matrix metalloproteinase production in gastric epithelial cells. Targeting the miR-29b-1-5p/PHLPP1 signaling axis could be a potential host-directed approach for regulating the outcome of *H. pylori* infection.
- Biogeochemistry of oxygen minimum zone (OMZ) sediments have crucial bearings on the benthic biota, gas and metal fluxes across the sediment-water interface, and carbon-sulfur cycling. Couple pore-fluid chemistry and comprehensive microbial diversity data reveal enhanced carbon-sulfur cycling in the sediments of Arabian Sea OMZ center.
- A first-ever long-term (2009–2015) study on the fine particulate matter (PM_{2.5}) and black carbon (BC) aerosol was conducted over the Himalayas. It revealed that up-gradation of the domestic fuel at the Indo Gangetic Plane regions in recent years has improved the regional air quality.
- Bose Institute participated in the Mega Science, Technology & Industry Expo at the India International Science Festival (IISF) 2018 held from 5th to 8th October at Lucknow. Many students visited the stall of Bose Institute and appreciated the display of replica of J.C. Bose's instruments, digitized diaries, Patent and publications of Bose Institute.

Centre for Nano and Soft Matter Sciences, Bengaluru

The highlights research work carried out during this period are briefly mentioned below:

Synthesis of metal oxide nanomaterials, functional materials and liquid crystals, porous Molybdenum dioxide via green route.

Preparation and characterization of quantum dot-liquid crystal composites, thin films of metallo-organics, nanoparticle-based guest-host system.

Devices such as triboelectric nanogenerator based on cheap and easily available materials, electrochemical biosensors, optical memory device through a judicious combination of photoisomerization and an AC electric field, Perovskite solar cells, printed electronics, nano-hole array based refractive index sensor, humidity sensor based on slanted titaniananorods are optimized.

Novel phenomena such as giant enhancement in photoluminescence in magneto-gels which could be used in emissive displays, all-dielectric optical metamaterials exhibiting strong forward scattering, nanorods tunable shape dependent properties of liquid crystals.

Three new prototype devices are developed based on in-house inventions, and are displayed in the Prototype Gallery meant for industry interaction. As many as five industries have shown interest in some of the devices/process and are in dialogue to take them to the next level of technology transfer.

Nearly 30 collaborations both at the national and global level is established, one major and three minor extramural projects are sanctioned, there are four new facilities commissioned including an HRTEM installed at the new campus, about 40 publications in refereed journals with average impact factor of ~ 2.5, 4 publications in conference proceedings, 4 patents filed, 1 book chapter published. Regarding manpower training one student is awarded PhD, about 34 students are being trained for their PhD programme, 11 RAs, 20 R&D assistants, 2 visiting students, and 17 ROI students are trained during this period. CeNS

outreached to several schools and colleges through popular lectures and demonstrations. As many as 2300 students from 19 schools/colleges benefitted through outside and sixty students through in-house, CeNS programmes.

Indian Association for the Cultivation of Sciences (IACS), Kolkata

Focus areas of the institute are - Physical Sciences, Materials Sciences, Chemical Sciences, Biological Sciences, Applied and Interdisciplinary Sciences, Mathematical and Computational Sciences.

Translational research in PPP model in Technical Research Centre (TRC) with the goal to develop liaison with industries is going on in full swing. Under this Centre, several sophisticated research facilities have been established. Facilities such as environmental SEM, ESI-MS secondary ion mass spectrometer, Mössbauer spectrometer, Ultrafast transient spectroscopy have been installed to support research work in molecular, applied, biological and materials sciences. A new animal and zebra fish house has been developed to give a boost to biological research. To strengthen collaborative work with industries, a laboratory for incubation and prototyping is being set up. An ultra-high resolution AFM has been installed very recently while a high power, high resolution X-ray diffractometer as well as a 25 litre/day Helium liquefier are installed. Many facilities for Biological research were added such as “Bacteria Culture System”.

Indian Institute of Astrophysics (IIA), Bengaluru

- The Institute celebrated 50 years of operations of Vainu Bappu Observatory (VBO) Kavalur. The Chairman of the Governing Council inaugurated a visitors' centre at VBO on the occasion.
- First science observation using the 0.7-m GROWTH-India telescope at the Indian Astronomical Observatory, Hanle is carried out. The object was a recurrent nova outburst (M31N-2008) in the nearby galaxy M31. During GROWTH winter school organized at IIT Mumbai, remote observations of GRB 1812A was carried out and the results are reported in the form of GCN circular.
- Digitized and calibrated white-light data obtained from Kodaikanal Solar Observatory for a period of 90 years is used to investigate long-term variation of sunspot penumbra to umbra area ratio. Observational evidence of the braiding of magnetic field lines has been reported. The radio signatures that occur in the solar corona were studied using the radio data obtained from the Gauribidanur Radio Observatory (IIA).
- As a part of international campaign AT2018COW was extensively monitored with the 2-m HCT. This turned out to be a fast-luminous optical transient, which represents a new class of astrophysical event and needs innovative exotic models to explain it.
- Even after seven decades of the discovery of active galactic nuclei (AGN), technology does not exist to resolve the central regions of these source via direct imaging. However, indirectly it is possible to probe the central regions of these objects. Based on optical and near-infrared observations carried out by using the HCT, the size of the dust torus in the AGN H0507+164 has been estimated as ~30 days. This is the first time measurement on this source.
- A new method based on the contour Minkowski Tensor to probe the shape and size statistics of ionized bubbles has been proposed.

- The Ultra-Violet Imaging Telescope (UVIT) onboard AstroSat, delivered by IIA to ISRO is taking regular observations. Routine observations indicate no degradation in the sensitivity of the instrument. More than a dozen research articles reporting remarkable results from UVIT have been published in international refereed journals in this year and the number is expected to increase in the coming days. Some of the key results from UVIT published this year include (a) first time imaging of the Bow-Tie nebula in CIV line enabling probing of the shock interaction with the nebula (b) identification of star forming regions in interacting galaxies (c) stellar population studies in the cores of globular clusters, (d) discovery of new RR Lyrae variable stars etc.
- Works related to the construction of Optics Fabrication Facility for segmented mirror polishing for the Thirty Meter Telescope (TMT) project is completed and is expected to be inaugurated in the fourth week of December 2018.
- System design of the Visible Emission Line Coronagraph (VELC), onboard Aditya-L1 space mission is completed. Fabrication of the Qualification Model (QM) is in progress.
- A new set of VSAT dish antenna used for the communication between CREST Hoskote and IAO Hanle has been erected at the respective sites. The process of obtaining mandatory clearances from the respective agencies are being carried out.
- The Detailed Project Report (DPR) of NLST have been submitted to DST along with the SFC document. At the Merak site, as part of the site survey, the weather data is continued to be recorded at 3-m and at 8-m heights. An all sky camera is also installed.

Indian Institute of Geomagnetism (IIG), Mumbai

Four new interdisciplinary research programs have been initiated at IIG which will be of immense societal value and relevance. These are *Space weather prediction, Climate variation and change, Ionospheric seismology* and *Coupling & Dynamics of lithosphere-atmosphere-ionosphere-magnetosphere* proxies (LAIM) system to develop *Integrated Earthquake Precursory Signals System* to mitigate natural disasters of varied origin.

Forecasting of the solar cycle characteristics is vital in understanding the space weather. Addressing this issue, two different models have been developed to predict peak of solar cycle (SC), and length of solar cycle. Employing Shannon Entropy estimates, the inherent randomness in the SC is found to vary with the phase as it progresses. The prediction has revealed a superior correlation coefficient of 0.94, suggesting that the upcoming SC 25 would be significantly weaker.

On the modeling and theoretical simulation front, one-dimensional Particle-in-Cell simulation of the head-on collision of multiple counter-propagating ion acoustic coherent phase space structures in the space plasma is performed and a new mechanism of electron acceleration via interaction of multiple coherent waves has been proposed. Such local electron acceleration may be relevant to the energetic electrons observed in the planetary magnetospheric plasmas.

A dedicated experiment to study the Lithosphere-Atmosphere-Ionosphere-Magnetosphere (LAIM) coupling has been initiated in NE India at Shillong Geophysical Research Center (SGRC). While exploring the effects of earthquakes on the medium, it is found that the seismic activity is one of the potential sources that can affect the ionospheric electron density at smaller scales prior to, during, or after an earthquake occurrence.

Institute of Advanced Study in Science and Technology (IASST), Guwahati

The institute is a multi-discipline autonomous institute carrying out research, development and outreach activities under five research programs: Basic and applied plasma physics, Advanced material Sciences, Bio-diversity and ecosystem research, Traditional knowledge based drug development and delivery and Mathematical and Computation Sciences. Major achievements of R&D activities in the institute during 2017-18 include - [1] development of comprehensive data base of human gut microbiome of 500 individuals from various ethnic groups of the North-east India, [2] first time characterization of the scented rice variety of Assam and discovery of higher content of omega3 and omega6 fatty acid in ratio which is ideal for healthy function of heart, [3] formulation of herbal a nutraceutical candy using endemic Garcinia powder as major component with its scientific validation for health benefit, [4] development of a dietary phytochemical as a potential drug candidate for curing breast cancer subtype, [5] development of a sensing platform for vitamin B12 and cholesterol using bio and nanostructured material, [6] fabricated intermolecular junctions of vertically aligned carbon nanotube prepared by atmospheric pressure PECVD. IASST's incubation centre (ISVEC) started its operation and in-house scientists have used the facility for product manufacturing in pilot scale. For example, IASST's patented technology on protection of bell metal against corrosion and luster enhancement by plasma coating was taken up in ISVEC. The first item to be plasma coated was a plaque of "Kamakhya Temple". Transmission Electron Microscope (TEM) facility, GE compliant Animal House facility, Centre Instrumentation and Drug Discovery Centre is going to be operational this year. A Quality Control & Quality Assurance laboratory facility under the phytopharmaceutical mission for North East India to promote expansion of herbal medicine industry has been put into operation under traditional knowledge based drug discovery program of IASST. Forty-seven families of two tribes (Rabha & Boro) in the adopted villages of IASST benefitted by producing mushroom, eri and vermicomposting year round using IASST's input and technical support.

Institute of Nano Science and Technology (INST), Mohali

Research and academic activities of the Institute focus on various areas of nano science and technology with major thrust on the following areas: Electrochemical devices for Energy Conversion and Storage, Smart materials for packaging, Terahertz Spectroscopy Imaging and its Applications, Topological materials for future devices, Nonlinear Optics/Mesoscopic Optics, Topological materials, Nanotechnology based technology in Agricultural and Food technology, Nanotoxicology, Biomechanics for understanding human disease and development of smart biomaterials, Theranostics for point of care and Nanomaterials from natural sources. INST has established laboratories Faraday Laboratory highly sophisticated instruments at its campus, in IISER, Mohali also at NABI and CIAB, Mohali.

The faculty (36) has made significant scientific contributions as reflected by the quality as well as number of research publications from INST over the last 05 years. Since its inception, INST has published more than ~230 papers in reputed international journals

Under its Ph. D. programme, presently INST has 121 Ph.D. students (114 are registered at IISER Mohali and 7 at Panjab University). Currently, 11 Post-doctoral/ National Post-Doc Fellows are pursuing research. The Outreach activities started by INST in 2014 have covered almost PAN-India including states like Tamil Nadu to Jammu & Kashmir and Madhya Pradesh to Manipur covering length and breadth of India. Till date, more than 18,500 students covered under the outreach lectures including students belonging to ST-community. Most of the projects sanctioned to INST, Mohali are focused on application-oriented research of societal relevance.

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad

ARCI's mandate is development of advanced materials & processes, demonstrate the technologies/solutions at an appropriate scale and transfer them to user industries for commercialization. Consistent with this mandate and the national missions, research and development activities have been pursued to provide technologies/products and solutions to various industrial and strategic sectors. Highlights are as follows:

Towards the electric mobility- Lithium ion battery pack/ modules (48V-1KWh) were indigenously fabricated and field tested on two-wheeler. In the area of solar energy - easy to clean coatings on solar PV panels have been successfully field tested and low-cost solar absorber coating technology was transferred to an industry for high temperature steam generation application. In the health sector - ARCI in collaboration with NEERI Nagpur and an Industry, launched 'GreenDispo'- an ecofriendly incinerator for disposal of sanitary napkins. On strategic applications side - Protective coating for helicopter compressor blades and vanes were developed and 600 coated blades were supplied to Indian Air Force and laser micro machined grids for microwave generators were supplied to DRDO. In order to exploit the application potential in aerospace sector, an ARCI-Industry Joint Special Coatings Centre has been established in PPP mode. Considering the importance of improving the efficiency of coal based energy generation - activities on establishment of a '*National Centre for Development of Advanced Materials and Manufacturing Processes for Clean Coal Technologies for Power Applications*' have been initiated with several partners from R&D, Academia and industry.

Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru

UGC on 24th May 2018, graded JNCASR as Category-I Deemed to be University as per the provisions of the UGC regulations. JNCASR was also rated as the best institution for research productivity, based on performance (per capita) of different Indian Institutions (Current Science 10 June 2018). Further JNCASR received the Clarivate Analytics India Innovation Award for 2018 in the academic institutions category.

JNCASR made major progress in research, which were published in the some of the high-impact science journals. Few of these are listed below:

1. Novel molecules were discovered that target a cell's ability to eliminate waste (termed auto phaggy) which may help develop therapeutics for neurodegenerative diseases.
2. Cause of faster replication of HIV-1C subtype has been found.
3. Scientists developed electrochemical sensor which detects levels of dopamine and paracetamol, in combination, in spiked human urine and serum samples.
4. Using a small molecule that activates two enzymes (CBP/p300 histone acetyltransferases), researchers from the Centre could recover long-term memory in mice with Alzheimer's disease.

Under Summer Research Fellowship Programme (SRFP) 2018, 63 students availed the fellowship. Student Buddy Programme, which is an outreach programme of the Centre that brings school children to JNCASR was a success. Further a number of lectures and demonstrations on science were conducted at the Centre and the faculty from JNCASR delivered lectures and interacted with a large number of students belonging to rural areas like Laxmeshwar (Karnataka), Gangolihat (Uttarakhand) etc.

Seven Patents were granted during 2018. Seven technological products originated from the Centre have been commercially launched in the market. Start Up companies established by few of the faculty of the Centre have commenced their operation successfully.

National Innovation Foundation (NIF), Gandhinagar

The National Innovation Foundation (NIF) - India is India's national initiative to strengthen the grassroots technological innovations and outstanding traditional knowledge. Its mission is to help India become a creative and knowledge - based society by expanding policy and institutional space for grassroots technological innovators.

NIF has pooled a database of over 310,000 technological ideas, innovations and traditional knowledge practices (not all unique, not all distinct) from over 608 districts of the country. NIF has till date recognised 992 innovators and school students at the national level in its various National Biennial Grassroots Innovation Award Functions and annual Dr A P J Abdul Kalam Ignite Children Award functions. In collaboration with various research & development (R&D) and academic institutions, agricultural & veterinary universities and others institutions, NIF has helped in getting several hundred technologies validated and / or value added. NIF has collaboration with Indian Council of Medical Research (ICMR) for validation of practices in herbal human health domain received from traditional knowledge holders.

NIF has also set up an augmented Fabrication Laboratory (Fab Lab) for product development and strengthening in-house research. NIF has filed over 1040 patents, including eight filed in the USA and 28 Patent Cooperation Treaty (PCT) applications, on behalf of the innovators and outstanding traditional knowledge holders. Of these, 72 patents have been granted in India and 5 in the USA. In the same time period NIF has filed 21 Design registrations for innovations of the grassroots and student innovators. In addition to this 10 trade mark applications have also been filed.

Micro Venture Innovation Fund (MVIF) at NIF, with support from Small Industries Development Bank of India (SIDBI), has provided risk capital to 230 innovation based enterprise projects, some of which are at different stages of incubation. NIF has succeeded in commercialising products across countries in six continents, apart from being successful in materialising 109 cases of technology licensing.

The INSPIRE Award - MANAK (Million Minds Augmenting National Aspiration and Knowledge) is being revamped and executed by Department of Science & Technology and National Innovation Foundation - India to align it with the action plan for "Start-up India" initiative launched by the Hon'ble Prime Minister of India.

NIF has built the ASEAN India Innovation Platform (AIIP) - Social Innovation commensurate with objectives of ASEAN - India Science, Technology and Innovation cooperation. NIF also hosts NIFientreC (NIF Incubation and Entrepreneurship Council), a Technology Business Incubator (TBI).

North East Centre for Technology Application and Reach (NECTAR)

The North East Centre for Technology Application and Reach (NECTAR) continued its focus in the North Eastern States. The following projects were taken up:

- CCTV extension Project at Tura, Meghalaya – In view of the successful implementation of the Phase I and its impact in controlling the law and order in the district, the state government requested NECTAR for implementing the extension project to cover at least 8 locations.

- Crime Control and Tracking Network System (CCTNS) project for Assam Police – Pilot Project – For improved connectivity between two police stations in Guwahati.
- Discussions have been held with Arunachal Police, Mizoram Police, Tripura Police and Manipur Police for similar project under MHA initiative.
- Setting up of Software Defined Radios (SDR) for Arunachal Police at a total cost of Rs. 21 Lakhs. This has improved inter-police station connectivity especially with the remote locations.
- Committee formed by National Green Tribunal (NGT) for Meghalaya for coal mining revival survey – NECTAR has supported with technology based products on mapping and surveying using satellite data.
- Mahanadi-Barmul survey – completion of the study
- National Institute of Fashion Technology, Shillong has associated NECTAR in finalising their intra-network, wi-fi zone and CCTV requirements for their new campus at Shillong.
 - Finalisation of Byelaws and Recruitment Rules of the Centre
 - Finalisation of NECTAR office space at Shillong

Raman Research Institute (RRI), Bengaluru

The Nobel Laureate Sir C V Raman founded RRI in the year 1948, with the objective of carrying out research in basic sciences. Today the research at RRI has focus in key unsolved problems in astronomy and astrophysics, light and matter physics, soft condensed matter and theoretical physics. Examples of a few highlights of these research are given below.

The Institute is building an X-ray polarimeter payload (POLIX) in collaboration with ISRO, to be launched onboard the XPoSat mission of ISRO in 2019, a first of its kind mission in the world. The POLIX instrument was conceived by RRI to measure X-ray polarization of cosmic sources. In 2018, the Preliminary Design Review of the payload and Overall Preliminary Design Review of the XPoSat satellite were completed. There has also been significant progress in making the Qualification Model of POLIX.

This year RRI experimentalists measured spin properties of atomic systems in and out of equilibrium via noise spectroscopy leading to extremely sensitive detection of magnetic fields (on the order of few nano-Tesla). Devices made using this technology have potential applications in diverse fields such as quantum metrology, gravimetry and quantum information processing.

Also in 2018, astrophysicists at RRI solved the long-standing problem of why the orbits of globular clusters (GCs) appear to ‘stall’ in the cores of dwarf galaxies, which is in contradiction with the predictions of Chandrasekhar’s dynamical friction formula. They found that due to the progressive loss of strong resonances at small radii, the net torque was suppressed by factors of 100 to 10,000, when compared with the Chandrasekhar torque resulting in the appearance of stalling at an orbital radius between 200 and 300 parsecs. This work was published in The Astrophysical Journal.

In another key research, RRI theorists studied the relation between qubit entanglement and Lorentzian geometry and proposed a test for detecting two-qubit entanglement. The entanglement criterion is based on Partial Lorentz Transformations (PLT) on individual qubits. Apart from testing for entanglement, the

approach also leads to the construction of a separable form for the density matrix in those cases where it exists. The approach leads to a simple graphical three dimensional representation of the state space which shows the entangled states within the set of all states.

In another study, the Brownian motion of a charged particle in a magnetic field revealed a qualitatively interesting transition from a monotonic to an oscillatory behaviour of the mean square displacement with increase in magnetic field strength. The predictions stemming from this study can be tested against experiments in trapped cold ions.

S. N. Bose National Centre for Basic Sciences, Kolkata

Satyendra Nath Bose National Centre for Basic Sciences was established in June 1986, for performing cutting edge basic research in various selected branches of science, including areas of potential applications in technology. The Centre has transformed itself from an institution with most activities in theoretical and computational areas, to an institution with a balance of theory, computer simulation, and modern experimentation. The Centre has also undertaken the challenge of carrying out translational research through an ongoing project on “Technical Research Centre” for benefits of the Science to the Society and the 1st Technology Transfer to a Start-up company has been successfully implemented very recently. On the occasion of 125th birth anniversary of S. N. Bose, the Centre has been involved in mentoring of young faculty/scientists from other institutes and organizing Science Outreach Programmes of various kinds, ranging from organizing workshops /Seminars in remote areas of the country, to holding public lectures by eminent scientists, and popular lectures for school and college students.

The Centre is involved in teaching and manpower training of about 200 M.Sc. & Ph.D. students with a total research publication of 177 in peer reviewed journals.

Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTMIST), Thiruvananthapuram

SCTMIST initiated four new priceless ventures in June 2018 as part of its continuity and commitment to serve the unique mandates. Dr Harsh Vardhan, Hon’ble Union Minister for Science and Technology formally launched on 23rd June 2018 (i) The Swasthya Suraksha Hospital complex under the Pradhan Mantri Swasthya Suraksha Yojana, (ii) The Combinational Devices Block for Biomedical Research, (iii) The Regional Technical Resource Centre for Health Technology Assessment and (iv) The Data Centre for advanced IT infrastructure.

During this’ period, product development initiatives were commenced for 15 products by our Biomedical Technology Wing, 8 patents were filed, 10 PhD scholars graduated and nearly 200 publications were made by the Institute. International launch of Vein Viewer product from the Division of ECD was done by the Technology partner Agappe Diagnostics Pert Ltd at “Medica 2018” Expo held at Dusseldorf, Germany on 15th of November, 2018. Many MoUs and License agreements were entered into by the institute with National and International Agencies.

Technology Information, Forecasting & Assessment Council (TIFAC), New Delhi

TIFAC is mandated to assess the state-of-the-at technology and set directions for future technological development in India in important socio-economic sectors. TIFAC has also been supporting innovations at academic institutions, R&D institutes, industry and also individuals through its various pioneering programmes in the innovation chain. These include programmes like Patent Facilitation Programme, Women Scientist Scheme, MSME programme, TIFAC- SIDBI Revolving Fund for Technology Innovation

Programme (Srijan) etc. The SRIJAN programme contributes towards make in India and promotes start-ups. Academia interaction platform provide technical support to the MSMEs through proximate & competent technical institutes. TIFAC has brought out the Technology Vision 2035 document. The Vision Document was unveiled by the Prime Minister of India in the 103rd Indian Science Congress in 2016 at Mysore. The Technology Vision2035 document articulates a vision for all Indians in 2035. Under the activity Technology Foresight for Automotive R&D (TFAR), TIFAC is also carrying out technology foresight studies on various aspects of electric mobility, rechargeable energy storage systems, and electric aircrafts/ drones. TIFAC has

Patent Facilitating Centre (PFC) has been in the forefront in creating awareness about intellectual property rights (IPR) in the country. PFC facilitates filing, prosecuting and maintenance of patents on behalf of academic and Government R&D Institutions. PFC also implements the Women Scientist Scheme, WOS-C of the DST popularly known as KIRAN IPR for one-year training on IPR.

Three technology foresight studies in the domains of “Natural Resources and environment security”; “Cyber security for digital economy-A roadmap”; “Securing society and infrastructure” have recently been carried out in collaboration with leading institutions of India

Vigyan Prasar, Noida

Vigyan Prasar uses multiple approaches to deliver value-added scientific and technological information / learning meant for a wide array of stakeholders. The activities of Vigyan Prasar are executed and carried out primarily through scientific divisions namely publication planning, audio/video programmes, astronomy popularisation, Vigyan Prasar network of science clubs, science communication and training, gender and technology communication, EduSat network and Ham radio communication.

A large number of Science and Technology based video programmes (158 episodes) were produced and telecast through Doordarshan and other TV channels. At radio, serials produced in 19 languages, and broadcast from 117 stations of AIR, India Science Wire (India Science News and Feature Service made steady progress to showcase contemporary science and technology as well as R & D in India labs). A large number of stories (483) were later released and the product had more than 15,800 tweet impressions and 10474 facebook followers. The social media like YouTube, NROER and other television channel programmes are being made available to public. Vigyan Prasar also developed a video compendium of 37 tools for women farmers, followed by interactions for capacity building, a book “Indian Scientists - the Saga of Inspired Mind” and its Hindi version “Bhartiya Vaigaynik Prerna Ki Srot” was published. Workshops on (i) Adolescent Health Training for Tribal Girls for in five states of India and (II) Health, Hygiene and sanitation awareness for tribal women in Assam work conducted. Nature activity camps for mobile schools of J&K in Kistwar Districts were also organized. Vigyan Prasar collaborated with different states council and educational organizations / institute for skill upgradation workshop and outreach activities of Science popularization. Vigyan Prasar also created unique national facilities like India Science Technology & Innovation (ISTI) Portal, Science Channel, Internet based Science & Technology Channel, India Science News Feature Service and Web presence of India Science Wire.

Wadia Institute of Himalayan Geology (WIHG), Dehradun

The institute has the mandate to carry out high quality research on various geological and geophysical aspects of the Himalaya.

The scientists of the Institute have published one Book published by Springer Singapore, one Monograph published by Wadia Institute of Himalayan Geology, Dehradun and ~60 research papers in various reputed National and International journals and >60 papers are either in press or under review. Five Ph.Ds. were awarded to research scholars of the Institute from different universities, and about same number of Ph.D. were submitted to various universities. Institute imparted summer and winter training to about 150 graduate and post-graduate students drawn from different Universities / IISERs / IITs etc. from across India in various field of geology and geophysics.

Upon completing 50 glorious years of existence, Institute organized series of lecture by eminent researchers across the country and two days “National Conference on Earth System Science with special reference to Himalaya: advancement and challenges” was organized during May 16-17, 2018.

Institute also organized outreach program of the India International Science Festival (IISF) 2018 on September 26-27, 2018. Besides, Institute also celebrated/observed ‘National Technology Day’ on May 11, 2018, Foundation Day on June 29, 2018 and Hindi Pakhwara during September 14-18, 2018.

Indian Academy of Sciences, Bengaluru

The Academy was founded in 1934 by Nobel laureate Prof C V Raman. The Academy strives to meet its objectives through promotion of original research and dissemination of scientific knowledge to the community via a variety of activities that include meetings, discussions, seminars, symposia and science education courses and workshops.

The Academy during the year published over 1362 peer-reviewed articles in 13 thematic journals and the entire contents are available in an open access platform (<http://www.ias.ac.in/journals/overview>). Freely accessible journals during the year had around 17 lakhs downloads of refereed articles. 15 special publications of topical interest and 3 books were published. Over 28000 individuals/universities/institutions receive print versions of these journals. Worldwide visibility to Academy journals increased with more submission of articles. 10 journals of the Academy are being co-published with Springer and Springer Nature provides access to the journals ‘content worldwide on its journal platform SpringerLink. Journals citations have enhanced over years. The Current Science Association works with the Academy in bringing out the frowningly multidisciplinary journal Current Science.

28 outstanding scientists from India and One foreign scientist were inducted into the Academy Fellowship and Honorary Fellowship respectively. Under the Associateship Programme, 23 promising young scientists were selected.

Towards attempts to improve the state of higher education and teaching of science in the country, major activities are implemented. Summer Research Fellowship and FAST –SF programme, about 1771 students and teachers undertook 2 months’ Fellowship and worked with Fellows and other mentors spread across 220 research institutions in the country. The academy, annually supports educational institutions in the country to hold lecture workshops and refresher courses in all major disciplines of sciences. About 162 lecture workshops and 31 refresher courses were held.

During the year, the academy held 2 annual meetings, 4 discussion meetings on various scientific themes. Seven public lectures were organized.

Under visiting chair professorship programme, Janaki Ammal Chair Professor Prof Nina Fedoroff from Penn State university, a molecular biologist known for her research in life sciences and biotechnology,

especially transposable elements or jumping genes. and plant stress response visited India during November. Prof. David Baker, University of Washington, a biochemist and computational biologist who has pioneered methods to predict and design the three-dimensional structures of proteins will be visiting India in December as Raman Chair professor.

Indian National Academy of Engineering (INAE), Gurugram

INAE jointly organized the Engineers Conclave 2018 with Larsen & Toubro Ltd on Oct 4-6, 2018 at LDA Lonawala. The themes of the EC2018 were “Defence Manufacturing in Industry” and “Engineering Challenges in Urban Infrastructure”. Actionable recommendations based on the deliberations of the two themes of Engineers Conclave 2018 have been finalized which are being actively progressed with the concerned Government Departments/Agencies for consideration.

INAE instituted the Abdul Kalam Technology Innovation National Fellowship in the year 2017 jointly with SERB, DST with the objective to recognize, encourage and support translational research by Indian Nationals working in various capacities of engineering profession, in public funded institutions. Five Fellowships were conferred this year, considering the quality of the translational research in the proposals received in response to the first call for nominations for the year 2018-19.

The Second Youth Conclave was organized at IIT Kharagpur on Aug 11-12, 2018 which was attended by about 250 engineering students and 50 INAE Fellows. The proceedings were interactive in nature and the general theme of the conclave was engineering excellence, youth leadership and nation building. Awardees of various competitions organized such as National Online Essay Competitions and hackathon were felicitated during the Youth Conclave.

The INAE Annual Convention of the Academy was held on Dec 13-15, 2018 at Research Centre Imarat (RCI), Hyderabad. The highlights of the Convention include Lectures by Life Time Contribution Award in Engineering awardees; technical presentations by newly elected Fellows and Young Associates; meetings of INAE Forums; Grand Award Function and Annual General Meeting of Fellows.

Indian National Science Academy (INSA), New Delhi

Indian National Science Academy (INSA) is a National body of Indian Science devoted to the pursuit of nurturing Excellence in Science. In the reporting year, 30 Fellows and 5 Foreign Fellows were elected to the Fellowship of the Academy in 2018. The Academy awarded 31 young scientists, the INSA Medal for Young Scientists for original research work carried out in India. This also included one award for research in the History of Science. It also selected 12 outstanding teachers for INSA Teachers Award. The academy supports the Indian National Young Academy of Science (INYAS) and this year 24 members were selected for the period 2018-2022.

In its international activities, INSA supported 24 scientists for participation in international conferences. This number would have been higher but for funding limitations. Further, 25 scientists were supported for visits to institutions overseas and 7 scientists from other countries were supported for their work in India.

Under the Science Promotion Programme, 02 Distinguished Professors, 05 Senior Scientists, 05 Honorary Scientists, and 30 Young Scientists Awardees and 01 Young Historian were supported for advanced research. INSA also supported 12 Conferences/ Seminars/ Symposia/ Workshops. Further 17 Scientists were offered the Visiting Fellowship under Visiting Fellowship Scheme for collaborative research and training. A total of research projects were supported under the History of Science Programme.

Over 20 Lectures in remote/rural areas were delivered to young students and teachers of schools and colleges by the INSA Fellows, Young Scientists, Teacher Awardees, and INYAS members.

The Academy continued to publish its three flagship journals that received over 10512 hits and downloads. It also published various books of national interest and biographical memoirs.

Indian Science Congress Association (ISCA), Kolkata

The Sessions of the Science Congress are generally held at different parts of India from January 3 to 7, every year under the Presidentship of eminent scientists. However, the 105th Indian Science Congress was held in Manipur University, Imphal from 16 to 20 March, 2018. Sri Narendra Modi, Hon`ble Prime Minister of India inaugurated the programme on 16th March, 2018. The programme of the session consisted of paper presentation, young scientists programme, Best Poster Award Presentations, endowment lectures, platinum jubilee lectures, children science programme, Science Communicators meet, Women Science Congress, Science exhibition, etc.

As per previous years the activities of the Association throughout the year consisted of publication of proceedings, “Everymans Science” bi-monthly journal and other usual publications, organizing national / international seminars and symposia, collaborative programmes, foreign scientist participation in the Science Congress Session, delegation to meetings abroad during their Scientific Congress, etc. For achieving these objects, the Association took several activities, viz, strengthening the activities of 28 ISCA Chapter and involving local Young Scientists in the discussion, Science awareness programmes, organizing follow-up of recommendations and Science Policy discussions, etc. Infrastructure development was also initiated. Every year, ISCA (Hqrs.) along with 28 Chapters observed National Technology, Day, World Environment Day, Doctor’s Day, Engineers’ Day, World Quality Day, International Yoga Day, National Science Day, etc.

National Academy of Sciences India (NASI), Allahabad

The Academy strongly feels that Science-Society programmes are a must to generate scientific temper as well as to solve many societal problems through scientific education and research. Presently, the programmes are being steered with active cooperation of more than 3500 Fellows/Members of NASI present in different corners of the country.

NASI envisions the cultivation and promotion of Science & Technology in all its branches. The Academy is striving hard to promote Science & Technology by regularly organizing several activities through its headquarters at Prayagraj and 20 local Chapters spread all across the country, such as: (1) publishing two quarterly journals (Proceedings of the National Academy of Sciences, India- Section A (Physical Sciences) and Section B (Biological Sciences) and one bi-monthly journal (National Academy Science Letters) in collaboration with Springer; (2) organizing the Annual Session in a scientific and academic institution, symposia, seminars and workshops on subjects of current national and scientific interest; (3) planning and executing hundreds of science communication programmes; (4) recognizing the significant contributions of scientists at every level by honoring them with Fellowship/Membership/Awards such as Lecture Awards, NASI-Reliance Awards, NASI-SCOPUS Awards, NASI-Young Scientist Awards etc.; (5) instituting prestigious Research Fellowships/Chairs/Senior-Scientist Fellowships etc. to honor distinguished scientists; (6) organizing sensitization programmes for women researchers/scientists all across the country; (7) conducting the ‘Safe water’ Nutrition & Health projects; (8) organizing/conducting other projects and schemes, such as Science Awareness Programme for Army Personnel, Entrepreneurship Development

Programmes and a joint programme of NASI & ICAR on Farm Mechanization/ Implementation, Tribal Welfare Programmes throughout the country; and establishing the river galleries.

Besides the fore-mentioned activities, the Academy also organizes several other activities jointly with other two National Science Academies- INSA and IASc- all through the year. The Academy holds a well-organized library connected with the NKN; the library has two sections, one for research students and teachers and the other for school students.

SCIENCE AND ENGINEERING RESEARCH BOARD

Government, with an aim to promote basic research with financial and administrative autonomy, had created the Science and Engineering Research Board (SERB) through an Act of Parliament, viz. the Science and Engineering Research Board Act, 2008. The Board, chaired by Secretary, Department of Science and Technology (DST), is comprised of 16 members including six Secretaries to the Government of India. The Board, since its operationalization in October, 2011, has taken significant decisions on R&D management in the country.

The competitive mode of funding schemes has been strengthened with more operational flexibility to Project Investigators through rationalization of budget heads. Young Scientists in the country have received overwhelming R&D support. The Early Career Research Award (ECRA) Scheme which aims to provide quick research support to the researchers who are in their early career for pursuing exciting and innovative research in frontier areas of science and engineering and the National Postdoctoral Fellowship (NPDF) Scheme that targets the motivated young researchers have received tremendous attention in the scientific fraternity. Implementation of fellowships like J.C Bose Fellowship to recognize and support active performing Indian scientists & engineers, Ramanujan Fellowship to attract outstanding Indian scientists and engineers from all over the world to take up scientific research in our country demonstrate the commitment of the Board in imparting quality research at par with international standards. Prime Minister's Fellowship Scheme for Doctoral Research in Public Private Partnership along with industry is an example of instituting innovative methods of engaging industry in academia in the areas of industrial importance. SERB Distinguished Fellowship Award to superannuated eminent scientists who are active and performing ensures the continuation their research activities at the highest level. Institution of Women Excellence Award in Science by the Board signifies the need of gender parity in all sectors including science. Board also implemented a special scheme titled Empowerment and Equity Opportunities for Excellence in Science to ensure enhanced participation of scientists belonging to SC/ST categories in research and development. The Scheme received overwhelming response from the stakeholders.

The Board is also in the process of building relations with international funding agencies. It has already developed programs with National Science Foundation (NSF) and National Institutes of Health (NIH), USA. SERB has partnered with The Royal Society, U.K for mobility of researchers to engage high ended R&D in frontier areas of science and engineering. The Overseas Doctoral and Postdoctoral Fellowship Schemes of the Board have received impressive response from top class universities / institutions across the world like Cambridge University, Rice University, Carnegie Mellon University etc.

Other Ministries of the Government, particularly Ministry of Food Processing approached the Board to process and implement their R&D activities. The Board has also undertaken some special studies like impact of EMF Radiation exposure from Mobile Towers and Handsets on Life etc. in partnership with Department of Telecommunication, Ministry of Communication & Information Technology. Attempts have been made to interconnect research with industry through Scheme for funding Industry Relevant R&D (IRDD) and the launch of new programmes like High Risk High Reward Research (HRHR) proved to be very innovative and first of this kind in the country.

The Board has initiated a new scheme titled 'Visiting Advanced Joint Research (VAJRA) Faculty' to tap the expertise of Overseas Faculty / scientists including Non-resident Indians (NRIs) & OCIs. It offers adjunct / visiting faculty positions to overseas scientist / faculty / R&D professional to undertake high

quality collaborative research in public funded academic and research Institutions in India. The Scheme facilitate collaborative research in frontier areas of S&T including the interdisciplinary areas of national priorities such as energy, water, environment, health, security, nutrition, waste processing, advanced materials, high performance computing, cyber-physical systems, smart machines and manufacturing, etc. and stimulate the latent potential of our academic and research sector.

In the year 2018-19, the Board was able to support close to 1700 new researchers through core support grant and Young Scientist Schemes including NPDF & ECRA. Close to 10000 sanctions have been issued so far by the Board. The Board was also able to directly connect another 2000 researchers through its various outreach programmes and spent Rs. 745 crores till December 2018 for various R&D activities. The Board is striving to stimulate R&D in academic sector which will significantly change the landscape of our country.

TECHNOLOGY DEVELOPMENT BOARD

The Government of India constituted the Technology Development Board (TDB) in September 1996, under the provisions of the Technology Development Board Act, 1995. The mandate of TDB is to provide financial assistance to the industrial concerns and other agencies attempting development and commercial application of indigenous technology or adapting imported technology for wider domestic application.

During the year 2018-19 (till November, 2018), TDB has signed 5 agreements with a total project cost of Rs. 164.15 crore with TDB's sanctioned financial assistance of Rs. 40.75 crore. The commitment for the FY 2018-19 is about Rs 200 crore. TDB's support covers various sectors such as Defence, Medical Devices, Healthcare, Engineering, Agriculture, Energy & Waste Utilization, Telecommunication and Information Technology.

Technology Day Function-2018

The Technology Day 2018 was celebrated on 11th May 2018 at Vigyan Bhawan, New Delhi. Hon'ble President of India, Shri Ram Nath Kovind graced the occasion as Chief Guest alongwith Hon'ble Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardhan who presided over the function. The theme of the function was "Commercializing Indigenous Technologies: Journey from Benchside to Business Programme".

National Award-2018 to an industrial concern who successfully developed & commercialized an indigenous technology, Awards for MSME 2018 and National Technology Start-up Award for promising new technology with potential for commercialization were presented by the Hon'ble President of India launched the product "Charger for the Lithium-Ion Battery" developed by M/s Ampere Vehicles Private Limited, Coimbatore under TDB's financial assistance, on the Technology Day.

SURVEY AND MAPPING CAPABILITY

A. SURVEY OF INDIA (SOI)

1. **Preparation of National Topographical Data Base (NTDB) as per National Map Policy -2005:**
 - a. **NTDB on 1:50K Scale completed:** 4200 DSMs and 3546 OSMs printed.
 - b. **NTDB on 1:250K Scale:** NTDB on 1:250,000 scale for entire country completed.
2. **Preparation of High Resolution National Topographical Data Base (HRNTDB):** Survey of India (SoI) has undertaken preparation of HRNTDB for approx. 1,72,000 sq. km. using High Resolution Satellite Imagery.
3. **Toponymy database:** SoI is preparing seamless toponymy layer (Standardised Place names) for entire country in English, Hindi and regional languages.
4. **Administrative Boundary Database:** Administrative boundaries database up to village level has been prepared and is being updated.
5. **National Spatial Reference Frame:** Maintaining and updating Ground Control Points library. SoI has redefined Indian Vertical Datum and has also prepared the β -version of the Geoid Model of India.
6. **SoI Geo-Portal:** SoI has developed a web-based Geo-Portal offering NTDB as service to cater for G2C (www.indiamaps.gov.in) and G2G (www.g2g.indiamaps.gov.in)
7. **SOI Mobile app (“सहयोग”):** SoI has developed a mobile app named “सहयोग” for its users to voluntarily support and contribute in preparing, updating and enriching the national database of the country.
8. **Publication of Indian Tide Tables:** SoI has published **Indian Tide Table -2019** and **Hugli River Tide Table- 2019**. Predictions of tides for 44 ports is being carried out by the SoI. Predictions for 29 other ports are received on an exchange basis (in accordance with International arrangements)
9. **National Level Projects:**
 - a. **Integrated Coastal Zone Management (ICZM) Project:** Mapping of 75,500 sq.km. at 1:10K scale with 0.5 m Contour Interval using High Resolution Satellite Imagery. The project has been completed.
 - b. **CMPDI Project:** Mapping of 30488 sq. km at 1:5K scale with CI 2 meters in plain and 3-5 meters in hilly terrain in GIS form based on Digital Photogrammetric Techniques using high resolution aerial photographs and adequate ground verification. The project has been completed.
 - c. **Map the Neighbourhood in Uttarakhand (MANU) Project:** SoI has completed DEM (Digital Elevation Model) and Mapping on 1:10K scale by using Ultra Modern Techniques of Air- Borne LiDAR and digital Aerial Photography (3605 Sq. Km approx.)

- d. National Hydrology Project (NHP) Project:** SoI has to generate DEM of vertical accuracy of 3-5m & 0.5m for flood modeling, Digital Geo-Database of 1:25K scale, Creation of Geoidal Model of 10 cm. accuracy and Establishment of CORS network.
- a. National Mission for Clean Ganga (NMCG) Project:** SoI has to generate High Resolution DEM and GIS ready database for the part of River Ganga using latest technology. Data acquisition component comprises Generation of 0.5m DEM and Ortho-Rectified Image (ORI) has been prepared for 22,892 Sq. Km.

B. NATIONAL ATLAS AND THEMATIC MAPPING ORGANIZATION (NATMO)

Project	Name of Map/Atlas Completed
International Project	INDIA-ASEAN Archaeological Atlas, Connectivity of Regional Culture Finite Routes and Infinite Values- 200 copies of the atlas has been received from GISTDA Bangkok for distribution in India after final release of the Atlas by the Government of Thailand.
Extra-Departmental Collaboration	Soil Nutrient Atlas for 14 district of West Bengal for Bidhan Chandra Krishi Viswa Vidyalaya
Golden Map Service	Karaghpur Medenipur Kohima Kulu Manali Ajmer Agartala
District Planning Map Series	Bengaluru Urban Bengaluru Rural Darjeeling Alappuzha Purulia Tirunelveli Unnao
Atlas	Goa State Atlas
Other	Medical Toursim Map of Kolkata

Atlas for Visually Impaired (in Braille):

This year The Braille Map workshop and Quiz has been conducted in 20 centers across the country where more than 25 schools have participated with around d 392 students. Copies of Braille atlas enhanced with audio chip has been distributed to many schools

Work going on (in Advanced Stage):

- i. Installation, Development and Management of NATMO's own Server for hosting the maps, atlases & digital data on different themes in the Open Domain for use of the public. The Technical Specification committee for setting up Geoportal for NATMO has finalized the Technical and Commercial bids and award of job is awaiting for ministry's acceptance.
- ii. Sharing the resources of NATMO with NSDI.
- iii. Contribute in societal evolution by extending the present scheme of preparing Braille Maps and Atlases for Visually Impaired Persons, e.g. School Atlas of Visually Impaired (English) to be continued vide TIFAC Programme, School Atlas of Visually Impaired with state level maps (Assamese), School Atlas of Visually Impaired with state level maps (Telegu) etc.
- iv. Achieve the scheduled target to prepare and publish thematic maps and atlases under following projects: -
 - a) Golden Map Service Maps/Atlases, large scale maps digitally prepared using GIS technology, very much related to the Smart City Programme.
 - b) District Planning Maps depicting existing resources of the district for the use of planning.
 - c) Atlases: - State Atlas of different states, Primary School Atlas of different states, Historical Atlas of India-Revision, National School Atlas (Eng. Version), National School Atlas (Beng. Version), Atlas on Environmental & Socio-Economic Stress, Cultural Heritage Atlas, Science & Technology Atlas, Reprinting/Revision Thematic Maps of National Atlas, etc.
- v. A high powered Committee (HPC) is constituted to restructure NATMO is in progress.

ADMINISTRATION AND FINANCE

EXHIBITION

The Exhibition Cell has the work of promotion and dissemination of scientific information on behalf of the Department. The Cell achieves its mandated by organising or directly participating in various exhibitions and seminars of national and international level. In addition, it has also been assigned the responsibility of coordinating the work relating to participation of the Department of Science & Technology along with its attached organisations in various exhibitions.

In the Financial Year 2018-19, Exhibition Cell participated in the following exhibitions, along with its subordinate offices/ aided institutions:

1. 4th Global Exhibition on Services (GES) in Mumbai during 15-18 May 2018 by Department of Commerce in partnership with Services Export Promotion Council (SEPC) and CII.
2. World Environment Day 2018 exhibition in New Delhi during 1-5 June 2018 by Ministry of Environment, Forest & Climate Change (MoEF&CC) in partnership with FICCI.
3. The 4th India International Science Festival – 2018 held at Lucknow during 5-8 October 2018 by Ministry of Science & Technology and Ministry of Earth Sciences in partnership with Vijnana Bharati.
4. The 106th National Science Conference-2019 held at Lovely Professional University, Jalandhar, during 3-7 January 2019.

The Cell also coordinated with subordinate offices and autonomous institutions working under the Department for participation in a number of exhibitions in various states.

STATEMENT SHOWING BUDGET & EXPENDIURE FOR THE CALENDAR YEAR 2018			
DEPARTMENT OF SCIENCE AND TECHNOLOGY	(Rs. In Crore)		
	RE 2017-18	BE 2017-18	EXPENDITURE DURING THE QUARTER JANUARY- MARCH, 2018
REVENUE	4821.78	4726.22	1174.76
CAPITAL	15.59	20.59	11.25
TOTAL	4837.37	4746.81	1186.01
DEPARTMENT OF SCIENCE AND TECHNOLOGY	(Rs. In Crore)		
	BE 2018-19	RE 2018-19	EXPENDITURE DURING THE QUARTER APRIL- DECEMBER, 2018
REVENUE	5067.38	5067.39	3549.91
CAPITAL	67.50	67.50	22.92
TOTAL	5134.88	5134.89	3572.83



सत्यमेव जयते

Government of India
Department of Science & Technology
Ministry of Science & Technology
New Delhi