Third Party Evaluation Report of the Research and Development in Information Technology /Electronics and CCBT

Executive Summary

I. About the Scheme: India's aspiration to achieve technological sovereignty has been steadily reinforced through strategic initiatives in research and innovation. A cornerstone of this vision is the Research and Development (R&D) in Information Technology (IT)/ Electronics/ Convergence Communication & Broadband Technologies (CC&BT) Scheme of the Ministry of Electronics and Information Technology (MeitY), Government of India (GoI), which seeks to transform India into a global hub for market driven research in Electronics, Information Technologies, and related domains.

II. Objectives of the Scheme: The R&D Scheme for the 15th Financial Cycle aimed at strengthening India's innovation and technology landscape through collaborative, inclusive, and self-reliant growth, The main objectives are as follows:

- Transition India to Product Nation
- To transform India into a global hub of Technologies by encouraging R&D and Innovation in Electronics and Information & Communication Technology (E&ICT) for inclusive and sustainable growth of the national economy.
- Nurture collaboration with Academia, Research Labs and Industry in India and abroad with a long-term road map.
- To create an ecosystem to provide a supply chain for electronics manufacturing in the country in identified thrust areas.
- To achieve self-reliance in E&ICT and allied sectors by creating IPs/products/technologies/solutions for Global market

III. Outcomes/ Impact: The Scheme has led to the development of strategic and critical technologies essential for the country's security and technological sovereignty. It is operationalized through six core Divisions: 'Information Technology (IT)', 'R&D in Electronics', 'Convergence, Communications & Broadband Technologies (CC&BT)', 'Innovation and IPR', 'Technology Development for Indian Languages', 'Cyber Security' & Strategic applications. In addition, it includes a Mission-mode project, the National Supercomputing Mission.

A brief overview of the Mission-mode project and the Core Areas/Divisions under the R&D Scheme is presented below.

1. Mission mode project:

1.1 National Supercomputing Mission (NSM):

Supercomputing infrastructure not only drives scientific research and technological leadership but also helps address complex social challenges. Recognizing this, the Cabinet Committee on Economic Affairs (CCEA) approved the National Supercomputing Mission (NSM) in 2015 to transform India's HPC capabilities and position the country as a global leader. The Mission was launched by the Ministry of Electronics and Information Technology (MeitY) and the Department of Science and Technology (DST), and executed by C-DAC Pune and IISc Bengaluru. The NSM is a Mission-mode program with an outlay of ₹4,500 Crores, structured across four verticals: infrastructure development, research and development, applications, and human resource development.

Years ago, India depended on imported supercomputers, which was costly, restricted customization, and created technological dependency. The NSM has fundamentally transformed this scenario by building an indigenous, self-reliant High-Performance Computing (HPC) ecosystem aligned with the vision of *Atmanirbhar Bharat.* Key achievements include the design and deployment of Rudra servers, the Trinetra interconnect, advanced liquid cooling systems, a complete indigenous software stack, and advancing chip-level sovereignty through the development of an indigenous HPC Processor System-on-Chip.

Under NSM, India has deployed 40 supercomputers with a combined capacity of 40 petaflops across academic institutions, research laboratories, and even Tier II and III cities. NSM's impact is visible across multiple sectors including disaster management, agriculture and climate science. HPC-driven models are improving crop forecasting, weather prediction, and environmental planning. NSM is well aligned with Digital India and the UN Sustainable Development Goals (SDGs) 9, 13, and 15, while advancing India toward exascale computing and expanded cloud-based HPC access.

India's National Supercomputing Mission (NSM) has strengthened global collaboration in High-Performance Computing (HPC). C-DAC is now a member of the Accelerated Data Analytics and Computing Institute (ADAC) at Oak Ridge National Laboratory (ORNL), USA, and collaborates with the European Union (EU) under the Trade and Technology Council (TTC). These partnerships aim to advance interoperable HPC solutions, address global challenges like climate change, natural hazards, and bioinformatics, and foster skill development.

The next phase of NSM will focus on the indigenous technologies in collaborative co-development. This will involve a strategic emphasis on designing and producing indigenous Central Processing Units (CPUs), General-Purpose Computing on Graphics Processing Units (GPGPUs), and accelerators to reduce dependency on foreign chip technologies, strengthen India's technological sovereignty, and ensure the continued expansion of its sovereign capabilities in HPC.

2. Core Divisions supporting specific areas of R&D Scheme:

2.1 R&D in Information Technology (IT):

In the last two decades, the IT industry has emerged as a major contributor to India's revenue and employment generation. The sector is rapidly transitioning from a service-oriented model to a global hub for research, innovation, and technology development. Recognizing the critical role of R&D, the Government views R&D as essential for the implementation of new initiatives.

The Information Technology Division drives country's leadership in quantum technologies, artificial intelligence, blockchain, free and open-source software, indigenous operating systems and database system to achieve technological sovereignty and cyber resilience. A 4-qubit superconducting quantum processor, post-quantum cryptography algorithms and an Indian web browser have been developed. The Bharat Operating System has been deployed on over 6.5 million devices. The National Blockchain Technology Stack offers Blockchain-as-a-Service, with NBFLite enabling rapid prototyping for startups and academia, while citizen-centric solutions like '*Praamaanik*', Property Chain, Certificate Chain, and eStamps enhance transparency in public services. AI innovations include tools for early Alzheimer's diagnosis, paediatric pneumonia detection, anaemia detection, visual speech training for hearing-impaired children, child face progression for tracing missing children, and deepfake detection tool. Over 9,000 users have been trained on QSim and Qniverse platforms, and 500+ individuals have been skilled in blockchain technologies. These developments foster inclusive economic growth, secure critical infrastructure, tech-sovereignty, indigenous platform, citizen centric solutions, attract global collaborations and democratize quantum education in Tier II/III cities.

2.2 R&D in Electronics:

R&D in Electronics focuses on driving indigenous innovation and achieving technological sovereignty from materials to system development. It includes following verticals: Electronic Materials and Components Development (EMCD), Nanotechnology, Microelectronics, Electronic Systems Development (ESDA), and Medical Electronics. The programs align with Industry 4.0, clean energy, defence, healthcare, sustainable waste management, and semiconductor self-reliance, ensuring national competitiveness and socio-economic inclusion. Technology development and proliferation is happening in 5 identified verticals which are given below:

2.1 (a) EMCD: Under the Electronic Materials and Components (EMCD) vertical 31 additive manufacturing technologies, and advanced photonics systems have been developed. Materials for strategic requirement and E-waste solutions have been delivered to more than 25 industries including one-ton/day PCB recycling unit, 500 KG Li-ion battery recycling unit and 500 KG Solar panel recycling unit, contributing to achieve circular economy in EEE sector alongside, training of 76,000+ professionals.

2.2 (b) Nanotechnology: Under the Nanotechnology vertical it has enabled 30 technology transfers, incubation/support of 41 startups, and led to various innovative indigenous products

for societal applications. With 200 patents, 1,000+ publications, and training for 10,000+ people, India now ranks 3rd globally in publishing high-impact nanotechnology research, consolidating its leadership in semiconductors and sensors.

2.2 (c) Microelectronics: Under the Microelectronics vertical indigenous processors (SHAKTI, VEGA, AJIT) have been developed being explored for strategic and industrial applications, over 1 million NavIC+GPS chipsets have been fabricated, 100 startups have been supported, and 45,000 professionals have been trained.

2.2 (d) ESDA: ESDA vertical has delivered 40+ commercialized technologies including Akash missile controllers, microgrid and EV subsystems, Intelligent Transport System (ITS), Unmanned Aerial Vehicle (UAV), robotics, and Agri-electronics by transferring the technologies to industry which generated ₹30+ crore in revenues while training 2,500+ professionals.

2.2 (e) Medical Electronics: In Medical Electronics vertical indigenous systems such as Indigenous Magnetic Resonance Imaging (IMRI), Linear Accelerator (LINAC), Colour Doppler Ultrasound Scanner with probes, X-ray-based blood irradiator, AI-enabled fundus cameras, and automated cervical cancer screening have been developed, supported by 5 patents, 131 publications, and training of 500+ professionals.

Collectively, R&D in Electronics Division has delivered 100+ Technologies developments, 100+ products and prototypes, 10 + Commercialization, 80+ technology transfers, ₹30+ crore revenues, 300 patents, 1,200+ publications, 90,000+ trained professionals, and incubation/support to 150+ startups. National impacts include a 1-ton/day PCB recycling facility promoting a circular economy, reduced semiconductor and medical device imports, and strengthened adoption of clean energy, e-mobility, and Agri-electronics, contributing to technological sovereignty, sustainable industry modernization, and inclusive socio-economic growth.

2.3 Convergence, Communications & Broadband Technologies (CC&BT) and Strategic Electronics: The CC&BT and Strategic Electronics Division, MeitY is driving India's advancement in next-generation communication and strategic electronic systems, with a strong emphasis on indigenous capability development, innovation, and global leadership. Over the past two decades, MeitY has supported R&D projects ranging from 4G, 5G, and beyond, contributing significantly to international standards, intellectual property, and technology prototypes. Key achievements include the development of an L-band NB-IoT (Narrowband Internet of Things) System-on-Chip (SoC) for GEO satellites, enabling various low-bit-rate satellite IoT applications; the Metro Area Quantum Access Network (MAQAN) for secure quantum key distribution, and the successful introduction of India's "Ubiquitous

Connectivity" use case scenario for IMT-2030 (6G) into the ITU framework. The programme has delivered indigenous systems like the MMW Radiometer; Establishment of MIL-STD EMI/EMC testing facilities which is generating revenue through certification services and is developing advanced simulation platforms and secure communication components to accelerate prototyping, validation, and deployment of next-generation networks. For defence, indigenous systems such as Conformal Jamming, Acoustic Gun Shot Detection System and Cognitive Radio Proof of Concept were demonstrated to the Indian Navy, DRDO, and others. Through the project "Next Generation Wireless Research and Standardization on 5G and beyond", more than 288 patents (including 40 potential Standard essential Patents (SEPs) have been filed and 687 contributions have been made to global standards bodies like 3GPP, IEEE, TSDSI and ITU. The CC&BT programme is strengthening Atmanirbhar Bharat by promoting standards leadership, commercialization and domestic manufacturing. The programme also created the Indian Open-Source 5G Network (IOS-5GN) ecosystem to support startups and academia. R&D initiatives cover critical areas such as massive MIMO, satellite–terrestrial 6G communication, AI-enabled systems, Internet of Things (IoT) and Machine-to-Machine (M2M), vehicular communication, cyber-physical systems, green and visible light communications. These initiatives are enabling affordable, inclusive, and sustainable digital solutions, advancing national initiatives, viz., 'Digital India', 'Make in India' and 'Atmanirbhar Bharat'.

2.4 Innovation & Intellectual Property Rights (IPR): The Innovation & IPR Division under MeitY aims to strengthen India's startup ecosystem through Technology Incubation and Development of Entrepreneurs (TIDE 2.0), Gen-Next Support for Innovative Startups (GENESIS), and Centres of Excellence, with a focus on inclusive entrepreneurship and IP creation. It has supported more than 3000 startups, developed over 2000+products/prototypes, and 500+ patent have been filed. These initiatives generated ₹600 crore+ revenue, and created 21,000+ jobs, with nearly one-third of startups being women-led. The impact includes enterprises like Greensupply Agro, serving 20,000 farmers with a valuation of ₹80 crore, and Core Technologies, delivering defence-grade solutions. Global outreach through partnerships with Google, Samsung, Meta, Micron, and the G20 Digital Innovation Alliance Summit further strengthens India's innovation-driven growth.

2.5 Technology Development for Indian Languages (TDIL): The Technology Development for Indian Languages Division is designed to enable digital inclusion across India's many scheduled languages by developing and deploying advanced language technologies, including machine translation, speech recognition, and text-to-speech systems. Achievements include integration with 200+ government portals, serving over 11+ crore farmers connected through chatbots, facilitating 30 lakh multilingual grievance submissions, and delivering farmer and health services in regional languages. Impacts extend to

agriculture, health, education, and justice, with over 1.8 million legal sentences translated and millions of citizens accessing critical services in their native languages. The ecosystem, underpinned by the Bhashini API, the ecosystem engages involves 70+ institutions and 200+ startups, driving nationwide AI adoption, 20 + language support and inclusive governance.

2.6 Cyber Security: The Cyber Security Division strengthens India's national digital resilience through a multifaceted approach encompassing key initiatives like the National Centre of Excellence (NCoE), the Cyber Security Grand Challenge, and the Use Case Clearing House (UCCH). This comprehensive effort has successfully incubated 153 startups through the NCoE and resulted in the filing of over 140 patents, with more than 40 already granted. A significant focus on human capital has led to the training of over 7,000 professionals and 200+ researchers annually, fostering inclusivity by empowering diverse communities. The vertical drives a robust research-to-market pipeline, producing 24 research projects and accelerating over 300 Proofs of Concept (PoCs), which have culminated in the deployment of more than 60 cyber solutions. These technologies address critical areas such as IoT security, hardware security, and post-quantum cryptography. This thriving ecosystem is supported by over 50 industry collaborations and a strong 22–25% annual investment growth. Ultimately, these achievements align with national goals for a safe digital economy and resilient institutions.

IV. Alignment with Global and National Priorities*:* The Scheme aligns with the United Nations and NITI Aayog's Sustainable Development Goals (SDGs), particularly SDG 9, by fostering innovation, resilient infrastructure, and sustainable industrialisation. Its emphasis on international collaboration and multi-stakeholder partnerships also advances SDG 17. Furthermore, the Scheme is synergistic with several flagship programmes of the Government of India and plays a pivotal role in shaping the nation's digital future, propelling India towards the vision of a self-reliant *Viksit Bharat @2047.*

V. Need and Framework of the Assessment: As per the mandate of the Department of Expenditure, Ministry of Finance, Government of India (Office Order No. 66(59)/PFC-II/2018), the Ministry of Electronics and Information Technology (MeitY) has to conduct an evaluation of its Schemes. The Indian Institute of Public Administration (IIPA) was nominated by MeitY to carry out the third-party evaluation of the R&D Scheme under the Digital India Umbrella Programme.

This report presents the findings of that evaluation exercise. It assesses the performance, impact, and strategic relevance of the Scheme up to August 2025, covering over 108 projects purposively sampled to capture diversity in scale, technology domain, and output maturity. The analysis is based exclusively on secondary sources, including official documentation, dashboards, utilisation reports, and policy papers, and follows NITI Aayog's RCEEIS framework (Relevance, Coherence, Effectiveness, Efficiency, Impact, and Sustainability) as detailed in Table 1.

VI. Key Findings of the Assessment: The study reveals that the R&D Scheme has been successful in strengthening national capabilities. This has been achieved by fostering academic excellence, driving innovation, and enabling context-specific technology development. The Scheme has also implicitly supported inclusive growth through several of its digital empowerment initiatives.

Some of the key achievements of the Scheme can be encapsulated as below:

- **Innovation and Commercialisation:** A number of indigenous technologies have been developed for both societal and commercial applications, many of which have been successfully commercialised by industry. The Scheme has incubated over 3,000 startups through TIDE 2.0, GENESIS, and Centres of Excellence (CoEs) across the country. These supported startups have filed over 500 patents, generated more than ₹600 crore in revenue, and created over 21,000 jobs, significantly strengthening India's startup ecosystem. Notably, nearly one-third of these startups are women-led.
- **Collaborations:** The R&D Scheme has played a pivotal role in strengthening industry–academia linkages and fostering collaboration across multiple Ministries for technology development and deployment. Several innovations developed under the Scheme are now being adopted by other Ministries and Government programmes. Notable examples include the Autonomous Bathymetric Survey Vessel (ABSV), Electric Vehicle Sub-System (EVSS), and R&D solutions for extracting critical minerals from e-waste. R&D initiatives taken for the development of nanotechnology-based solutions for various societal problems in association with multiple stakeholders including Department of Science and Technology (DST), State Governments and Industries. A new initiative to establish a National Sensor Hub is under formulation with line ministry and other Stake holders.

  To advance a circular economy in electronics, the Scheme has promoted joint efforts involving MeitY, the Ministry of Mines, MoEF&CC, State Governments, Industries, and Recyclers. Under the EVSS initiative, key technologies such as motors and controllers, converters, chargers, and battery management systems for different segments of electric vehicles have been developed in collaboration with industry partners. Following successful field trials and certification, these technologies are now being promoted by the Ministry of Heavy Industries for adoption by various Original equipment manufacturer (OEMs). The Advanced Glacier Lake Profiling Software (AGLPS), another outcome of the Scheme, has been successfully deployed at several high-altitude glacier lakes in Himachal Pradesh, including Baspa and Vasuki lakes located above 14,000 feet. The software provides valuable scientific data on lake morphology, volume estimation, and potential outburst risks. Building on its success, all Himalayan States are set to adopt the MeitY-funded ABSV technology for glacier lake monitoring and GLOF mitigation. Through collaborations with premier institutions such as IITs, IIITs, CDAC, and Universities, TDIL developed key technologies for speech recognition, machine translation, and optical character recognition for India's 22 scheduled languages. Under the Nanotechnology Initiatives, several technologies like Point-of-Care Diagnostics Devices for Healthcare, Soil Moisture Sensors for Agriculture, GaN HEMT, High Power Fibre Laser, OTP memory, etc. for Strategic, Air Quality Monitoring

System for environmental applications, Pantographs for Railways, Fibre optics based sensors for health monitoring of buildings, etc. have been developed for which the potential users are ICMR, Ministry of Healthcare, IARI, ISRO, DRDO, BEL and Ministry of Railways, etc.

- **Technological Impact:** Major R&D milestones include 40 supercomputers under NSM (delivering 40 petaflops), Open source Indian 5G and beyond platforms, State-of-the-art microprocessors, Quantum Simulator (QSim), blockchain technology stack, basic components of quantum technologies, voice-first AI platforms, position controller of launch systems for Akash Missile, Smart Energy Meters, Microgrids controllers, Vehicle Control Unit (VCU) & Train Communication Network (TCN) for Rolling Stock Application, Microgrid, AC/DC EV Charger, Wireless EV Charger, Air Quality Monitoring System (AirPravah), aquatic pesticide residue monitoring (AquaSuraksha), Nanosniffer[1] and SoilSens[2]. Deployments feature power electronics, electric vehicles, medical electronics, strategic electronics, Agri-Tech robotics (A-TRACT), Automotive and IoT solutions impacting power sector, renewable energy, green mobility, healthcare, agriculture, disaster management, and education.

  The National Supercomputing Mission (NSM) has significantly advanced India's technological capabilities by strategically deploying supercomputing systems across 14 States, fostering regional research and innovation hubs. It has driven indigenous innovation through Rudra 6 HPC servers, the ARM-based AUM HPC processor, and the TRINETRA high-speed interconnect, complemented by a robust software ecosystem including C-CHAKSHU, PARADE, and CAPC. NSM has built a domestic manufacturing ecosystem, producing over 6,000 servers with Indian partners, localizing components, and developing the HPC supply chain. It has also enabled national priority applications such as flood early warning, drug discovery, urban modelling, and seismic imaging. By transitioning from "Buy to Build," NSM promotes industrial growth and technological self-reliance.

- **National Capacity Building:** The Scheme has trained over 127,000+ specialized professionals, including 26,000+ in HPC, 2,500+ in ESDA, 7,000+ in Cybersecurity, 6,000+ in CC&BT, 76,000+ in EMCD, and 9500+ in IT. In addition, more than 150 PhDs have been supported, and thousands of entrepreneurs and startups have received mentoring. These efforts have established strong academic pipelines and created a skilled workforce for future industries. Specifically, the HPC Shiksha programme has contributed to workforce development, high-tech job creation, and inclusive participation, reinforcing India's global leadership in supercomputing.

- **Socioeconomic Inclusion:** The Scheme has achieved substantial outreach through the deployment of linguistic AI tools such as TDIL/Bhashini across more than 200 Government portals, reaching over 40 crore citizens. Targeted initiatives have supported North Eastern Region (NER) and SC/ST communities through language preservation, tech skilling, and enterprise development. TDIL covers over 22 Indian languages and has been integrated into

[1] Explosive Trace Detector
[2] Soil Moisture Sensors

major national portals including CPGRAMS, PM-KISAN, IRCTC, and the National Train Enquiry System, providing multilingual services to millions of citizens.

In the area of e-waste management, over 85% of recycling in India is carried out by the informal sector, supporting the livelihoods of more than 20 lakh workers. However, current recycling practices are often non-scientific and environmentally unsound, posing health hazards to workers and the public. Under its Circular Economy action plan, MeitY has initiated a pilot project to equip the informal sector with environmentally safe recycling techniques, enabling them to sustain their livelihoods while adopting safer and more sustainable practices.

In healthcare, the development of affordable nanotechnology-based diagnostic platforms for diabetes, anemia, and liver and kidney disorders has enhanced access to preventive care. Environmental safety has been contributed through real-time air quality monitoring systems, enabling data-driven pollution control. GaN HEMT and RF amplifiers based on next-generation electronics have strengthened energy efficiency. Additionally, civil infrastructure safety has improved with the deployment of advanced fiber optics-based vibration and strain sensors, supporting structural health monitoring in bridges, buildings, and public assets.

- **Cyber Security:** NCoE's initiatives have drawn 22–25% growth in cybersecurity investment and supported six major Global Capability Centers (GCCs). A collaborative Web Based portal has been developed. 187 Active users are already on the portal and 50 technology researchers and providers are leveraging the UCCH portal for sharing their innovative ideas. Startups supported by NCoE have filed over 140 patents, with 40+ granted. Over 300 PoCs were accelerated, and 60+ have seen real-world deployment.

- **Global Positioning:** Bilateral and multilateral R&D initiatives, including partnerships with National Science Foundation (NSF), USA, industry leaders (Google, Samsung, Meta), Indo-EU under NSM, MoUs and collaborations with global academic institutes and labs for research collaboration and 200+ institutions, underline India’s growing presence in global technology standard-setting and frontier research consortia.

- **Patents and Publications:** The R&D Scheme has significantly advanced India’s scientific and technological landscape, generating a total of 1,389 research publications and 1,258 patents across key domains. Nanotechnology leads research output with 700 publications, while IT (200), CC&BT (191), Medical Electronics (154), and ESDA (144) have also made strong contributions. On the innovation front, the Innovation & IPR vertical has filed 536 patents, followed by CC&BT (339), Nanotechnology (203), and Cyber Security (180), reflecting a deep commitment to creating and protecting new technologies. The patents span frontier areas such as next-generation wireless technologies (5G and 6G, including 40 potential Standard Essential Patents in CC&BT) and emerging IT applications like Blockchain. Collectively, these achievements underscore the Scheme’s dual impact in expanding knowledge and translating it into tangible and high-value innovations.

Table 1: Overall Assessment of R &D Scheme of MeitY on NITI Aayog's RCEEIS Framework

S.No.	NITI Aayog's Evaluation Framework	Key Achievements of the R&D Scheme
1.	Relevance	• Advances national missions such as the National Supercomputing Mission (NSM) • Builds indigenous and critical technologies including LINAC, 5G and beyond platforms, Quantum Simulator, Blockchain Technology Stack, Superconducting Magnet Technology, Radio Frequency Technology for MR, UAV and multilingual frameworks. • Empowers SC & ST/NER/PWD communities through dedicated projects like DCTC, Electronic Toys, tech-based training through Visual Speech Training Software for Hearing Impaired (VSTS) & DHAWANI (Medical electronics) • Supports Startups/MSMEs in Tier II/III cities • Addresses critical national priorities across agriculture, transportation, healthcare, disaster management, Secured and trusted platforms and compute systems by developing strategic technologies, strengthening the domestic value chain through intellectual property creation and collaborative innovation • Fosters self-reliance through the development of intellectual property (IP) and strategic collaborations, building a robust domestic value chain. • Promotes self-reliance in technologies in time of complex and ever-changing geopolitical realities
2.	Coherence	• Adopted a whole-of-government approach with strong collaboration across ministries, academia, R&D organisations, industry, and startups. • It has facilitated interministerial collaborations with ANRF, BIRAC, DST, MNRE, MoHUA, DoT, TSDSI, MoES, ISRO, DRDO, MoHFW, and other key agencies. • C-DAC has joined the US-based Accelerated Data Analytics and Computing (ADAC) Institute as an affiliate member. ADAC is a global consortium of 23 organisations, including Oak Ridge and Lawrence Livermore (USA), RIKEN R-CCS (Japan), NCI (Australia), ETH Zurich (Switzerland), and Finland's IT Center for Science, collectively hosting five of the world's six most powerful supercomputers. • Shared platforms such as INUP and Bhashini are leveraged to strengthen technology deployment and citizen services. • The programme engages international partners including the NSF and the European Union, and contributes to standards in 5G and beyond technologies through bodies like ITU and 3GPP. • It complements existing initiatives in digital health and technology innovation, expanding impact across sectors. • Under the ITS Programme, over 20 technologies, systems, and products have been developed and transferred to more than 15 industries, including CosiCost and Witrac, which are deployed nationwide. • Electric Vehicle Sub-System development has been achieved through strong collaboration with the Ministry of Heavy Industries, academia, R&D organisations, industry, and startups.

3.	Effectiveness	**a. Technology:** • Delivered outcomes: SimInu flood portal, SeisRTM seismic software, SWFMS[3] supports wildfire prediction in Sikkim, NPGDD platform helps the Ministry of AYUSH with cancer research, COVID-19 studies, and finding new uses for Ayurvedic drugs. • Vehicle Control Unit (VCU) is being used on Indian Railways. These are being manufactured and used by Indian Railways in new and old locomotives. **b. Indigenous Value Chain:** • Supported startups: 153 in Cybersecurity NCoE, 200+ via TDIL, 3000+ via TIDE 2.0, GENESIS & CoEs and 33 via Nanotechnology • Deployed indigenous technologies: *Rudra*-I,II,III, *Trinetra* servers and more such projects across the verticals • SHAKTI & VEGA microprocessors used by ISRO & DAE • More than 1 Lakh units of indigenously developed Hall Effect Current Sensor have been commercialized for power device applications. • Vehicle Control Units (VCUs) for railway propulsion: More than 40% of the developed VCU is supplied to Indian Railways through Industry partners, resulting more than Rs. 100 Crores worth cumulative Forex savings. Additional 5-10 year long term handholding with Indian Railways is envisaged with total production of more than 3000 units. Model EV Charging Station including wireless charger, DC fast Chargers and AC chargers for 2W/3W/4W have been developed in Thiruvananthapuram, Kerela. • Indigenous Position Controllers for Akash Missile launch system is being used by DRDO for strategic applications in Defence Sectors (Every year more than 500 units are supplied by M/s Tata Advanced System Ltd. (ToT partner) to Indian Defence) • Deployment of microgrid at 07 different places throughout the country for renewable energy sector. • More than 50 commercial units of Air Quality Monitoring (AirPravah) Systems have been deployed through various state pollution control boards. India's first indigenously developed Planar magnetic components with compact, high-frequency transformers or inductors • India's first and indigenous SMITHA tool for smart meter validation testing tool used for automated functional testing, calibration, and compliance verification of smart energy meters **c. Capacity Building and Inclusivity:** • Trained over 127,000+ specialized professionals, including 26,000+ in HPC, 2,500+ in ESDA, 7,000+ in Cybersecurity, 6,000+ in CC&BT, 76,000+ in EMCD, and 9500+ in IT. • Supporting the indigenization of Operating system, database system, browsers, and other core IT tools. Over 9,000 users have been trained on QSim and Qniverse platforms and 500+ individuals have been skilled in blockchain technology. • Under Electronics Toys Project 60, Engineers of SC/ST /NER Community got one year internship in R&D domain and developed about 30 indigenous technologies for toy manufacturing. The interns got placed in the Toy Industry. **d. Infrastructure Development:** • Developed indigenous capabilities in MEMS/NEMS, Graphene, and 2D materials through CoE with world-class cleanrooms, targeting critical sectors including healthcare, agriculture, defence, and energy

[3] Satellite-based Wildfire Forecasting and Monitoring System

		● Cyber test beds, blockchain infrastructure ● Test bed for 5G.
4.	Efficiency	● Public-private partnership model for cost-sharing & scalability (CoE for E-Waste, National Mission on Power Electronics Technology (NaMPET), Electric Vehicle Sub-systems (EVSS) ● Resource optimization using shared platforms (INUP, Bhashini), DLI, C2S ● Milestone-based, phased funding & ePPMS tool for management ● National Supercomputing Mission (NSM) promotes a modular and open-source approach to high-performance computing, enabling flexible system configurations and scalable deployments across diverse research and academic institutions. By developing indigenous hardware components like Rudra servers and TRINETRA interconnects in a modular design, and supporting open-source software platforms such as C-CHAKSHU, PARADE, and CAPC, NSM encourages innovation, interoperability, and customization for specific applications. This approach not only facilitates cost-effective upgrades and expansion but also fosters collaboration, knowledge sharing, and a vibrant ecosystem of startups, academia, and research institutions, strengthening India's technological self-reliance and scientific capabilities. ● Focus on cost-effective, national solutions (SeisRTM, SimInu, VCU, Smart Energy Meters, SMITHA tool, Electric Vehicle sub systems such asMotors, Chargers for EV and Air Quality Monitoring Systems) ● National Blockchain Framework (NBF) provides a comprehensive blockchain technology stack to help various stakeholders—including developers, startups, academia and Government facilitate adoption of blockchain technology. With features like core infrastructure, smart contract layers, OpenAPIs, Bring Your Own Identity (BYOI) support, and distributed setup, it enables rapid innovation, prototyping, and deployment of secure blockchain applications. It reduces the need for skilled human resources and enables technological support to organisations in developing and deploying blockchain applications. ● Indigenous technology is enabling the development of affordable and accessible medical devices, reducing import dependence and improving healthcare reach across India. ● An amount of Rs. 88.5 lakhs has been sanctioned by the Ministry of Earth Science under "Deep Sea" mission for developing Fiber optic wave sensor and ocean depth and pressure sensors. The amount of Rs. 82.95 lakhs have been approved by the Ministry of Earth Science under "Prihtvi" Scheme for development of accelerometer.
5.	Impact	● Strengthens self-reliance, reduces imports ● Globally, only a few countries can manufacture 6MV Medical LINACs for cancer treatment. With sustained MeitY-led R&D efforts, India has now joined this elite group by indigenously developing a 6MV LINAC, marking a major step towards self-reliance in critical healthcare technology and affordable cancer care. ● Panacea Medical Technologies is already generating revenues from the SAMEER-developed indigenous LINAC, showcasing successful commercialization of India's R&D in advanced cancer care. ● NSM – India is one among the few countries to make completely indigenous supercomputers and boards and a complete ecosystem for the same. ● Technology/ Product ecosystem: NSM/ Super Computer, LINAC-MRI, 5G Test bed and Broadband Wireless Simulator, EVSS, ITS ● NSM has built a complete HPC ecosystem in India, including indigenous hardware (Rudra servers, TRINETRA interconnect), software platforms (C-CHAKSHU, PARADE, CAPC), domestic manufacturing (6,000 servers with VVDN, Kaynes, Avalon), and HPC infrastructure across 14 states. With strong industry, academic, and research collaborations and training of 26,000+ professionals, this ecosystem supports

		key applications like flood forecasting, drug discovery, urban modelling, and seismic imaging, while promoting self-reliance, innovation, and a skilled high-tech workforce. ● Citizen benefits: Bhashini serves 40 crore users, HPC used for weather forecasting and disaster management ● India positioned as global leader: 200+ IPs in nanotech; 250+ patents in 5G and beyond ● Launched Blockchain Technology Stack for Blockchain as a Service (BaaS) with various applications for promoting trusted digital service delivery to citizens. A number of blockchain-based citizen centric solutions such as *Praamaanik* (for Mobile App Origin Verification), Property Chain, Certificate Chain, blockchain based e-Stamps solutions have been developed and deployed. ● Strengthening India's technological sovereignty and digital self-reliance by promoting indigenous ICT solutions in critical sectors, reducing dependence on foreign technologies, and enabling widespread deployment of national platforms such as the Bharat Operating System on over 6.5 million devices, while supporting the indigenization of database system, browsers and other core IT tools. ● Shakti and Vega indigenous processors.
6.	Sustainability	● Builds a self-reliant R&D ecosystem, reduces import dependence ● Adapts to AI and quantum technological advancements ● Self-sustaining CoEs and incubation centers with revenue through its offerings. ● Promotes circular economy: e-waste recycling, solar lanterns ● Focus on indigenous IP commercialization via startups ● Train thousands of skilled manpower to maintain innovation and expertise in the long-term

The present study affirms that the R&D Scheme of MeitY is an essential pillar of India's digital transformation journey. The R&D Scheme comprehensively supports the entire research and development lifecycle, covering all key stages from Idea Generation and Conceptualization, Literature Review and Background Research, Feasibility Analysis and Planning, Funding and Resource Allocation, Research and Development, Prototyping and Design, Testing and Validation, Regulatory Approval and Compliance, Support for Standards Development, Productization and Implementation, to Post-Market Evaluation and Iteration. This holistic approach ensures that concepts are systematically transformed into viable, market-ready solutions while fostering innovation, compliance, and continuous improvement. However, certain enhancements in its basic design and implementation could help it to delivering better its promise of innovation, inclusivity, and competitiveness.

VII. Challenges: The Scheme's achievements, though notable, are accompanied by persistent headwinds. The programme contends with risks of stagnation at the prototype stage, inadequate infrastructure to support higher Technology Readiness Levels (TRL 7–9), and dependency on overseas facilities. Addressing these challenges necessitates targeted interventions such as greater Industry Collaboration, strengthening domestic talent pools in frontier technologies, ensuring equitable regional access, and revisiting auditing and monitoring frameworks for greater accountability. In addition, external dynamics, including emerging cybersecurity considerations and the increasing space of industry–academia collaboration, further shape the trajectory of scale-up and the potential for effective commercialisation.

VIII. Conclusive Remarks: The R&D in IT/Electronics/CC&BT Scheme represents India's strategic commitment to achieving technological self-reliance and positioning itself as a dominant global force in digital innovation. Based on the comprehensive impact assessment, it is strongly recommended that the Scheme must continue into the XVIth Finance Cycle and beyond March 2026 to realize the Government of India's vision of *Viksit Bharat @ 2047*, Make in India, and *Atmanirbhar Bharat*. Sustained support is crucial for transforming India into a true Product Nation, one that designs, builds, and scales its own technologies. At the same time, R&D stands at a pivotal intersection of import substitution, technological innovation, and ambitious "moonshot" projects. The key recommendations are as follows:

i. **Decentralize Research Infrastructure and Promote Regional R&D Hubs**
To stimulate local innovation ecosystems and ensure equitable access to advanced R&D facilities, priority must be given to the geographic diversification of infrastructure. The Scheme should actively establish and support Knowledge & Research Centers (KRCs), Centres of Excellence (CoEs), and Innovation Hubs in Tier II and Tier III cities, thereby extending capabilities beyond major metropolitan areas.

ii. Bridge Commercialization Gaps and Promote Translational Research
Addressing the persistent "valley of death" between Technology Readiness Level (TRL) 5 and TRL 9 is paramount for transforming research into market-ready products. This effort will be significantly aided by the establishment of a Technology Transfer Office (TTO), which should facilitate the commercialization of developed technologies, manage Intellectual Property (IP), evaluate inventions, and negotiate licensing agreements to move innovations from the lab to the marketplace.

iii. Enhance Ecosystem Collaboration, Academia-Industry-Startup Partnerships, and Intellectual Property Management
Given the interdisciplinary nature of contemporary technologies, the Scheme must intensify collaboration among academia, R&D institutions, industry, and start-ups, fostering cross-sector partnerships through joint R&D calls and shared access platforms. The TTO, established to manage intellectual property, licensing, and commercialization, will play a key role in enhancing Indian research global impact and will also provide essential services to Start-Ups, including market research and mentoring.

iv. Scale Strategic Technology Domains and Promote Innovation
The Scheme must strategically broaden its expanse to include dedicated and sustained financial support for New Age Technologies (NATs) such as quantum computing, advanced medical electronics, UAVs, 5G and beyond telecommunications, and strategic microelectronics. Investments are required to nurture moonshot technologies, develop indigenous software solutions, and upgrade testbed infrastructure to internationally accredited standards.

v. Foster Inclusive Societal Impact Initiatives and Address Societal Challenges
A core objective is focusing R&D on tackling pressing societal needs, leveraging Electronics and Information and Communication Technologies (E&ICT) interventions in governance domains such as health, education, and agriculture. Successful pilots, such as

AI-enabled healthcare diagnostics, should be scaled nationwide, utilizing community co-creation to ensure developed technologies are contextualized, affordable, and readily adopted by intended users.

vi. **Evolve Schemes, Policies, and Audit Mechanisms for R&D**

Crucially, the evaluation of the Scheme must adopt a Scientific Audit framework, which requires all verticals and related projects to undergo recursive monitoring and evaluation processes. This process must focus on achievements, technological advancements, patents, and societal impact based on pre-identified Key Performance Indicators (KPIs), moving beyond conventional financial or compliance metrics. The suggested Key Performance Indicators (KPIs) to map the Scheme's objectives for the upcoming Finance Cycle are as follows:

- IPs, patents, specialised manpower generation, ToTs / productization
- Market ready technologies, products, solutions, use cases, deployment in the field
- Testbeds, pilot deployment
- Any other indicators as may be relevant

Going forward, the Scheme should strongly focus on the following

a. Transform India to Product Nation
b. Develop resilient Supply chain for key critical technologies/products
c. Identify key products for development of IPs, technologies and systems
d. Enable R&D ecosystem for Trusted Supply Chain
e. R&D foundation for Electronics System Design and Manufacturing ecosystem
f. Building indigenous Hardware and Software Stacks
g. Moving towards self-reliance by creating secured and cyber-safe IPs / products / technologies / solutions at par Global markets.

IX. Recommendation for Continuation of the R&D in IT/Electronics and CCBT Scheme: Based on this evaluation, the Indian Institute of Public Administration strongly recommends that the R&D in IT/Electronics and CCBT Scheme be continued beyond March 2026, into the XVIth Finance Cycle. The Scheme should prioritize critical technologies and indigenization based on Products to strengthen India's self-reliance in strategic sectors, and to address societal challenges/requirements. To achieve this, a consistent and adequate budget allocation by the Government is essential.

Sustained support under this Scheme is crucial to advancing the Government of India's vision of Viksit Bharat @ 2047, Made in India, and Atmanirbhar Bharat. It will foster research, innovation, and the development of a self-reliant ecosystem in critical technologies, enabling India to emerge as a global leader in technological development and a major supplier of indigenous solutions.

To develop complete hardware and software stacks indigenously, enhanced financial support for research is necessary. While mindful of fiscal constraints, the Scheme proposes joint collaborations with other Ministries, State Governments, Industries and autonomous bodies.

Furthermore, the Scheme will actively engage with industry partners, not only for collaborative R&D but also to attract significant private investment, thereby strengthening India's technological capabilities and creating a sustainable, innovation-driven ecosystem.

Emerging and horizon technologies demand sustained investment, whereas critical technologies necessitate focused support and nurturing from the Government. The Scheme must continuously be upgraded and guidelines for funding also need revision to make it more stake holder friendly. Continuation of the Scheme is, therefore, imperative to transform India into a product nation, accelerate self-reliance in critical technologies, and secure a leadership position in the global technology landscape.